DEPARTMENT OF MECHANICAL ENGINEERING

Kurukshetra University, Kurukshetra (K.U.K) – 136119, Haryana, INDIA

(Established by the state Legislature Act XII of 1956; 'A+' Grade, NAAC Accredited)

A. Definition of Credit:

1 Hour Lecture (L) per week	1 credit
1Hour Tutorial (T) per week	1 credit
1 Hour Practical (P) per week	0.5 credit
2 Hours Practical (Lab) per week	1 credit

B. Range of Credits:

A total credit of 160 is required for a student to be eligible to get Under Graduate degree in **Mechanical Engineering**. A student will be eligible to get Under Graduate degree **(B.Tech.) with Honours**, if he/she completes an additional 20 credits. These could be acquired through MOOCs at Swayam portal or with in-house examination being conducted. In order to have an Honours degree, a student may choose minimum 20 credits provided that the student must ensure the course is approved by the Competent Authority, Government of India.

BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER III(w.e.f. session 2019-2020)

S. No.	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	BS-201A	Optics & Waves	3:0:0	3	3	75	25	0	100	3
2	BS-205A	Advanced Engineering Mathematics	3:0:0	3	3	75	25	0	100	3
3	ES-203A	Basic Electronics Engineering	3:0:0	3	3	75	25	0	100	3
4	MEC-201A	Theory of Machines	3:1:0	4	4	75	25	0	100	3
5	MEC-203A	Mechanics of Solids-I	3:1:0	4	4	75	25	0	100	3
6	MEC-205A	Thermodynamics	3:1:0	4	4	75	25	0	100	3
7	MEC-207LA	Theory of Machines Lab	0:0:2	2	1	0	40	60	100	3
8	MEC-209LA	Mechanics of Solids Lab	0:0:2	2	1	0	40	60	100	3
9	*MEC-211A	Industrial Training-I	2:0:0	2	-	-	100	-	100	
10	**MC-901A	Environmental Sciences	3:0:0	3	-	100	-	0	100	3
			Total	**30**	**23**	**450**	**230**	**120**	**800**	

*MEC-211Ais a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.

**MC-901A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING) CREDIT BASED

KURUKSHETRA UNIVERSITY KURUKSHETRA

SCHEME OF STUDIES/EXAMINATION

SEMESTER IV(w.e.f. session 2019-2020)

S. No.	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	ES-204A	Materials Engineering	3:0:0	3	3	75	25	0	100	3
2	MEC-202A	Applied Thermodynamics	3:0:0	3	3	75	25	0	100	3
3	MEC-204A	Fluid Mechanics & Fluid Machines	3:1:0	4	4	75	25	0	100	3
4	MEC-206A	Mechanics of Solids-II	3:1:0	4	4	75	25	0	100	3
5	MEC-208A	Instrumentation& Control	3:0:0	3	3	75	25	0	100	3
6	ES-206LA	Materials Engineering Lab	0:0:2	2	1	0	40	60	100	3
7	MEC-210LA	Fluid Mechanics & Fluid Machines Lab	0:0:2	2	1	0	40	60	100	3
8	*MC-902A	Constitution of India	3:0:0	3	-	100	-	-	100	3
			Total	**24**	**19**	**375**	**205**	**120**	**700**	

*MC-902A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

Note: All the students have to undergo 4 to 6 weeks Industrial Training after 4th semester which will be evaluated in 5th semester.

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BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING) CREDIT BASED

KURUKSHETRA UNIVERSITY KURUKSHETRA

SCHEME OF STUDIES/EXAMINATION

SEMESTER V(w.e.f. session 2020-2021)

S. No.	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	HM-905A	Entrepreneurship	3:0:0	3	3	75	25	0	100	3
2	MEC-301A	Heat Transfer	3:1:0	4	4	75	25	0	100	3
3	MEC-303A	Production Technology	3:0:0	3	3	75	25	0	100	3
4	MEC-305A	Mechanical Vibrations and Tribology	3:0:0	3	3	75	25	0	100	3
5	MEC-307LA	Heat Transfer lab	0:0:2	2	1	0	40	60	100	3
6	MEC-309LA	Production Technology Lab	0:0:2	2	1	0	40	60	100	3
7	MEC-311LA	Mechanical Vibrations and Tribology Lab	0:0:2	2	1	0	40	60	100	3
8	MEC-313LA	Project-I	0:0:2	2	1	-	0	100	100	3
9	*MEC-315A	Industrial Training-II	2:0:0	2	-	-	100	-	100	-
10	**MC-903A	Essence of Indian Traditional Knowledge	3:0:0	3	-	100	-	-	100	3
			Total	**26**	**17**	**300**	**220**	**280**	**800**	

*MEC-315A is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.

**MC-903Ais a mandatory credit-less course in which the students will be required to get passing marks in the majortest.

BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER VI(w.e.f. session 2020-2021)

S. No.	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	HM-901A	Organizational Behaviour	3:0:0	3	3	75	25	0	100	3
2	MEC-302A	Manufacturing Technology	3:0:0	3	3	75	25	0	100	3
3	MEC-304A	Design of Machine Elements	2:4:0	6	6	75	25	0	100	4
4	MEC-306LA	Mechanical Engineering Lab-I	0:0:2	2	1	0	40	60	100	3
5	MEC-308LA	Mechanical Engineering Lab-II	0:0:2	2	1	0	40	60	100	3
6	MEC-310LA	Project-II	0:0:6	6	3	0	0	100	100	3
7	MEP*	Program Elective-I	3:1:0	4	4	75	25	0	100	3
8	MEP*	Program Elective -II	3:1:0	4	4	75	25	0	100	3
			Total	**30**	**25**	**375**	**205**	**220**	**800**	

Course No.	ProgramElective I
MEP-302A	Internal Combustion Engines
MEP-304A	Gas Dynamics and Jet Propulsion
MEP-306A	Design of Transmission Systems

Course No.	ProgramElective II
MEP-308A	Composite Materials
MEP-310A	Refrigeration and Air Conditioning
MEP-312A	Product Engineering

Note: All the students have to undergo 4 to 6 weeks Industrial Training after 6th semester which will be evaluated in 7th semester.

*** The course of Program Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER VII(w.e.f. session 2021-2022)

S. No.	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	MEO*	Open Elective-I	3:0:0	3	3	75	25	0	100	3
2	MEC-401A	Automation in Manufacturing	3:0:0	3	3	75	25	0	100	3
3	MEC-403LA	Mechanical Engineering Lab-III	0:0:2	2	1	0	40	60	100	3
4	MEC-405LA	Project-III	0:0:10	10	5	0	100	100	200	3
5	MEP*	Program Elective-III	3:0:0	3	3	75	25	0	100	3
6	MEP*	Program Elective -IV	3:0:0	3	3	75	25	0	100	3
7	**MEC-407A	Industrial Training-III	2:0:0	2	-	-	100	-	100	
			Total	**26**	**18**	**300**	**240**	**160**	**700**	

Program Elective-III			**Program Elective-IV**			**Open Electives-I**	
Course No.	**Course Name**		**Course No.**	**Course Name**		**Course No.**	**Course Name**
MEP-401A	Computer Aided Design		MEP-407A	Mechatronic Systems		MEO-401A	Smart Materials
MEP-403A	Finite Element Analysis		MEP-409A	Industrial Robotics		MEO-405A	Non-Destructive Testing
MEP-405A	Power Plant Engineering		MEP-411A	Solar Energy Analysis		MEO-407A	Manufacturing Cost Estimation
						MEO-409A	Ergonomics
						MEO-411A	Air and Noise Pollution

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**
****MEC-407A**is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.

BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER VIII(w.e.f. session 2021-2022)

S. No.	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	MEC-402LA	Project-IV	0:0:10	10	5	-	100	100	200	3
2	MEO*	Open Elective-II	3:0:0	3	3	75	25	0	100	3
3	MEO*	Open Elective-III	3:0:0	3	3	75	25	0	100	3
4	MEP*	Program Elective-V	3:0:0	3	3	75	25	0	100	3
5	MEP*	Program Elective-VI	3:0:0	3	3	75	25	0	100	3
			Total	**22**	**17**	**300**	**200**	**100**	**600**	

Program Elective- V		**Program Elective-VI**	
Course No.	**Course Name**	**Course No.**	**Course Name**
MEP-402A	Non-Conventional Machining	MEP-408A	Welding Technology
MEP-404A	Automobile Engineering	MEP-410A	Design of Pressure Vessels and Piping
MEP-406A	Product Design and Manufacturing	MEP-412A	Quality and Reliability Engineering

Open Elective- II		**Open Elective-III**	
Course No.	**Course Name**	**Course No.**	**Course Name**
MEO-402A	Supply Chain Management	MEO-408A	Lubricants and Lubrication
MEO-404A	Competitive Manufacturing Systems	MEO-410A	Total Quality Management
MEO-406A	Concurrent Engineering	MEO-412A	Energy Conservation and Management

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

BACHELOR OF TECHNOLOGY (AERONAUTICAL ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER-IIIw.e.f. 2019-20 ONWARDS

S. No.	Course Code	Course Title	Teaching Schedule					Examination Schedule (Marks)				Duration of Exam (Hrs.)
			L	T	P	Hours/Week	Credits	Major Test	Minor Test	Practical	Total	
1	AER-201	Elements of Aeronautics	3	0	0	3	3	75	25	0	100	3
2	#BS-205A	Advance Engineering Mathematics	3	0	0	3	3	75	25	0	100	3
3	#ES-203A	Basic Electronics Engineering	3	0	0	3	3	75	25	0	100	3
4	AER-203	Fluid Mechanics	3	1	0	4	4	75	25	0	100	3
5	#MEC-203A	Mechanics of Solids-I	3	1	0	4	4	75	25	0	100	3
6	#MEC-205A	Thermodynamics	3	1	0	4	4	75	25	0	100	3
7	AER-205	Fluid Mechanics Lab	0	0	2	2	1	0	40	60	100	3
8	#MEC-209LA	Mechanics of Solids Lab	0	0	2	2	1	0	40	60	100	3
9	*AER-207	Industrial Training – I	2	0	0	2	-	-	100	-	100	
10	**MC-901A	Environmental Sciences	3	0	0	3	-	100	-	-	100	3
		Total	**23**	**3**	**4**	**30**	**23**	**450**	**230**	**120**	**800**	

Note:

*1. *AER-207 is a mandatory non-credit course in which students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.*

2. **MC-901A is mandatory credit-less course in which the students will be required to get passing marks in the major test.

3. # The coursesare common with B. Tech. (Mechanical Engineering).

BACHELOR OF TECHNOLOGY (AERONAUTICAL ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER-IV *w.e.f.*2019-20 ONWARDS

S. No.	Course Code	Course Title	Teaching Schedule					Examination Schedule (Marks)				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week	Credits	Major Test	Minor Test	Practical	Total	
1	#ES-204A	Materials Engineering	3	0	0	3	3	75	25	0	100	3
2	AER-202	Aircraft Structure-I	3	1	0	4	4	75	25	0	100	3
3	AER-204	Aerodynamics-I	3	1	0	4	4	75	25	0	100	3
4	#MEC-206A	Mechanics of Solids-II	3	1	0	4	4	75	25	0	100	3
5	AER-206	Propulsion-I	3	0	0	3	3	75	25	0	100	3
6	#ES-206LA	Materials Engineering Lab	0	0	2	2	1	0	40	60	100	3
7	AER-208	Propulsion Lab	0	0	2	2	1	0	40	60	100	3
8	*MC-902A	Constitution of India	3	0	0	3	-	100	-	-	100	3
		Total	**18**	**3**	**4**	**25**	**20**	**375**	**205**	**120**	**700**	

Note:

1. **MC-902A is a mandatory credit-less course in which the students will be required to get passing marks in major test.*
2. *All the students have to undergo 4 to 6 weeks industrial training after 4th semester and it will be evaluated in 5th semester.*
3. #The coursesare common with B.Tech. (Mechanical Engineering).

BACHELOR OF TECHNOLOGY (AERONAUTICAL ENGINEERING) CREDIT BASED

KURUKSHETRA UNIVERSITY KURUKSHETRA

SCHEME OF STUDIES/EXAMINATION

SEMESTER-V *w.e.f* 2020-21 ONWARDS

S. No.	Course Code	Course Title	Teaching Schedule				Credit	Examination Schedule (Marks)				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week		Major Test	Minor Test	Practical	Total	
1	#HM-905A	Entrepreneurship	3	0	0	3	3	75	25	0	100	3
2	AER-301	Aircraft Structure-II	3	1	0	4	4	75	25	0	100	3
3	AER-303	Aerodynamics-II	3	1	0	4	4	75	25	0	100	3
4	AER-305	Propulsion-II	3	0	0	3	3	75	25	0	100	3
5	AER-307	Aircraft Materialsand Manufacturing Processes	3	0	0	3	3	75	25	0	100	3
6	AER-309	Aircraft Structure Lab	0	0	2	2	1	0	40	60	100	3
7	AER-311	Aerodynamics Lab	0	0	2	2	1	0	40	60	100	3
8	AER-313	Project-I	0	0	2	2	1	0	0	100	100	3
9	*AER-315	Industrial Training-II	2	0	0	2	-	0	100	0	100	
10	**MC-903A	Essence of Indian Traditional Knowledge	3	0	0	3	-	100	-	-	100	3
		Total	**20**	**2**	**6**	**28**	**20**	**375**	**205**	**220**	**800**	

Note:

1. *AER-315 is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.
2. ***MC-903A is mandatory credit-less course in which the students will be required to get passing marks in the major test.*
3. #The course is common with B.Tech. (Mechanical Engineering).

BACHELOR OF TECHNOLOGY (AERONAUTICAL ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER-VI *w.e.f.*2020-21 ONWARDS

S. No.	Course Code	Course Title	Teaching Schedule					Examination Schedule (Marks)				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week	Credit	Major Test	Minor Test	Practical	Total	
1	#HM-901A	Organizational Behaviour	3	0	0	3	3	75	25	0	100	3
2	AER-302	Aircraft Design	3	0	0	3	3	75	25	0	100	3
3	AER-304	Aircraft Stability and Control	3	0	0	3	3	75	25	0	100	3
4	AER-306	Aircraft Design Lab	0	0	2	2	1	0	40	60	100	3
5	AER-308	Aircraft Structure Repair Lab	0	0	2	2	1	0	40	60	100	3
6	AER-310	Project-II	0	0	6	6	3	0	0	100	100	3
7	AEP*	Program Elective-I	3	1	0	4	4	75	25	0	100	3
8	AEP*	Program Elective-II	3	0	0	3	3	75	25	0	100	3
		Total	**15**	**1**	**10**	**26**	**21**	**375**	**205**	**220**	**800**	

Program Elective-I			**Program Elective-II**	
Course Code	**Course Title**		**Course Code**	**Course Title**
AEP-302	Aeroelasticity		AEP-308	Aircraft Systems
AEP-304	Aircraft Composite Materials		AEP-310	Aircraft Engineering Practices
AEP-306	Aerospace Heat Transfer		AEP-312	Airplane Performance

Note:

1. **The course of Program Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.*

2. All the students have to undergo 4 to 6 weeks industrial training after 6th semester and it will be evaluated in 7th semester.

3. #The course is common with B.Tech. (Mechanical Engineering).

BACHELOR OF TECHNOLOGY (AERONAUTICAL ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER-VII *w.e.f.*2021-22 ONWARDS

S. No.	Course Code	Course Title	Teaching Schedule					Examination Schedule (Marks)				Duration of Exam (Hrs.)
			L	T	P	Hours/Week	Credit	Major Test	Minor Test	Practical	Total	
1	AEO*	Open Elective-I	3	0	0	3	3	75	25	0	100	3
2	AER-401	Avionics	3	0	0	3	3	75	25	0	100	3
3	AER-403	Avionics Lab	0	0	2	2	1	0	40	60	100	3
4	AER-405	Project-III	0	0	10	10	5	0	100	100	200	3
5	AEP*	Program Elective – III	3	0	0	3	3	75	25	0	100	3
6	AEP*	Program Elective-IV	3	0	0	3	3	75	25	0	100	3
7	**AER-407	Industrial Training-III	2	0	0	2	-	0	100	0	100	
		Total	**14**	**0**	**12**	**26**	**18**	**300**	**240**	**160**	**700**	

Program Elective-III		Program Elective-IV		Open Elective-I	
Course Code	Course Title	Course Code	Course Title	Course Code	Course Title
AEP-401	Principles of Helicopter Engineering	AEP-409	Computational Fluid Dynamics	AEO-401	Flight Dynamics
AEP-403	Boundary Layer Theory	AEP-411	Finite Element Methods	AEO-403	Aircraft Communication and Navigation Systems
AEP-405	Aircraft Maintenance of Power Plant and Systems	AEP-413	Aircraft Maintenance of Airframe and Systems	AEO-405	Experimental Aerodynamics
AEP-407	Fuels and Propellant Technology	AEP-415	Ergonomics in Aerospace	AEO-407	Microprocessor and Interfacing

Note:

1. **The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.*
2. **AER-407 is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.

BACHELOR OF TECHNOLOGY (AERONAUTICAL ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER-VIII *w.e.f.*2021-22 ONWARDS

S. No.	Course Code	Course Title	Teaching Schedule					Examination Schedule (Marks)				Duration of Exam(Hrs.)
			L	T	P	Hours/Week	Credit	Major Test	Minor Test	Practical	Total	
1	AER-402	Project-IV	0	0	10	10	5	0	100	100	200	3
2	AEO*	Open Elective-II	3	0	0	3	3	75	25	0	100	3
3	AEO*	Open Elective-III	3	0	0	3	3	75	25	0	100	3
4	AEP*	Program Elective-V	3	0	0	3	3	75	25	0	100	3
5	AEP*	Program Elective-VI	3	0	0	3	3	75	25	0	100	3
		Total	**12**	**0**	**10**	**22**	**17**	**300**	**200**	**100**	**600**	

Open Elective-II		Open Elective-III	
Course Code	**Course Title**	**Course Code**	**Course Title**
AEO-402	Wind Tunnel Techniques	AEO-410	Rockets and Missiles
AEO-404	Robotics and Automation	AEO-412	Introduction to Automatic Flight Control
AEO-406	Computer Aided Design	AEO-414	Aerospace Power Electronics
AEO-408	Product Design and Manufacturing	AEO-416	Non-Destructive Testing

Program Elective-V		Program Elective-VI	
Course Code	**Course Title**	**Course Code**	**Course Title**
AEP-402	Space Dynamics	AEP-410	Air Transportation and Aircraft Maintenance Management
AEP-404	Aircraft Quality Control, Quality Assurance and Certification	AEP-412	Aircraft Modeling and Simulation
AEP-406	Aircraft Systemsand Instrumentation	AEP-414	Control Theory and Practices
AEP-408	Theory of Vibrations	AEP-416	Mechatronics

Note:*1.*The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.*

BACHELOR OF TECHNOLOGY (AUTOMOBILE ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER III (w. e .f. session 2019-2020)

S. No	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	#BS-201A	Optics & Waves	3:0:0	3	3	75	25	0	100	3
2	#BS-205A	Advanced Engineering Mathematics	3:0:0	3	3	75	25	0	100	3
3	#ES-203A	Basic Electronics Engineering	3:0:0	3	3	75	25	0	100	3
4	#MEC-201A	Theory of Machines	3:1:0	4	4	75	25	0	100	3
5	#MEC-203A	Mechanics of Solids-I	3:1:0	4	4	75	25	0	100	3
6	#MEC-205A	Thermodynamics	3:1:0	4	4	75	25	0	100	3
7	#MEC-207A	Theory of Machines Lab	0:0:2	2	1	0	40	60	100	3
8	#MEC-209A	Mechanics of Solids Lab	0:0:2	2	1	0	40	60	100	3
9	*AEC-201	Industrial Training-I	2:0:0	2	-	-	100	-	100	
10	**MC-901A	Environmental Sciences	3:0:0	3	-	100	-	0	100	3
		Total	**23:3:4**	**30**	**23**	**350**	**230**	**120**	**800**	

***Note: ****AEC-201 is a mandatory non-credit course in which students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.*

******MC-901A is mandatory credit-less course in which the students will be required to get passing marks in the major test.

The course is common with B. Tech. (Mechanical Engineering).

BACHELOR OF TECHNOLOGY (AUTOMOBILE ENGINEERING) CREDIT BASED

KURUKSHETRA UNIVERSITY KURUKSHETRA

SCHEME OF STUDIES/EXAMINATION

SEMESTER IV(w.e.f. session 2019-2020)

S. No.	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	#ES-204A	Materials Engineering	3:0:0	3	3	75	25	0	100	3
2	AEC-202	Auto Fuels and Lubricants	3:0:0	3	3	75	25	0	100	3
3	#MEC-204A	Fluid Mechanics and Fluid Machines	3:1:0	4	4	75	25	0	100	3
4	#MEC-206A	Mechanics of Solids-II	3:1:0	4	4	75	25	0	100	3
5	AEC-204	Two and Three Wheeler Vehicles	3:0:0	3	3	75	25	0	100	3
6	#ES-206A	Materials Engineering Lab	0:0:2	2	1	0	40	60	100	3
7	#MEC-210A	Fluid Mechanics and Fluid Machines Lab	0:0:2	2	1	0	40	60	100	3
8	*MC-902A	Constitution of India	3:0:0	3	-	100	-	-	100	3
		Total	**18:2:4**	**24**	**19**	**375**	**205**	**120**	**700**	

Note:*MC-902A is a mandatory credit-less course in which the students will be required to get passing marks in major test.*

#The course is common with B.Tech (Mechanical Engineering).

All the students have to undergo 4 to 6 weeks industrial training after 4th semester and it will be evaluated in 5th semester.

BACHELOR OF TECHNOLOGY (AUTOMOBILE ENGINEERING) CREDIT BASED

KURUKSHETRA UNIVERSITY KURUKSHETRA

SCHEME OF STUDIES/EXAMINATION

SEMESTER V (w.e.f. session 2020-2021)

S. No.	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	#HM-905A	Entrepreneurship	3:0:0	3	3	75	25	0	100	3
2	#MEC-301A	Heat Transfer	3:1:0	4	4	75	25	0	100	3
3	AEC-301	Design of Automobile Components	3:0:0	3	3	75	25	0	100	3
4	AEC-303	Auto Transmission and Electrical Systems	3:0:0	3	3	75	25	0	100	3
5	#MEC-307A	Heat Transfer lab	0:0:2	2	1	0	40	60	100	3
6	AEC-305	Design of Automobile Components Lab	0:0:2	2	1	0	40	60	100	3
7	AEC-307	Auto Transmission and Electrical Systems Lab	0:0:2	2	1	0	40	60	100	3
8	AEC-309	Project-I	0:0:2	2	1	-	0	100	100	3
9	*AEC-311	Industrial Training-II	2:0:0	2	-	-	100	-	100	-
10	**MC-903A	Essence of Indian Traditional Knowledge	3:0:0	3	-	100	-	-	100	3
		Total	**17:1:8**	**26**	**17**	**300**	**220**	**280**	**800**	

Note:*AEC-311 is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.

***MC-903A is mandatory credit-less course in which the students will be required to get passing marks in the major test.*

#The course is common with B.Tech (Mechanical Engineering).

BACHELOR OF TECHNOLOGY (AUTOMOBILE ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER VI(w.e.f. session 2020-2021)

S. No.	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	#HM-901A	Organizational Behaviour	3:0:0	3	3	75	25	0	100	3
2	AEC-302	Automotive Engines	3:1:0	4	4	75	25	0	100	3
3	AEC-304	Auto Pollution and Control	4:1:0	5	5	75	25	0	100	3
4	AEC-306	Auto Pollution and Control Lab	0:0:2	2	1	0	40	60	100	3
5	AEC-308	Automotive Engines Lab	0:0:2	2	1	0	40	60	100	3
6	AEC-310	Project-II	0:0:6	6	3	0	0	100	100	3
7	AEP*	Program Elective-I	3:1:0	4	4	75	25	0	100	3
8	AEP*	Program Elective -II	3:1:0	4	4	75	25	0	100	3
		Total	**16:4:10**	**30**	**25**	**375**	**205**	**220**	**800**	

Course No.	Program Elective-I
AEP-302	Internal Combustion Engineering
AEP-304	Marketing and Sales Management
AEP-306	Tribology and Preventive Maintenance

Course No.	Program Elective-II
AEP-308	Microprocessor and Interfacing
AEP-310	Automotive Air Conditioning
AEP-312	Production Engineering

Note:*The course of Program Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.*
#The course is common with B.Tech (Mechanical Engineering).
All the students have to undergo 4 to 6 weeks industrial training after 6th semester and it will be evaluated in 7th semester.

BACHELOR OF TECHNOLOGY (AUTOMOBILE ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER VII(w.e.f. session 2021-2022)

S. No.	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	AEO*	Open Elective-I	3:0:0	3	3	75	25	0	100	3
2	AEC-401	Vehicle Body Engineering	3:0:0	3	3	75	25	0	100	3
3	AEC-403	Vehicle Maintenance Lab	0:0:2	2	1	0	40	60	100	3
4	AEC-405	Project-III	0:0:10	10	5	0	100	100	200	3
5	AEP*	Program Elective-III	3:0:0	3	3	75	25	0	100	3
6	AEP*	Program Elective -IV	3:0:0	3	3	75	25	0	100	3
7	**AEC-407	Industrial Training-III	2:0:0	2	-	-	100	-	100	
	Total		**14:0:12**	**26**	**18**	**300**	**240**	**160**	**700**	

Program Elective-III		Program Elective-IV		Open Elective-I	
Course No.	Course Name	Course No.	Course Name	Course No.	Course Name
AEP-401	Computer Integrated Manufacturing	AEP-407	Mechatronics Engineering	AEO-401	Tractor and Farm Equipments
AEP-403	Finite Element Analysis	AEP-409	Robotics and Automation	AEO-403	Non-Destructive Testing and Techniques
AEP-405	Mechanical Vibrations	AEP-411	Hybrid Vehicle Systems	AEO-405	Process Planning and Cost Estimation
				AEO-407	Modern Vehicle Technology
				AEO-409	Automotive Aerodynamics

Note: *The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.
****AEC-407** is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 6th semester and students will berequired to get passing marks to qualify.

BACHELOR OF TECHNOLOGY (AUTOMOBILE ENGINEERING) CREDIT BASED
KURUKSHETRA UNIVERSITY KURUKSHETRA
SCHEME OF STUDIES/EXAMINATION
SEMESTER VIII(w.e.f. session 2021-2022)

S. No.	Course No.	Course Name	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	AEC-402	Project-IV	0:0:10	10	5	-	100	100	200	3
2	AEO*	Open Elective-II	3:0:0	3	3	75	25	0	100	3
3	AEO*	Open Elective-III	3:0:0	3	3	75	25	0	100	3
4	AEP*	Program Elective-V	3:0:0	3	3	75	25	0	100	3
5	AEP*	Program Elective-VI	3:0:0	3	3	75	25	0	100	3
		Total	**12:0:10**	**22**	**17**	**300**	**200**	**100**	**600**	

Program Elective-V		Program Elective-VI	
Course No.	**Course Name**	**Course No.**	**Course Name**
AEP-402	Modern Machining Technology	AEP-408	Energy Management
AEP-404	Manufacturing Management	AEP-410	Management Information Systems
AEP-406	Statistical Quality Control and Reliability Engineering	AEP-412	Motor Vehicle and Environment Protection

Open Elective-II		Open Elective-III	
Course No.	**Course Name**	**Course No.**	**Course Name**
AEO-402	Materials Handling Management	AEO-408	Lubricants and Lubrication Technology
AEO-404	Mechanical Measurement and Metrology	AEO-410	Transport Management
AEO-406	Industrial Safety and Environment	AEO-412	Vehicle Design and Data Characteristics

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section**

New Scheme for Bachelor of Technology of Civil Engineering (CE), and Syllabus
For
Bachelor of Technology First Year in
Civil Engineering (CE),
To be implemented from session 2018- 2019 in, KUK
(Credit - based system)
As per Model Curriculum Provided by AICTE

Course Code and Definition for First Year Scheme

Course Code	Break up of Credits	Definitions
BS	26	Basic Science
ES	23	Engineering Science
HM	11	Humanities and Social Sciences including Management
MC	Non Credits	Mandatory coarse
CE	67	Professional Core
PE	18	Program Elective
OE	6	Open Elective
CEL	9	Project Work, seminar and internship in industry
Total	**160**	

Bachelor of Technology (CIVIL Engineering), KUK
Credit-Based (2018-19 Onwards)
*SCHEME OF STUDIES/EXAMINATIONS (***Semester -III***)*

S. No.	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	HM-251A	Introduction to Civil Engineering	2:0:0	2	2	75	25	0	100	3
2	CE-201A	Introduction to solid Mechanics	2:0:0	2	2	75	25	0	100	3
3	ES-205A	Engineering Mechanics	2:0:0	2	2	75	25	0	100	3
4	CE-203A	Fluid Mechanics	2:1:0	3	3	75	25	0	100	3
5	CE-205A	Surveying & Geomatics	2:0:0	2	2	75	25	0	100	3
6	CE-207A	Building Construction Practice	2:0:0	2	2	75	25	0	100	3
7	CE-213LA	Fluid Mechanics Lab	0:0:2	2	1	-	40	60	100	3
8	CE-215LA	Surveying & Geomatics Lab	0:0:2	2	1	-	40	60	100	3
9	CE-217LA	Computer-aided Civil Engineering Drawing	0:0:2	2	1	-	40	60	100	3
10	MC-201A	Environmental Sciences	2:0:0	2	0	--	100	0	100	3
11	**SIM-201A***	Seminar on Summer Internship*	2:0:0	2	0	--	50	0	50	
		Total	14:1:6	21	16	450	370	180	1000	

Note: *Note: SIM-201A* is a mandatory credit-less course in which the students will be evaluated for the Summer Internship (training) undergone after 2nd semester and students will be required to get passing marks to qualify.

Bachelor of Technology (CIVIL Engineering), KUK
Credit-Based (2018-19 Onwards)
*SCHEME OF STUDIES/EXAMINATIONS (***Semester -IV***)*

S. No.	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	HM-252A	Civil Engineering - Societal & Global Impact	2:0:0	2	2	75	25	0	100	3
2	BS-104A	Mathematics –III	3:1:0	4	4	75	25	0	100	3
3	CE-202A	Structural Analysis-I	2:1:0	3	3	75	25	0	100	3
4	CE-204A	Design of Steel Structure-I	2:0:0	2	2	75	25	0	100	3
5	CE-206A	Soil Mechanics	2:0:0	2	2	75	25	0	100	3
6	CE-208A	Concrete Technology	2:0:0	2	2	75	25	0	100	3
7	CE-212LA	Structural Analysis-I Lab	0:0:2	2	1	-	40	60	100	3
8	CE-216LA	Soil Mechanics Lab	0:0:2	2	1	--	40	60	100	3
9	CE-218LA	Concrete Technology Lab	0:0:2	2	1	--	40	60	100	3
		Total	13:2:6	21	18	450	270	180	900	

Bachelor of Technology (CIVIL Engineering), KUK
Credit-Based (2018-19 Onwards)
*SCHEME OF STUDIES/EXAMINATIONS (***Semester -V***)*

S. No.	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	HM-255A	Professional Practice, Law & Ethics	2:0:0	2	2	75	25	0	100	3
2	CE-301A	Structural Analysis-II	2:1:0	3	3	75	25	0	100	3
3	CE-303A	Design of Concrete Structure-I	2:0:0	2	2	75	25	0	100	3
4	CE-305A	Hydrology	2:0:0	2	2	75	25	0	100	3
5	CE-307A	Geotechnical Engineering	2:0:0	2	2	75	25	0	100	3
6	CE-309A	Engineering Geology	2:0:0	2	2	75	25	0	100	3
7	CE-311LA	Structural Analysis-II Lab	0:0:2	2	1	-	40	60	100	3
8	CE-317LA	Geotechnical Engineering Lab	0:0:2	2	1	--	40	60	100	3
9	CE-319LA	Engineering Geology Lab	0:0:2	2	1	--	40	60	100	3
10	CE-315LA	Survey Camp	0:0:0	0	0	--	40	60	100	
		Total	12:1:6	19	16	450	310	240	1000	

Note: (1) All students have to undertake the Survey Camp for 2 weeks after 4th semester which will be evaluated in 5th semester.

Bachelor of Technology (CIVIL Engineering), KUK
Credit-Based (2018-19 Onwards)
*SCHEME OF STUDIES/EXAMINATIONS (***Semester -VI***)*

S. No.	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	CE-302A	Design of Steel Structure-II	2:0:0	2	2	75	25	0	100	3
2	CE-304A	Transportation Engineering	2:0:0	2	2	75	25	0	100	3
3	CE-306A	Irrigation Engineering	2:0:0	2	2	75	25	0	100	3
4	OE-I	Open Elective-I	2:0:0	2	2	75	25	0	100	3
5	EL-I	Elective-I	3:0:0	3	3	75	25	0	100	3
6	EL-II	Elective-II	3:0:0	3	3	75	25	0	100	3
7	CE-314LA	Transportation Engineering Lab	0:0:2	2	1	-	40	60	100	3
8	CE-316LA	Irrigation Engineering Drawing	0:0:3	3	1.5	--	40	60	100	3
9	CE-318LA	Field Training-II	0:0:0	0	0	--	100	0	100	3
10	***MC-902A**	Constitution of India*	3:0:0	3	0	75	25	0	100	3
		Total	17:0:5	22	16.5	525	430	120	1000	

Note: (1) *MC-902A is a mandatory credit-less course in which the students will be required to get passing marks in the major test

(1) SIM-903 is a credit course in which the students will be evaluated for the Summer Internship (training) undergone after 6th semester and whose credit will be evaluated in 7th semester.

OPEN ELECTIVE-I

Sl. No	Code No.	Subject	Semester	Credits
1.	OE-308A	Soft Skills and Interpersonal Communication	VI	3
2.	OE-310A	Introduction to Art and Aesthetics	VI	3
3.	OE-312A	Cyber Law and Ethics	VI	3
3.	OE-320A	Human Resource Development and Organizational Behavior	VI	3

ELECTIVE-I

Sl. No	Code No.	Subject	Semester	Credits
1.	EL-322A	Disaster Preparedness & Planning	VI	3
2.	EL-324A	Solid and Hazardous waste Management	VI	3
3.	EL-326A	Open Channel flow	VI	3
4.	EL-328A	Ground Water	VI	3

ELECTIVE-II

Sl. No	Code No.	Subject	Semester	Credits
1.	EL-330A	Repair & Rehabilitation of Structures	VI	3
2.	EL-332A	Construction Engineering & Management	VI	3
3.	EL-334A	Structure Analysis by Matrix Method	VI	3
4.	EL-336A	Structure Dynamics	VI	3

Bachelor of Technology (CIVIL Engineering), KUK
Credit-Based (2018-19 Onwards)
*SCHEME OF STUDIES/EXAMINATIONS (***Semester -VII***)*

S. No.	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	CE-401A	Design of Concrete Structure-II	2:0:0	2	2	75	25	0	100	3
2	ES-212A	Energy Science & Engineering	2:0:0	2	2	75	25	0	100	3
3	CE-405A	Water Resources Engineering	2:0:0	2	2	75	25	0	100	3
4	OE-II	Open Elective-II	2:0:0	2	2	75	25	0	100	3
5	EL-III	Elective-III	3:0:0	3	3	75	25	0	100	3
6	EL-IV	Elective-IV	3:0:0	3	3	75	25	0	100	3
7	CE-411LA	Concrete Drawing	0:0:3	3	1.5	-	40	60	100	3
8	ES-212LA	Energy Science & Engineering Lab	0:0:2	2	1	-	40	60	100	3
9	CE-415LA	Minor Project	0:0:8	8	4	-	40	60	100	3
	SIM-903A	Seminar on Summer Internship	1:0:0	1	0	--	50	--	50	3
		Total	15:0:13	28	22.5	450	320	180	950	

Note: (1) SIM-903 is a credit course in which the students will be evaluated for the Summer Internship (training) undergone after 6th semester.
(2) The student have to carry out the MINOR Project either from Transportation Engineering, Hydraulic Engineering and Geotechnical Engineering.

OPEN ELECTIVE - II

Sl. No	Code No.	Subject	Semester	Credits
1.	OE-407A	Metro Systems and Engineering	VII	3
2.	OE-409A	Indian Music System	VII	3
3.	OE-417A	Introduction to Philosophical Thoughts	VII	3

ELECTIVE-III

Sl. No	Code No.	Subject	Semester	Credits
1.	EL-419A	Environmental Impact Assessment	VII	3
2.	EL-421A	Air and Noise Pollution Control	VII	3
3.	EL-423A	Foundation engineering	VII	3
4.	EL-425A	Rock Mechanics	VII	3

ELECTIVE-IV

Sl. No	Code No.	Subject	Semester	Credits
1.	EL-427A	Railway Engineering	VII	3
2.	EL-429A	Airport Planning and Design	VII	3
3.	EL-431A	River Engineering	VII	3
4.	EL-433A	Pipeline Engineering	VII	3

Bachelor of Technology (CIVIL Engineering), KUK
Credit-Based (2018-19 Onwards)
*SCHEME OF STUDIES/EXAMINATIONS (***Semester -VIII***)*

S. No.	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	CE-402A	Engineering Economics, Estimation & Costing	2:0:0	2	2	75	25	0	100	3
2	CE-404A	Bridge Engineering	2:0:0	2	2	75	25	0	100	3
3	OE-III	Open Elective-III	2:0:0	2	2	75	25	0	100	3
4	EL-V	Elective-V	3:0:0	3	3	75	25	0	100	3
5	EL-VI	Elective-VI	3:0:0	3	3	75	25	0	100	3
6	CE-412LA	Compressive Viva	0:0:0	0	0	--	--	50	50	3
7	CE-414LA	Major Project	0:0:10	10	5	-	40	60	100	3
8	CE-416LA	Seminar-II	2:0:0	2	0	--	50	0	50	3
		Total	14:0:10	24	19	375	215	110	700	

Note: The student have to carry out the MAJOR Project either from Structural Engineering, Environmental Engineering and Water Resource Engineering.

OPEN ELECTIVE - III

Sl. No	Code No.	Subject	Semester	Credits
1	OE-406A	ICT for Development	VII	3
2	OE-408A	Comparative Study of Literature	VIII	3
3	OE-410A	History of Science & Engineering	VIII	3
4	OE-418A	Economic Policies in India	VIII	3

ELECTIVE-V

Sl. No	Code No.	Subject	Semester	Credits
1.	EL-420A	Prestress Concrete	VIII	3
2.	EL-422A	Earthquake Engineering	VIII	3
3.	EL-424A	Offshore Engineering	VIII	3
4.	EL-426A	Structural Geology	VIII	3

ELECTIVE-VI

Sl. No	Code No.	Subject	Semester	Credits
1.	EL-428A	Wastewater Treatment	VIII	3
2.	EL-430A	Water and Air Quality Modelling	VIII	3
3.	EL-432A	Traffic Engineering and Management	VIII	3
4.	EL-434A	Infrastructure Planning and Design	VIII	3

ANNEXURE-A

Additional Courses for B.Tech. (Honours Degree)Branch/Course: B.Tech. –Civil Engineering

A student will be eligible to get Under Graduate degree '**B.Tech. with Honours'**, if he/she completes an additional 20 credits. These could be acquired through MOOCs or with in-house examination being conducted. In order to have an Honours degree, a student may choose minimum 20 credits from the following professional electives courses in addition, provided that the student must ensure the course is approved by the Competent Authority, Government of India. The professional electives courses may be selected excluding these. In addition to the following list, the student can also opt some more courses offered under MOOCs at Swayam portal from time to time.

Bachelor of Technology (Civil Engg.)

Credit-Based Scheme of Studies/Examination

Additional Courses for B.Tech. (Honours Degree)

S.No.	Course Code	Subject	L:T:P	Hours/ Week	Week Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	CE-501A	Contracts Mangement, construction Equipment & Automation	3:1:0	4	4	100	-	0	100	3
2	CE-502A	Advance Design of Steel Structure	3:1:0	4	4	100	-	0	100	3
3	CE-503A	Advanced Design of Concrete Structure	3:1:0	4	4	100	-	0	100	3
4	CE-504A	Earthquake Engineering	3:1:0	4	4	100	-	0	100	3
5	CE-505A	Urban Transport Planning	3:1:0	4	4	100	-	0	100	3
6	CE-506A	Hydraulic Modeling	3:1:0	4	4	100	-	0	100	3
7	CE-507A	Advanced Soil Mechanics	3:1:0	4	4	100	-	0	100	3
8	CE-513LA	Material Testing Lab	0:0:2	2	1	0	-	100	100	3
9	CE-514LA	Geomatics Lab	0:0:2	2	1	0	-	100	100	3
10	CE-515LA	Advance CAD Lab	0:0:2	2	1	0	-	100	100	3

Bachelor of Technology (Mechatronics Engineering)
Kurukshetra University, Kurukshetra
SCHEME OF STUDIES/EXAMINATIONSw. e. f. 2019-20 onwards
Semester–III

S. No.	Course No.	Course Title	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	#BS-201A	Optics & Waves	3:0:0	3	3	75	25	0	100	3
2	#BS-205A	Advanced Engineering Mathematics	3:0:0	3	3	75	25	0	100	3
3	#ES-203A	Basic Electronics Engineering	3:0:0	3	3	75	25	0	100	3
4	MTC-201	Thermal Engineering	3:0:0	3	3	75	25	0	100	3
5	MTC-203	Applied Engineering Mechanics	3:1:0	4	4	75	25	0	100	3
6	MTC-205	Theory of Machines-I	3:1:0	4	4	75	25	0	100	3
7	ES-205L	Basic Electronics Engineering Lab	0:0:2	2	1	0	40	60	100	3
8	MTC-207	Applied Engineering Mechanics Lab	0:0:2	2	1	0	40	60	100	3
9	MTC-209	Theory of Machines-I Lab	0:0:2	2	1	0	40	60	100	3
10	*MTC-211	Industrial Training-I	2:0:0	2	-	-	100	-	100	
11	**MC-901A	Environmental Sciences	3:0:0	3	-	100	-	0	100	3
		Total	23:2:6	31	23	450	270	180	900	

Note:

*1. * MTC-211 is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.*

*2.**MC-901A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.*

3. Students are allowed to use programmable scientific calculator during examination.

4. #The courses are common with B. Tech. Mechanical Engineering.

Bachelor of Technology (Mechatronics Engineering)
Kurukshetra University, Kurukshetra
SCHEME OF STUDIES/EXAMINATIONSw. e. f. 2019-20 onwards
Semester–IV

S. No.	Course No.	Course Title	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	#ES-204A	Materials Engineering	3:0:0	3	3	75	25	0	100	3
2	MTC-202	Digital Electronics	3:0:0	3	3	75	25	0	100	3
3	MTC-204	Fluid Mechanics and Heat Transfer	3:0:0	3	3	75	25	0	100	3
4	MTC-206	Production Technology-I	3:0:0	3	3	75	25	0	100	3
5	MTC-208	Theory of Machines-II	3:1:0	4	4	75	25	0	100	3
6	MTC-210	Fluid Mechanics and Heat Transfer Lab	0:0:3	3	1.5	0	40	60	100	3
7	MTC-212	Theory of Machines-II Lab	0:0:3	3	1.5	0	40	60	100	3
8	MTC-214	Digital Electronics Lab	0:0:2	2	1	0	40	60	100	3
9	*MC-902A	Constitution of India	3:0:0	3	-	100	-	-	100	3
		Total	18:1:8	27	20	375	245	180	800	

Note:

1. **MC-902Ais a mandatory credit-less course in which the students will be required to get passing marks in the major test.*
2. *Students are allowed to use programmable scientific calculator during examination.*
3. *All the students have to undergo six weeks industrial training after 4th semester and it will be evaluated in 5th semester.*
4. *#The courses are common with B. Tech. Mechanical Engineering.*

Bachelor of Technology (Mechatronics Engineering)
Kurukshetra University, Kurukshetra
SCHEME OF STUDIES/EXAMINATIONSw. e. f. 2020-21 onwards
Semester–V

S. No.	Course No.	Course Title	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	#HM-905A	Entrepreneurship	3:0:0	3	3	75	25	0	100	3
2	MTC-301	Communication Systems	3:1:0	4	4	75	25	0	100	3
3	MTC-303	Production Technology-II	3:0:0	3	3	75	25	0	100	3
4	MTC-305	Automatic Control Systems	3:0:0	3	3	75	25	0	100	3
5	MTC-307	Embedded Systems-I	3:0:0	3	3	75	25	0	100	3
6	MTC-309	Communication Systems Lab	0:0:2	2	1	0	40	60	100	3
7	MTC-311	Production Technology-II Lab	0:0:4	4	2	0	40	60	100	3
8	MTC-313	Embedded Systems-I Lab	0:0:2	2	1	0	40	60	100	3
9	MTC-315	Project-I	0:0:2	2	1	0	0	100	100	3
10	*MTC-317	Industrial Training-II	2:0:0	2	-	0	100	0	100	
11	**MC-903A	Essence of Indian Traditional Knowledge	3:0:0	3	-	100	-	-	100	3
		Total	20:1:10	31	21	375	245	280	900	

Note:

1. **MTC-317 is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 4th semester.*
2. ***MC-903A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.*
3. *Students are allowed to use programmable scientific calculator during examination.*
4. *#The courses are common with B. Tech. Mechanical Engineering.*

Bachelor of Technology (Mechatronics Engineering)
Kurukshetra University, Kurukshetra
SCHEME OF STUDIES/EXAMINATIONSw. e. f. 2020-21 onwards
Semester–VI

S. No.	Course No.	Course Title	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	#HM-901A	Organizational Behaviour	3:0:0	3	3	75	25	0	100	3
2	MTC-302	Embedded Systems-II	3:0:0	3	3	75	25	0	100	3
3	MTC-304	Pneumatic and Hydraulic Instrumentation	3:0:0	3	3	75	25	0	100	3
4	MTP*	Program Elective-I	3:0:0	3	3	75	25	0	100	3
5	MTP*	Program Elective-II	3:0:0	3	3	75	25	0	100	3
6	MTC-306	Embedded Systems-II Lab	0:0:3	3	1.5	0	40	60	100	3
7	MTC-308	Pneumatic and Hydraulic InstrumentationLab	0:0:3	3	1.5	0	40	60	100	3
8	MTC-310	Project-II	0:0:6	6	3	0	0	100	100	3
		Total	15:0:12	27	21	375	205	220	800	

Program Elective-I		Program Elective-II	
Course No.	**Course Title**	**Course No**	**Course Title**
MTP-302	Internal Combustion Engines	MTP-308	Computer Aided Design and Manufacturing
MTP-304	Refrigeration and Air Conditioning	MTP-310	Microcontrollers
MTP-306	Digital Image Processing	MTP-312	Automobile Engineering and Autotronics

Note:

1. All the students have to undergo 4 to 6 weeks Industrial Training after 6th semester which will be evaluated in 7th semester.

2. The course of Program Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

3. Students are allowed to use programmable scientific calculator during examination.

4.#The courses are common with B. Tech. Mechanical Engineering.

Bachelor of Technology (Mechatronics Engineering)
Kurukshetra University, Kurukshetra
SCHEME OF STUDIES/EXAMINATIONSw. e. f. 2021-22 onwards
Semester–VII

S. No.	Course No.	Course Title	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	MTO*	Open Elective-I	3:0:0	3	3	75	25	0	100	3
2	MTC-401	Robotics and Automation	3:0:0	3	3	75	25	0	100	3
3	MTP*	Program Elective-III	3:0:0	3	3	75	25	0	100	3
4	MTP*	Program Elective-IV	3:0:0	3	3	75	25	0	100	3
5	MTC-403	Robotics and Automation Lab	0:0:2	2	1	0	40	60	100	3
6	MTC-405	Project-III	0:0:8	8	4	0	100	100	200	3
7	*MTC-407	Industrial Training-III	2:0:0	2	-	0	100	0	100	
		Total	14:0:10	24	17	300	240	160	700	

Course No.	Program Elective-III	Course No.	Program Elective-IV	Course No.	Open Elective-I
MTP-401	Advanced Manufacturing Technology	MTP-407	Renewable Energy Resources	MTO-401	Applied Numerical Techniques and Computer Programming
MTP-403	Finite Element Methods	MTP-409	Computational Fluid Dynamics	MTO-403	Non-Destructive Testing
MTP-405	Smart Materials	MTP-411	Consumer Electronics	MTO-405	Internet of Things

Note:

*1.*MTC-407 is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.*

*2. *The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.*

3. Students are allowed to use programmable scientific calculator during examination.

Bachelor of Technology (Mechatronics Engineering)
Kurukshetra University, Kurukshetra
SCHEME OF STUDIES/EXAMINATIONSw. e. f. 2021-22 onwards
Semester–VIII

S. No.	Course No.	Course Title	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	MTC-402	Project-IV	0:0:10	10	5	-	100	100	200	3
2	MTO*	Open Elective-II	3:0:0	3	3	75	25	0	100	3
3	MTO*	Open Elective-III	3:0:0	3	3	75	25	0	100	3
4	MTP*	Program Elective-V	3:0:0	3	3	75	25	0	100	3
5	MTP*	Program Elective-VI	3:0:0	3	3	75	25	0	100	3
		Total	12:0:10	22	17	300	200	100	600	

Course No.	Program Elective-V	Course No.	Program Elective-VI	Course No.	Open Elective-II	Course No.	Open Elective-III
MTP-402	Non-Conventional Machining	MTP-408	Artificial Intelligence & Expert Systems	MTO-402	Sound and Noise Control	MTO-408	Operation Research and Optimization Techniques
MTP-404	Welding Technology	MTP-410	Micro Electro Mechanical Systems	MTO-404	Lubricants and Lubrication	MTO-410	Sensors and Actuators
MTP-406	Industrial Ergonomics	MTP-412	Quality and Reliability Engineering	MTO-406	Competitive Manufacturing Systems	MTO-412	Solar Energy

Note:

1. The course of both Program Elective and open elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

2. Students are allowed to use programmable scientific calculator during examination.

Bachelor of Technology (Textile Technology) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester III (w.e.f. session 2019-2020)

Sr. No.	Course No./Code	Subject	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	PCC-TEX-201A	Textile Fibre – I	3:1:0	4	4	75	25	0	100	3
2	PCC-TEX-203A	Yarn Manufacturing-I	3:1:0	4	4	75	25	0	100	3
3	PCC-TEX-205A	Fabric Manufacturing-I	3:1:0	4	4	75	25	0	100	3
4	PCC-TEX-207A	Textile Chemical Processing-I	3:1:0	4	4	75	25	0	100	3
5	PCC-TEX-209LA	Textile Fibre - I Lab	0:0:2	2	1	-	40	60	100	3
6	PCC-TEX-211LA	Yarn Manufacturing-I Lab	0:0:2	2	1	-	40	60	100	3
7	PCC-TEX-213LA	Fabric Manufacturing-I Lab	0:0:2	2	1	-	40	60	100	3
8	PCC-TEX-215LA	Textile Chemical Processing-I Lab	0:0:2	2	1	-	40	60	100	3
Total				**24**	**20**	**300**	**260**	**240**	**800**	
9	*MC-901A	Environmental Sciences	3:0:0	3	-	100	-	0	100	3

*MC-901A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

Bachelor of Technology (Textile Technology) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester IV (w.e.f. session 2019-2020)

S. No.	Course No./Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	PCC-TEX-202A	Textile Fibre – II	3:1:0	4	4	75	25	0	100	3
2	PCC-TEX-204A	Yarn Manufacturing-II	3:1:0	4	4	75	25	0	100	3
3	PCC-TEX-206A	Fabric Manufacturing-II	3:1:0	4	4	75	25	0	100	3
4	PCC-TEX-208A	Textile Chemical Processing-II	3:1:0	4	4	75	25	0	100	3
5	PCC-TEX-210LA	Yarn Manufacturing-II Lab	0:0:2	2	1	-	40	60	100	3
6	PCC-TEX-212LA	Fabric Manufacturing-II Lab	0:0:2	2	1	-	40	60	100	3
7	PCC-TEX-214LA	Textile Chemical Processing-II Lab	0:0:2	2	1	-	40	60	100	3
Total				**22**	**19**	**300**	**220**	**180**	**700**	
8	*MC-902A	Constitution of India	3:0:0	3	-	100	-	0	100	3
*MC-902A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.										

Note: All the students have to undergo 4 to 6 weeks Industrial Training after 4th semester which will be evaluated in 5th semester.

Bachelor of Technology (Textile Technology) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester V (w.e.f. session 2020-2021)

S. No.	Course No./Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PCC-TEX-301A	Textile Testing-I	3:1:0	4	4	75	25	-	100	3
2	PCC-TEX-303A	Yarn Manufacturing-III	3:1:0	4	4	75	25	-	100	3
3	PCC-TEX-305A	Fabric Manufacturing-III	3:1:0	4	4	75	25	-	100	3
4	PCC-TEX-307A	Fabric Structure & Design	3:1:0	4	4	75	25	-	100	3
5	PCC-TEX-309LA	Textile Testing-I Lab	0:0:2	2	1	-	40	60	100	3
6	PCC-TEX-311LA	Fabric Manufacturing-III Lab	0:0:2	2	1	-	40	60	100	3
7	*SI-301A	Seminar on Summer Internship-I	2:0:0	2	-	-	100	-	100	3
Total				**22**	**18**	**300**	**280**	**120**	**700**	
8	**MC-903A	Essence of Indian Traditional Knowledge	3:0:0	3	-	100	-	-	100	3
**MC-903A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.										

***SI-301A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.**

Bachelor of Technology (Textile Technology) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester VI (w.e.f. session 2020-2021)

S. No.	Course No./Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PCC-TEX-302A	Textile Testing-II	3:1:0	4	4	75	25	0	100	3
2	PCC-TEX-304A	Garment Technology	3:1:0	4	4	75	25	0	100	3
3	PCC-TEX-306A	Knitting Technology	3:1:0	4	4	75	25	0	100	3
4	PCC-TEX-308A	Theory of Textile Structure	3:1:0	4	4	75	25	0	100	3
5	PCC-TEX-310LA	Textile Testing-II Lab	0:0:2	2	1	-	40	60	100	3
6	PCC-TEX-312LA	Garment Technology Lab	0:0:2	2	1	-	40	60	100	3
7	PCC-TEX-314LA	Knitting Technology Lab	0:0:2	2	1	-	40	60	100	3
8	*PEC-TEX	Program Elective-I	3:1:0	4	4	75	25	0	100	3
		Total		**26**	**23**	**375**	**245**	**180**	**800**	

Course No.	ProgramElective I
PECTEX-316A	Multi Fibre Spinning
PEC-TEX-318A	Structure and Properties of Fibre
PEC-TEX-320A	Manufacturing of Speciality Fabrics

*** The course of Program Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

Note: All the students have to undergo 4 to 6 weeks Industrial Training after 6th semester which will be evaluated in 7th semester.

Bachelor of Technology (Textile Technology) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester VII (w.e.f. session 2021-2022)

S. No.	Course No./Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	PCC-TEX-401A	Technical Textiles-I	3:1:0	4	4	75	25	0	100	3
2	PCC-TEX-403A	Advanced Chemical Processing	3:1:0	4	4	75	25	0	100	3
3	*PEC-TEX	Program Elective-II	3:1:0	4	4	75	25	0	100	3
4	*OEC-TEX	Open Elective-I	3:1:0	4	4	75	25	0	100	3
5	PCC-TEX-405LA	Advanced Chemical Processing Lab	0:0:2	2	1	-	40	60	100	3
6	PROJ-TEX-407A	Project-I	0:0:6	6	3	100	-	100	200	3
7	**SI-401A	Seminar on Summer Internship-II	2:0:0	2	-	-	100	-	100	3
		Total		**26**	**20**	**400**	**240**	**160**	**800**	

CourseNo.	Program Elective-II
PEC-TEX-409A	Process Control in Spinning & Weaving
PEC-TEX-411A	Process Control in Garment
PEC-TEX-413A	Process Control in Chemical Processing

CourseNo.	Open Elective-I
OEC-TEX-415A	Fundamentals of Management
OEC-TEX-417A	Statistical Analyses
OEC-TEX-419A	Theory and Design of Textile Machinery

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

****SI-401Ais a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.**

Bachelor of Technology (Textile Technology) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester VIII (w.e.f. session 2021-2022)

S. No.	Course No./Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	PCC-TEX-402A	Technical Textiles-II	3:1:0	4	4	75	25	0	100	3
2	*PEC-TEX	Program Elective-III	3:1:0	4	4	75	25	0	100	3
3	*PEC-TEX	Program Elective-IV	3:1:0	4	4	75	25	0	100	3
4	*OEC-TEX	Open Elective-II	3:1:0	4	4	75	25	0	100	3
6	PROJ-TEX-404A	Project-II	0:0:6	3	3	100	-	100	200	3
7	**SIM-406A	Seminar	3:0:0	3	-	-	100	-	100	3
		Total		**22**	**19**	**400**	**200**	**100**	**700**	

ProgramElective-III		ProgramElective-IV		OpenElectives-II	
CourseNo.	CourseName	CourseNo.	CourseName	CourseNo.	CourseName
PEC-TEX-408A	Post Extrusion Process	PEC-TEX-414A	Computer Aided Design	OEC-TEX-420A	Textile Costing
PEC-TEX-410A	High Performance Fibres	PEC-TEX-416A	Apparel Marketing & Merchandising	OEC-TEX-422A	Management of Textile Production
PEC-TEX-412A	Nonwoven Technology	PEC-TEX-418A	Quality Assurance in Apparel Industry	OEC-TEX-424A	Product Design and Development

***The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

****SIM-406A is a mandatory credit-less course in which the students will be required to get passing marks to qualify.**

Additional Courses for B.Tech. (Honours Degree)
Branch/Course: B.Tech. – Textile Technology

A student will be eligible to get Under Graduate degree '**B.Tech. with Honours'**, if he/she completes an additional 20 credits. These could be acquired through MOOCs or with in-house examination being conducted. In order to have an Honours degree, a student may choose minimum 20 credits from the following professional electives courses in addition, provided that the student must ensure the course is approved by the Competent Authority, Government of India. The professional electives courses may be selected excluding these. In addition to the following list, the student can also opt some more courses offered under MOOCs at Swayam portal from time to time.

Bachelor of Technology (Textile Technology)										
Credit-Based Scheme of Studies/Examination										
Additional Courses for B.Tech. (Honours Degree)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/ Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	PEC-TEX-313A	Nanofibres& Nanotechnology in Textile	3:1:0	4	4	100	--	0	100	3
2	PEC-TEX-315A	Processing of Manmade & Blended Textile	3:1:0	4	4	100	--	0	100	3
3	PEC-TEX-322A	Advanced Apparel Production	3:1:0	4	4	100	--	0	100	3
4	PEC-TEX-421A	Textile Composites	3:1:0	4	4	100	--	0	100	3
5	PEC-TEX-423A	Science of Clothing Comfort	3:1:0	4	4	100	--	0	100	3
6	PEC-TEX-426A	Coated & Laminated Textile	3:1:0	4	4	100	--	0	100	3
7	PEC-TEX-428A	Plasma Technologies for Textile	3:1:0	4	4	100	--	0	100	3
8	PEC-TEX-324LA	Apparel Construction Lab	0:0:2	2	1	0	--	100	100	3
9	PEC-TEX-425LA	Comfort Lab	0:0:2	2	1	0	--	100	100	3
10	PEC-TEX-430LA	Computer Aided Design Lab	0:0:2	2	1	0	--	100	100	3

Model Curriculum Scheme

for

Undergraduate Degree Course

in

Bachelor of Technology (B.Tech)

Chemical Engineering (CHE)

(Credit-Based Scheme of Studies/Examination for3rd to 8th semester in Phased Manner)

KURUKSHETRA UNIVERSITY, KURUKSHETRA (K.U.K) – 136119, HARYANA, INDIA

Bachelor of Technology in CHEMICAL ENGINEERING

KURUKSHETRA UNIVERSITY, KURUKSHETRA (K.U.K) – 136119, HARYANA, INDIA

A. Definition of Credit:

1 Hour Lecture (L) per week	1 credit
1HourTutorial (T) per week	1 credit
1 HourPractical (P) per week	0.5 credit
2 Hours Practical(Lab) per week	1 credit

B. Range of Credits:

A total credit of 160is required for a student to be eligible to get Under Graduate degreeinChemicalEngineering.A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

C. Abbreviations Used for Various Course Codes:

BS: Basic Science Courses

ES: Engineering Science Courses

HM: Humanities and Social Sciences including Management Courses

PC: Professional Core Courses

MC: Mandatory Courses

PE: Professional Elective Courses/Program Elective Courses

OE: Open Elective Courses

PROJ: Project

CHE: Chemical Engineering

OE-CHE: Open Elective Courses-Chemical Engineering

Bachelor of Technology (Chemical Engineering)

Credit-Based Scheme of Studies/Examination

Semester III(w.e.f. session 2019-2020)

S. No.	Course Code	Subject	L:T:P	Hours /Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1.	ES-CHE-201A	Chemical Engineering Thermodynamics-I	3:0:0	3	3	75	25	0	100	3
2.	BS-CH-203A	Chemistry-II	3:0:0	3	3	75	25	0	100	3
3.	PC-CHE-203A	Chemical Engineering Process Calculations	3:1:0	4	4	75	25	0	100	3
4.	PC-CHE-205A	Fluid Flow	3:0:0	3	3	75	25	0	100	3
5.	BS-205A	Advanced Engineering Mathematics	3:0:0	3	3	75	25	0	100	3
6.	PC-CHE-207A	Unit Processes	3:0:0	3	3	75	25	0	100	3
7.	BS-CH-209LA	Chemistry-II (Lab)	0:0:3	3	1.5	0	40	60	100	3
8.	PC-CHE-211LA	Fluid Flow Lab	0:0:3	3	1.5	0	40	60	100	3
Total				**25**	**22**	**450**	**230**	**120**	**800**	
9.	SIM-201A*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	

***Note:** SIM-201A* is a mandatory credit-less course in which the students will be evaluated for the Summer Internship (training)undergone after 2nd semester and students will be required to get passing marks to qualify.

Bachelor of Technology (Chemical Engineering)

Credit-Based Scheme of Studies/Examination

Semester IV(w.e.f. session 2019-2020)

S. No.	Course Code	Subject	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	HM-202A	Fundamental of management	3:0:0	3	3	75	25	0	100	3
2	PC-CHE-204A	Heat Transfer	3:1:0	4	4	75	25	0	100	3
3	PC-CHE-206A	Mechanical Operations	3:0:0	3	3	75	25	0	100	3
4	PC-CHE-208A	Numerical Methods in Chemical Engineering	3:0:0	3	3	75	25	0	100	3
5	ES-CHE-212A	Material Technology	3:0:0	3	3	75	25	0	100	3
6	PC-CHE-214LA	Heat Transfer (Lab)	0:0:3	4	1.5	0	40	60	100	3
7	PC-CHE-216LA	Mechanical Operations (Lab)	0:0:3	4	1.5	0	40	60	100	3
Total				**24**	**19**	**375**	**205**	**120**	**700**	
8	MC-901A	Environmental Sciences	3:0:0	3	0		100	0	100	3

Note:

1. Students be encouraged to go to 6-8 weeks summer internships mandatory during the summer break after the completion of fourth semester exams.
2. MC-901A is a mandatory credit-less course in which the students will be required to get passing marks to qualify.

Bachelor of Technology (Chemical Engineering)
Credit-Based Scheme of Studies/Examination
Semester V(w.e.f. session 2020-2021)

S. No.	Course Code	Subject	L:T:P	Hours /Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PC-CHE-301A	Chemical Reaction Engineering-I	3:1:0	4	4	75	25	0	100	3
2	PC-CHE-303A	Chemical Technology-I	3:0:0	3	3	75	25	0	100	3
3	PC-CHE-305A	Mass Transfer-I	3:0:0	3	3	75	25	0	100	3
4	PC-CHE-307A	Thermodynamics-II	3:1:0	4	4	75	25	0	100	3
5	PC-CHE-309A	Process Instrumentation	3:0:0	3	3	75	25	0	100	3
6	PC-CHE-311LA	Chemical Reaction Engineering-I (Lab)	0:0:3	3	1.5	0	40	60	100	3
7	PC-CHE-313LA	Mass Transfer-I (Lab)	0:0:3	3	1.5	0	40	60	100	3
Total				**23**	**20**	**375**	**205**	**120**	**700**	
9	MC-904A	Energy Resources & Management	3:0:0	3	0	0	100	0	100	3
10	SIM-301A*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	2

***Note:**

1. SIM-301A*is a mandatory credit-less course in which the students will be evaluated for the Summer Internship undergone after 4th semester and students will be required to get passing marks to qualify.
2. MC-904A is a mandatory credit-less course in which the students will be required to get passing marks to qualify.

Bachelor of Technology (Chemical Engineering)

Credit-Based Scheme of Studies/Examination

Semester VI(w.e.f. session 2020-2021)

S. No.	Course Code	Subject	L:T:P	Hours /Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	PC-CHE-302A	Chemical Reaction Engineering-II	3:1:0	4	4	75	25	0	100	3
2	PC-CHE-304A	Chemical Technology-II	3:0:0	3	3	75	25	0	100	3
3	PC-CHE-306A	Mass Transfer-II	3:0:0	3	3	75	25	0	100	3
4	PC-CHE-308A	Process Dynamics Control	3:0:0	3	3	75	25	0	100	3
5	PE-	Elective-I	3:0:0	3	3	75	25	0	100	3
6	PC-CHE-310LA	Chemical Reaction Engineering-II (Lab)	0:0:3	3	1.5	0	40	60	100	3
7	PC-CHE-312LA	Mass Transfer-II (Lab)	0:0:2	2	1	0	40	60	100	3
8	PC-CHE-314LA	Process Dynamics Control (Lab)	0:0:3	3	1.5	0	40	60	100	3
Total				**25**	**20**	**375**	**245**	**180**	**800**	

	PEC Elective-I	
S.No.	**Course Code**	**Subject**
1.	PE-CHE-316A	Water Conservation and Management
2.	PE-CHE-318A	Polymer Science and Engineering:
3.	PE-CHE-320A	Nanoscience and Nanotechnology
4.	PE-CHE-322A	Food Technology

Note: Students be encouraged to go to 6-8 weeks summer internships mandatory during the summer break after the completion of sixth semester exams.

Bachelor of Technology (Chemical Engineering)

Credit-Based Scheme of Studies/Examination

Semester VII(w.e.f. session 2021-2022)

S. No.	Course Code	Subject	L:T:P	Hours /Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	PC-CHE-401A	Process Modeling and Simulation	3:1:0	4	4	75	25	0	100	3
2	PC-CHE-403A	Petroleum Processing Engineering	3:0:0	3	3	75	25	0	100	3
3	PC-CHE-405A	Process Equipment Design	3:0:0	3	3	75	25	0	100	3
4	PE-	Elective-II	3:0:0	3	3	75	25	0	100	3
5	OE-	Open Elective-I	3:0:0	3	3	75	25	0	100	3
6	PC-CHE-407LA	Process Modeling and Simulation (Lab)	0:0:2	2	1	0	40	60	100	3
Total				**18**	**17**	**375**	**165**	**60**	**600**	
7	SIM-401A*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	3

	PEC Elective-II	
S.No.	**Course Code**	**Subject**
1.	PE-CHE-409A	Pulp and Paper Technology
2.	PE-CHE-411A	Catalytic Processes
3.	PE-CHE-413A	Novel Separation Techniques
4.	PE-CHE-415A	Fermentation Technology

	OEC Elective-I	
S.No.	**Course Code**	**Subject**
1.	OE-CHE-417A	Pollution and Control
2.	OE-CHE-419A	Management Information System
3.	OE-CHE-421A	Energy Audit
4.	OE-CHE-423A	Bioinformatics

***Note:** SIM-401A* is a mandatory credit-less course in which the students will be evaluated for Summer Internshipundergone after 6th semester and students will be required to get passing marks to qualify.

Bachelor of Technology (Chemical Engineering)

Credit-Based Scheme of Studies/Examination

Semester VIII (w.e.f. session 2021-2022)

S. No.	Course Code	Subject	L:T:P	Hours /Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	PC-CHE-402A	Process Engineering and Technology	3:0:0	3	3	75	25	0	100	3
2	PC-CHE-404A	Energy Technology	3:0:0	3	3	75	25	0	100	3
3	PC-CHE-406A	Industrial Hazards and Safety	3:0:0	3	3	75	25	0	100	3
4	PE	Elective-II	3:0:0	3	3	75	25	0	100	3
5	OE	Open Elective-II	3:0:0	3	3	75	25	0	100	3
6	PROJ-CHE-408A	Major Project	0:0:12	12	6	0	75	125	200	3
		Total		**27**	**21**	**375**	**200**	**125**	**700**	

	PEC Elective-III	
S.No.	**Course Code**	**Subject**
1.	PE-CHE-410A	Introduction to Bio-chemical Engineering
2.	PE-CHE-412A	Optimization Techniques in Chemical engineering
3.	PE-CHE-414A	Petrochemical Engineering
4.	PE-CHE-416A	Fuel Cell Technology

	OEC Elective-II	
S.No.	**Course Code**	**Subject**
1.	OE-CHE-418A	Energy Resources & Technology
2.	OE-CHE-420A	Entrepreneurship
3.	OE-CHE-422A	Consumer Electronics
4.	OE-CHE-424A	Modern Vehicle Technology

Note: The course of both PE & OE will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

Model Curriculum Scheme for Bachelor of Technology (B.Tech.) in Computer Science and Engineering (CSE) Program

(Credit-Based Scheme of Studies/Examination from 2019-20 Onwards in Phased Manner)

A. Definition of Credit:

1 Hour Lecture (L) per week	1 credit
1Hour Tutorial (T) per week	1 credit
1 Hour Practical (P) per week	0.5 credit
2 Hours Practical (Lab) per week	1 credit

B. Range of Credits:

A total credit of 160 is required for a student to be eligible to get Under Graduate degree in Computer Science and Engineering. A student will be eligible to get Under Graduate degree **(B.Tech.) with Honours**, if he/she completes an additional 20 credits. These could be acquired through University Exam or through MOOCs (i.e. Swayam portal of Government of India) examination approved by the Competent Authority, Government of India.

C. Abbreviations Used for Various Course Codes:

BS: Basic Science Courses
ES: Engineering Science Courses
HM: Humanities and Social Sciences including Management Courses
PC: Professional Core Courses
MC: Mandatory Courses
PE: Professional Elective Courses/Program Elective Courses
OE: Open Elective Courses
PROJ: Project
CS: Computer Science & Engineering
OE-CS: Open Elective Courses-Computer Science & Engineering
A: Applications
D: Data Science and Machine Intelligence
S: Systems
T: Theory and Algorithms

Bachelor of Technology (Computer Science & Engineering)										
Credit-Based Scheme of Studies/Examination										
Semester III (w.e.f. session 2019-2020)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	ES-205A	Principles of Programming Languages	3:0:0	3	3	75	25	0	100	3
2	PC-CS-201A	Data Structure & Algorithms	3:0:0	3	3	75	25	0	100	3
3	ES-207A	Digital Electronics	3:0:0	3	3	75	25	0	100	3
4	PC-CS-203A	Object Oriented Programming	3:0:0	3	3	75	25	0	100	3
5	BS-205A	Mathematics-III	3:0:0	3	3	75	25	0	100	3
6	HM-902A	Business Intelligence and Entrepreneurship	2:0:0	2	2	75	25	0	100	3
7	PC-CS-205LA	Data Structure & Algorithms Lab	0:0:4	4	2	0	40	60	100	3
8	ES-209LA	Digital Electronics Lab	0:0:4	4	2	0	40	60	100	3
9	PC-CS-205 LA	Object Oriented Programming Lab	0:0:4	4	2	0	40	60	100	3
Total				**29**	**23**	**450**	**270**	**180**	**900**	
10	SIM-201A*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	

***Note:** SIM-201A* is a mandatory credit-less course in which the students will be evaluated for the Summer Internship (training) undergone after 2nd semester and students will be required to get passing marks to qualify.

Bachelor of Technology (Computer Science & Engineering)										
Credit-Based Scheme of Studies/Examination										
Semester IV (w.e.f. session 2019-2020)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	PC-CS-202A	Discrete Mathematics	3:0:0	3	3	75	25	0	100	3
2	PC-CS-204A	Internet Technology and Management	3:0:0	3	3	75	25	0	100	3
3	PC-CS-206A	Operating Systems	3:0:0	3	3	75	25	0	100	3
4	PC-CS-208A	Design & Analysis of Algorithms	3:0:0	3	3	75	25	0	100	3
5	HM-901A	Organizational Behaviour	3:0:0	3	3	75	25	0	100	3
6	PC-CS-210LA	Internet Technology and Management Lab	0:0:4	4	2	0	40	60	100	3
7	PC-CS-212LA	Operating Systems Lab	0:0:4	4	2	0	40	60	100	3
8	PC-CS-214LA	Design & Analysis of Algorithms Lab	0:0:4	4	2	0	40	60	100	3
Total				**27**	**21**	**375**	**245**	**180**	**800**	
9	MC-901A	Environmental Sciences	3:0:0	3	0		100	0	100	3

Note: Students be encouraged to go to 6-8 weeks summer internships mandatory during the summer break after the completion of fourth semester exams.

Bachelor of Technology (Computer Science & Engineering)										
Credit-Based Scheme of Studies/Examination										
Semester V (w.e.f. session 2020-2021)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	ES-301A	Signals & Systems	3:0:0	3	3	75	25	0	100	3
2	PC-CS-301A	Database Management Systems	3:0:0	3	3	75	25	0	100	3
3	PC-CS-303A	Formal Language & Automata Theory	3:0:0	3	3	75	25	0	100	3
4	PC-CS-305A	Essential of Information Technology	3:0:0	3	3	75	25	0	100	3
5	PC-CS-307A	Computer Organization & Architecture	2:0:0	2	2	75	25	0	100	3
6	PE	Elective-I	3:0:0	3	3	75	25	0	100	3
7	PC-CS-309LA	Database Management Systems Lab	0:0:4	4	2	0	40	60	100	3
8	PC-CS-311LA	Essential of Information Technology Lab	0:0:4	4	2	0	40	60	100	3
Total				**25**	**21**	**450**	**230**	**120**	**800**	
9	MC-904A	Energy Resources & Management	3:0:0	3	0	0	100	0	100	3
10	SIM-301A*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	

PEC Elective-I
Digital Data Communication: PE-CS-T301A
Parallel and Distributed Computing: PE-CS-T303A
Information Theory and Coding: PE-CS-T305A
Advanced Algorithms: PE-CS-T307A

***Note:** SIM-301A* is a mandatory credit-less course in which the students will be evaluated for the Summer Internship undergone after 4th semester and students will be required to get passing marks to qualify.

Bachelor of Technology (Computer Science & Engineering)										
Credit-Based Scheme of Studies/Examination										
Semester VI (w.e.f. session 2020-2021)										
S. No.	Course Code	Subject	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	PC-CS-302A	Complier Design	3:0:0	3	3	75	25	0	100	3
2	PC-CS-304A	Computer Networks	3:0:0	3	3	75	25	0	100	3
3	*	Elective-II	3:0:0	3	3	75	25	0	100	3
4	**	Elective-III	3:0:0	3	3	75	25	0	100	3
5	***	Open Elective-I	3:0:0	3	3	75	25	0	100	3
6	PROJ – CS-302A	Project-1	0:0:6	6	3	0	40	60	100	3
7	PC-CS-306LA	Complier Design Lab	0:0:4	4	2	0	40	60	100	3
8	PC-CS-308LA	Computer Networks Lab	0:0:4	4	2	0	40	60	100	3
Total				**29**	**22**	**375**	**245**	**180**	**800**	

*** Elective-II**	**** Elective-III**
Advanced Computer Architecture: PE-CS-S302A	Simulation & Modeling: PE-CS-S310A
Distributed Systems: PE-CS-S304A	Mobile Computing: PE-CS-S312A
Fault Tolerant Computing: PE-CS-S306A	Unix & Linux Programming: PE-CS-S314A
Ad-Hoc and Sensor Networks: PE-CS-S308A	Real Time Systems: PE-CS-S316A
***** Elective-I**	
Soft Skills and Interpersonal Communication: OE-CS-302A	
Management Information System: OE-CS-304A	
Enterprise Resource Planning: OE-CS-306A	

Note: Students be encouraged to go to 6-8 weeks summer internships mandatory during the summer break after the completion of sixth semester exams.

The course of both PE & OE will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

Bachelor of Technology (Computer Science & Engineering)										
Credit-Based Scheme of Studies/Examination										
Semester VII (w.e.f. session 2021-2022)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	PE	Elective-IV	3:0:0	3	3	75	25	0	100	3
2	PE	Elective-V	3:0:0	3	3	75	25	0	100	3
3	OE	Open Elective-II	3:0:0	3	3	75	25	0	100	3
4	PROJ-CS-401A	Project-II	0:0:12	12	6	0	40	60	100	3
5	PE-417LA	Elective-IV Lab	0:0:2	2	1	0	40	60	100	3
6	PE-419LA	Elective-V Lab	0:0:2	2	1	0	40	60	100	3
Total				**21**	**17**	**225**	**115**	**60**	**400**	
7	SIM-401A*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	

PEC Elective-IV	**PEC Elective-V**
Data Mining: PE-CS-D401A	Soft Computing: PE-CS-D409A
Speech and Natural Language Processing: PE-CS-D403A	Neural Networks and Deep Learning: PE-CS-D411A
Information Retrieval: PE-CS-D405A	Object Oriented Software Engineering: PE-CS-D413A
Software Verification and Validation and Testing: PE-CS-D407A	Expert Systems: PE-CS-D415A

OEC Elective-II
Cyber Law and Ethics: OE-CS-401A
Bioinformatics: OE-CS-403A
Fiber Optic Communications: OE-CS-405A
Industrial Electrical Systems: OE-CS-407A

The course of both PE & OE will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

***Note:** SIM-401A* is a mandatory credit-less course in which the students will be evaluated for Summer Internship undergone after 6th semester and students will be required to get passing marks to qualify.

Bachelor of Technology (Computer Science & Engineering)										
Credit-Based Scheme of Studies/Examination										
Semester VIII (w.e.f. session 2021-2022)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	PE	Elective-VI	3:0:0	3	3	75	25	0	100	3
2	OE	Open Elective-III	2:0:0	2	2	75	25	0	100	3
3	OE	Open Elective-IV	2:0:0	2	2	75	25	0	100	3
4	PROJ-CS-402A	Project-III	0:0:12	12	6	0	40	60	100	3
5	PE410-LA	Elective-VI Lab	0:0:4	4	2	0	40	60	100	3
		Total		**23**	**15**	**225**	**155**	**120**	**500**	

The course of both PE & OE will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

PE Elective-VI
Cloud Computing: PE-CS-A402A
Computer Graphics: PE-CS-A404A
Web and Internet Technology: PE-CS-A406A
Mobile Apps Development: PE-CS-A408A

OE Elective-III	**OE Elective-IV**
Cyber Security: OE-CS-402A	Software Quality Models: OE-CS-410A
Satellite Communication: OE-CS-404A	Automation in Manufacturing: OE-CS-412A
Social Networks: OE-CS-406A	IPR, Bioethics and Biosafety: OE-CS-414A
Agile Software Engineering: OE-CS-408A	Microprocessor & Interfacing: OE-CS-416A

Additional Courses for B.Tech. (Honours Degree)
Branch/Course: B.Tech. - Computer Science Engineering

A student will be eligible to get Under Graduate degree '**B.Tech. with Honours'**, if he/she completes an additional 20 credits. These could be acquired through University Exam or through MOOCs examination.
The professional electives courses may be selected excluding these. In addition to the following list, the student can also opt some more courses offered under MOOCs at Swayam portal of Government of India from time to time.

Bachelor of Technology (Computer Science & Engineering)										
Credit-Based Scheme of Studies/Examination										
Additional Courses for B.Tech. (Honours Degree)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours /Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	PE-CS-T509A	Graph Theory	3:0:0	3	3	100	--	0	100	3
2	PE-CS-S611A	Software Engineering	3:0:0	3	3	100	--	0	100	3
3	PE-CS-S612A	Embedded Systems	3:0:0	3	3	100	--	0	100	3
4	PE-CS-D709A	Artificial Intelligence	3:0:0	3	3	100	--	0	100	3
5	PE-CS-A805A	Cryptography & Network Security	3:0:0	3	3	100	--	0	100	3
6	PE-CS-S613A	Internet-of-Things	3:0:0	3	3	100	--	0	100	3
7	PE-CS-D710A	Data Analytics	3:0:0	3	3	100	--	0	100	3
8	PE-CS-D711A	Machine Learning	3:0:0	3	3	100	--	0	100	3
9	PE-CS-S611LA	Software Engineering Lab	0:0:4	4	2	0	--	100	100	3
10	PE-CS-S612LA	Embedded Systems Lab	0:0:4	4	2	0	--	100	100	3
11	PE-CS-D710LA	Data Analytics Lab	0:0:4	4	2	0	--	100	100	3
12	PE-CS-D711LA	Machine Learning Lab	0:0:4	4	2	0	--	100	100	3

Model Curriculum Scheme for Bachelor of Technology (B.Tech.) in Information Technology (IT) Program

(Credit-Based Scheme of Studies/Examination from 2018-19 Onwards in-Phased Manner)

Kurukshetra University, Kurukshetra

('A+' Grade, NAAC Accredited)

A. Definition of Credit:

1 Hour Lecture (L) per week	1 credit
1HourTutorial (T) per week	1 credit
1 HourPractical (P) per week	0.5 credit
2 Hours Practical(Lab) per week	1 credit

B. Range of Credits:

A total credit of 160is required for a student to be eligible to get Under Graduate degreein Information Technology (IT).

C. Abbreviations Used for Various Course Codes:

BS: Basic Science Courses
ES: Engineering Science Courses
HM: Humanities and Social Sciences including Management Courses
PC: Professional Core Courses
MC: Mandatory Courses
PE: Professional Elective Courses/Program Elective Courses
OE: Open Elective Courses
PROJ: Project
IT: Information Technology (IT)
OE-IT: Open Elective Courses-Information Technology (IT)
A: Applications
D: Data Science and Machine Intelligence
S:Systems
T: Theory and Algorithms

Bachelor of Technology (Information Technology)										
Credit-Based Scheme of Studies/Examination										
Semester III(w.e.f. session 2019-2020)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	ES-201A	Basic Electronics	3:0:0	3	3	75	25	0	100	3
2	ES-203A	Digital Electronics and logic design	3:0:0	3	3	75	25	0	100	3
3	PC-IT-205A	Data Structure	3:0:0	3	3	75	25	0	100	3
4	PC-IT-207A	Object Oriented Programming using C++	3:0:0	3	3	75	25	0	100	3
5	BS-209A	Mathematics - III	3:0:0	3	3	75	25	0	100	3
6	HM-902A	Fundamentals of Management	3:0:0	3	3	75	25	0	100	3
7	ES-211AL	Basic ElectronicsLab	0:0:2	2	1	0	40	60	100	3
8	ES-213AL	Digital Electronics and logic designLab	0:0:2	2	1	0	40	60	100	3
9	PC-IT-215A L	Object Oriented Programming Lab	0:0:3	3	1.5	0	40	60	100	3
Total				**25**	**21.5**	**450**	**270**	**180**	**900**	
10	SIM-201A*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	

***Note:**SIM-201A*is a mandatory credit-less course in which the students will be evaluated for the Summer Internship (training)undergone after 2nd semester and students will be required to get passing marks to qualify.

Bachelor of Technology (Information Technology)										
Credit-Based Scheme of Studies/Examination										
Semester IV(w.e.f. session 2019-2020)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	ES-IT-202A	Basics of Communication	3:0:0	3	3	75	25	0	100	3
2	PC-IT-204A	Discrete Mathematics	3:0:0	3	3	75	25	0	100	3
3	PC-IT-206A	Operating System	3:0:0	3	3	75	25	0	100	3
4	PC-IT-208A	Microprocessor Interfacing and Application	3:0:0	3	3	75	25	0	100	3
5	PC-IT-210A	Database Management Systems	3:0:0	3	3	75	25	0	100	3
6	HM-901A	Management Information system	3:0:0	3	3	75	25	0	100	3
7	PC-IT-212AL	Microprocessor Interfacing and applicationLab	0:0:3	3	1.5	0	40	60	100	3
8	PC-IT-214AL	Operating Systems Lab	0:0:3	3	1.5	0	40	60	100	3
9	PC-IT-216AL	Database Management Systems Lab	0:0:3	3	1.5	0	40	60	100	3
Total				**27**	**22.5**	**450**	**270**	**180**	**00**	
10	MC-901A	Environmental Sciences	3:0:0	3	0		100	0	100	3

Note: Students be encouraged to go to 6-8 weeks summer internships mandatory during the summer break after the completion of fourth semester exams.

Bachelor of Technology (Information Technology)										
Credit-Based Scheme of Studies/Examination										
Semester V(w.e.f. session 2020-2021)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	ES-301A	JAVA Programming	3:0:0	3	3	75	25	0	100	3
2	PC-IT-301A	Internet and Web Technology	3:0:0	3	3	75	25	0	100	3
3	PC-IT-303A	Computer Graphics	3:0:0	3	3	75	25	0	100	3
4	PC-IT-305A	Computer Organization & Architecture	3:0:0	3	3	75	25	0	100	3
5	PC-IT-307A	Programming with MATLAB	2:0:0	2	2	75	25	0	100	3
6	OE	Elective-I	3:0:0	3	3	75	25	0	100	3
7	PC-IT-309AL	JAVA programming Lab	0:0:4	4	2	0	40	60	100	3
8	PC-IT-311AL	Internet and Web TechnologyLab	0:0:4	4	2	0	40	60	100	3
Total				**25**	**21**	**450**	**230**	**120**	**800**	
9	MC-904A	Energy Resources & Management	3:0:0	3	0	0	100	0	100	3
10	SIM-301A*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	

OE Elective-I
Digital Data Communication: OE-IT-T301A
Computer Networks: OE-IT-T303A
Wireless sensor networks: OE-IT-T305A

***Note:** SIM-301*is a mandatory credit-less course in which the students will be evaluated for the Summer Internship undergone after 4th semester and students will be required to get passing marks to qualify.

Bachelor of Technology (Information Technology)										
Credit-Based Scheme of Studies/Examination										
Semester VI(w.e.f. session 2020-2021)										
S. No.	Course Code	Subject	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PC-IT-302A	Software Engineering	3:0:0	3	3	75	25	0	100	3
2	PC-IT-304A	Linux	3:0:0	3	3	75	25	0	100	3
3	PE	Elective-II	3:0:0	3	3	75	25	0	100	3
4	PE	Elective-III	3:0:0	3	3	75	25	0	100	3
5	OE	Open Elective-I	3:0:0	3	3	75	25	0	100	3
6	PROJ –IT-302A	Project-1	0:0:6	6	3	0	40	60	100	3
7	PC-IT-306AL	Software Engineering Lab	0:0:3	3	1.5	0	40	60	100	3
8	PC-IT-308AL	Linux Lab	0:0:3	3	1.5	0	40	60	100	3
Total				**29**	**21**	**375**	**245**	**180**	**800**	

PEC Elective-II	**PEC Elective-III**
Data ware housing and Data Mining: PE-IT-S302A	Soft computing: PE-IT-S310A
Advance Database management System: PE-IT-S304A	Mobile Computing: PE-IT-S312A
Big Data Analytics: PE-IT-S306A	Agile Software Engineering:PE-IT-S314A

OEC Elective-I
Soft Skills and Interpersonal Communication: OE-IT-302A
Non conventional Energy Resources: OE-IT-304A
Enterprise Resource Planning: OE-IT-306A

Note: Students be encouraged to go to 6-8 weeks summer internships mandatory during the summer break after the completion of sixth semester exams.

The course of both PE & OE will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

Bachelor of Technology (Information Technology)										
Credit-Based Scheme of Studies/Examination										
Semester VII(w.e.f. session 2021-2022)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	PE	Elective-IV	3:0:0	3	3	75	25	0	100	3
2	PE	Elective-V	3:0:0	3	3	75	25	0	100	3
3	OE	Open Elective-II	3:0:0	3	3	75	25	0	100	3
4	PROJ-IT-401A	Project-II	0:0:12	12	6	0	40	60	100	3
5	PE-L	Server side programming Lab	0:0:3	3	1.5	0	40	60	100	3
6	PE-L	Mobile Application Development lab	0:0:3	3	1.5	0	40	60	100	3
Total				**21**	**18**	**225**	**115**	**60**	**400**	
7	SIM-401A*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	

PEC Elective-IV	**PEC Elective-V**
Advanced Computer Networks: PE-IT-D401A	Software Testing: PE-IT-D409A
Introduction to computer animation: PE-IT-D403A	Software Project management:PE-IT-D411A
Parallel Computing: PE-IT-D405A	Distributed Operating System: PE-IT-D413A
Complier Design: PE-IT-D407A	Natural Language Processing: PE-IT-D415A
OEC Elective-II	
Cyber Law and Ethics: OE-IT-401A	
Signal and System: OE-IT-403A	
Neural Networks and Deep Learning: OE-IT-405A	
Digital Signal Processing: OE-IT-407A	

The course of both PE & OE will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

***Note:** SIM-401*is a mandatory credit-less course in which the students will be evaluated for Summer Internshipundergone after 6th semester and students will be required to get passing marks to qualify.

Bachelor of Technology (Information Technology)										
Credit-Based Scheme of Studies/Examination										
Semester VIII(w.e.f. session 2021-2022)										
S. No.	**Course Code**	**Subject**	**L:T:P**	**Hours/Week**	**Credits**	**Examination Schedule (Marks)**				**Duration of Exam (Hrs.)**
						Major Test	**Minor Test**	**Practical**	**Total**	
1	PE	Elective-VI	3:0:0	3	3	75	25	0	100	3
2	OE	Open Elective-III	2:0:0	2	2	75	25	0	100	3
3	OE	Open Elective-IV	2:0:0	2	2	75	25	0	100	3
4	PROJ-IT-402A	Project-III	0:0:12	12	6	0	40	60	100	3
5	PE-L	Elective-VI Lab	0:0:4	4	2	0	40	60	100	3
		Total		**23**	**15**	**225**	**155**	**120**	**500**	

The course of both PE &OE will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

PE Elective-VI
Introduction to Internet of Things: PE-IT-A402A
Cloud Computing: PE-IT-A404A
Machine learning: PE-IT-A406A
Mobile Apps Development: PE-IT-A408A

OE Elective-III	**OE Elective-IV**
Cyber Security: OE-IT-402A	Information Security: OE-IT-410A
Bioinformatics: OE-IT-404A	Image Processing: OE-IT-412A
Social Networks: OE-IT-406A	IPR, Bioethics and Biosafety: OE-IT-414A
Human Computer Interaction: OE-IT-408A	Sensor and Transducer: OE-IT-416A

KURUKSHETRA UNIVERSITY KURUKSHETRA

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)

A. Definition of Credit:

1 Hour Lecture (L) per week	1 credit
1Hour Tutorial (T) per week	1 credit
1 Hour Practical (P) per week	0.5 credit
2 Hours Practical (Lab) per week	1 credit

B. Range of Credits:

A total credit of 160 is required for a student to be eligible to get Under Graduate degree in **Electronics and Communication Engineering**. A student will be eligible to get Under Graduate degree **(B.Tech.) with Honours**, if he/she completes an additional 20 credits. These could be acquired through MOOCs at Swayam portal or with in-house examination being conducted. In order to have an Honours degree, a student may choose minimum 20 credits provided that the student must ensure the course is approved by the Competent Authority, Government of India.

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester III (w.e.f. session 2019-2020)

Sr. No.	Course No.	Subject	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	BS-201A	Optics & Waves	3:0:0	3	3	75	25	0	100	3
2	EC-201A	Electronic Devices	3:0:0	3	3	75	25	0	100	3
3	EC-203LA	Electronic Devices Lab	0:0:2	2	1	-	40	60	100	3
4	EC-205A	Digital Electronics	3:0:0	3	3	75	25	0	100	3
5	EC-207LA	Digital Electronics Lab	0:0:2	2	1	-	40	60	100	3
6	EC-209A	Signals & Systems	3:0:0	3	3	75	25	0	100	3
7	EC-211LA	Signals & Systems Lab	0:0:2	2	1	-	40	60	100	3
8	EC-213A	Network Theory	3:0:0	3	3	75	25	0	100	3
9	ES-201A	Essentials of Information Technology	3:0:0	3	3	75	25	0	100	3
10	*EC-215A	Industrial Training-I	2:0:0	2	-	-	100	-	100	3
11	**MC-901A	Environmental Sciences	3:0:0	3	-	100	-	0	100	3
		Total		**26**	**21**	**450**	**270**	**180**	**900**	

*EC-215A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.
**MC-901A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester IV (w.e.f. session 2019-2020)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	BS-204A	Higher Engineering Mathematics	3:0:0	3	3	75	25	0	100	3
2	HM-903A	Soft Skills & Interpersonal Communication	3:0:0	3	3	75	25	0	100	3
3	EC- 202A	Digital Communication	3:0:0	3	3	75	25	0	100	3
4	EC-204LA	Communication Lab	0:0:2	2	1	-	40	60	100	3
5	EC-206A	Analog Circuits	3:0:0	3	3	75	25	0	100	3
6	EC-208LA	Analog Circuits Lab	0:0:2	2	1	-	40	60	100	3
7	EC-210A	Microprocessors & Microcontrollers	3:0:0	3	3	75	25	0	100	3
8	EC-212LA	Microprocessors & Microcontrollers Lab	0:0:2	2	1	0	40	60	100	3
9	ES-202A	Basics of Analog Communication	3:0:0	3	3	75	25	60	100	3
10	*MC-902A	Constitution of India	3:0:0	3	-	100	-	0	100	3
		Total		**27**	**21**	**550**	**270**	**240**	**900**	

*MC-902A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

Note: All the students have to undergo 4 to 6 weeks Industrial Training after 4th semester which will be evaluated in 5th semester.

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester V (w.e.f. session 2020-2021)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	EC-301A	Electromagnetic Waves	3:0:0	3	3	75	25	0	100	3
2	EC-303LA	Electromagnetic Waves Lab	0:0:2	2	1	-	40	60	100	3
3	EC-305A	Computer Organization & Architecture	3:0:0	3	3	75	25	0	100	3
4	EC-307A	Information Theory and Coding	3:0:0	3	3	75	25	0	100	3
5	EC-309A	Digital Signal Processing	3:0:0	3	3	75	25	0	100	3
6	EC-311LA	Digital Signal Processing Lab	0:0:2	2	1	0	40	60	100	3
7	ECP*	Program Elective-I	3:0:0	3	3	75	25	0	100	3
8	ECO*	Open Elective-I	3:0:0	3	3	75	25	0	100	3
9	**EC-313A	Industrial Training-II	2:0:0	2	-	-	*100	-	*100	3
10	***MC-903A	Essence of Indian Traditional Knowledge	3:0:0	3	-	100	-	0	100	3
		Total		**27**	**20**	**550**	**230**	**120**	**900**	

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

**EC-313A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.

***MC-903A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester VI (w.e.f. session 2020-2021)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	HM-901A	Organizational Behavior	3:0:0	3	3	75	25	0	100	3
2	EC-302A	Control System Engineering	3:0:0	3	3	75	25	0	100	3
3	EC-304LA	Control System Engineering Lab	0:0:3	3	1.5	-	40	60	100	3
4	EC-306A	Verilog HDL	3:0:0	3	3	75	25	0	100	3
5	EC-308LA	Verilog HDL Lab	0:0:3	3	1.5	-	40	60	100	3
6	EC-310LA	Mini Project/Electronic Design Workshop	0:0:4	4	2	-	40	60	100	3
7	ECP*	Program Elective-II	3:0:0	3	3	75	25	0	100	3
8	ECO*	Open Elective-II	3:0:0	3	3	75	25	0	100	3
		Total		**25**	**20**	**375**	**245**	**180**	**800**	

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

Note: All the students have to undergo 4 to 6 weeks Industrial Training after 6th semester which will be evaluated in 7th semester.

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester VII (w.e.f. session 2021-2022)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	HM- 904A	Intellectual Property Rights for Technology Development & Management	3:0:0	3	3	75	25	0	100	3
2	ECP*	Program Elective-III	3:0:0	3	3	75	25	0	100	3
3	ECP*	Program Elective-IV	3:0:0	3	3	75	25	0	100	3
4	ECP*	Program Elective-V	3:0:0	3	3	75	25	0	100	3
5	ECO*	Open Elective-III	3:0:0	3	3	75	25	0	100	3
6	EC-401LA	Project Stage-I	0:0:6	6	3	-	40	60	100	3
7	**EC-403A	Industrial Training-III	2:0:0	2	-	-	*100	-	*100	3
		Total		**23**	**18**	**375**	**165**	**60**	**600**	

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

**EC-403A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester VIII(w.e.f. session 2021-2022)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam. (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	ECP*	Program Elective-VI	3:0:0	3	3	75	25	0	100	3
2	ECP*	Program Elective-VII	3:0:0	3	3	75	25	0	100	3
3	ECO*	Open Elective-IV	3:0:0	3	3	75	25	0	100	3
4	ECO*	Open Elective-V	3:0:0	3	3	75	25	0	100	3
5	EC-402LA	Project Stage-II	0:0:14	14	7	-	40	60	100	3
		Total		**26**	**19**	**300**	**140**	**60**	**500**	

***The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)
KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination

LIST OF OPEN ELECTIVES (B.TECH. ECE)		
SEM	**CODE**	**SUBJECT**
V	ECO-1A	Computer Networks
	ECO-2A	Mechatronics
	ECO-3A	Electronic Measurement and Instruments
	ECO-4A	Renewable Energy Resources
VI	ECO-5A	Data Structures
	ECO-6A	Multimedia Communication
	ECO-7A	Consumer Electronics
	ECO-8A	Transducers and Their Applications
VII	ECO-9A	Bio-informatics
	ECO-10A	Electromechanical Energy Conversion
	ECO-11A	Operating Systems
	ECO-12A	Robotics
VIII	ECO-13A	Machine Learning
	ECO-14A	Soft Computing
	ECO-15A	Neural Networks and Fuzzy Logic
	ECO-16A	Software Defined Radio
	ECO-17A	Statistics and Operational Research
	ECO-18A	Biomedical Signal Processing
	ECO-19A	Internet of Things
	ECO-20A	Wireless Sensor Networks

LIST OF PROGRAM ELECTIVES (B.TECH. ECE)		
SEM	**CODE**	**SUBJECT**
V	ECP-1A	Probability Theory & Stochastic Processes
	ECP-2A	Speech and Audio Processing
	ECP-3A	Introduction to MEMS
	ECP-4A	Power Electronics
	ECP-5A	VLSI
VI	ECP-6A	Antennas and Propagation
	ECP-7A	CMOS Design
	ECP-8A	Bio-Medical Electronics
	ECP-9A	Scientific Computing
VII	ECP-10A	Fiber Optic Communications
	ECP-11A	Nano electronics
	ECP-12A	Microwave Theory and Techniques
	ECP-13A	Adaptive Signal Processing
VIII	ECP-14A	Wireless Sensor Networks
	ECP-15A	Satellite Communication
	ECP-16A	High Speed Electronics
	ECP-17A	Wavelets
	ECP-18A	Embedded systems
	ECP-19A	Mixed Signal Design
	ECP-20A	Error correcting codes
	ECP-21A	Digital Image & Video Processing
	ECP-22A	Mobile Communication and Networks

KURUKSHETRA UNIVERSITYKURUKSHETRA

Bachelor of Technology(ElectricalEngineering)

Scheme of Studies/Examination SemesterIII(w.e.f.Session 2018-19 onwards)

Sr. No.	Course No.	Subject	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	***EE-201A**	**Electrical Circuit Analysis**	3:1:0	4	4	75	25	0	100	3
2	EE-203A	Analog Electronics	3:0:0	3	3	75	25	0	100	3
3	***EE-205A**	**Electrical Machines - I**	3:1:0	4	4	75	25	0	100	3
4	BSC-202A	Higher Engineering Mathematics	3:0:0	3	3	75	25	0	100	3
5	HM-903A	Soft Skills & Interpersonal Communication	3:0:0	3	3	75	25	0	100	3
6	***EE-211A**	**Electrical Machines– I Lab**	0:0:2	2	1	-	40	60	100	3
7	EE-207A	Analog Electronics Lab	0:0:2	2	1	-	40	60	100	3
8	**EE-209A	Industrial Training-I	2:0:0	2	-	-	100	0	100	3
9	***MC-901A	Environmental Sciences	3:0:0	3	-	100	-	0	100	3
		Total		**26**	**19**	**375**	**205**	**120**	**700**	

* Subjects Common with IIIrd Semester. B.Tech. [Electrical & Electronics Engg.] Scheme, K.U.K.

**EE-209A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.

***MC-901A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

KURUKSHETRA UNIVERSITYKURUKSHETRA
BachelorofTechnology(ElectricalEngineering)
Scheme of Studies/Examination SemesterIV(w.e.f.Session2018-19 onwards)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	EE-202A	Digital Electronics	3:1:0	4	4	75	25	0	100	3
2	EE-204A	Signals and Systems	3:1:0	4	4	75	25	0	100	3
3	***EE- 206A**	**Electrical Machines – II**	3:1:0	4	4	75	25	0	100	3
4	***EE-208A**	**Power Electronics**	3:1:0	4	4	75	25	0	100	3
5	EE-216A	Electromagnetic Fields	3:0:0	3	3	75	25	0	100	3
7	***EE-210A**	**Electrical Machines- II Lab**	0:0:2	2	1	-	40	60	100	3
8	***EE-212A**	**Power Electronics Lab**	0:0:2	2	1	-	40	60	100	3
9	EE-214A	Digital Electronics Laboratory	0:0:2	2	1	-	40	60	100	3
10	**MC-902A	Constitution of India	3:0:0	3	-	100	-	0	100	3
		Total		**28**	**22**	**375**	**245**	**180**	**800**	

* Subjects Common with IV Semester. B.Tech. [Electrical & Electronics Engg.] Scheme, K.U.K.
**MC-902A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

Note: All the students have to undergo 4 to 6 weeks Industrial Training after 4th semester which will be evaluated in 5th semester.

KURUKSHETRA UNIVERSITYKURUKSHETRA
BachelorofTechnology(ElectricalEngineering)
Scheme of Studies/Examination SemesterV(w.e.f.Session 2018-19 onwards)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	***EE-301A**	**Power Systems – I**	3:1:0	4	4	75	25	0	100	3
3	***EE-305A**	**Control Systems**	3:1:0	4	4	75	25	0	100	3
4	EEP**	Program Elective-I	3:0:0	3	3	75	25	0	100	3
5	***EE-309A**	**Microprocessors**	3:0:0	3	3	75	25	0	100	3
6	EEO**	Open Elective-I	3:0:0	3	3	75	25	0	100	3
7	***EE-313A**	**Power Systems- I Lab**	0:0:2	2	1	-	40	60	100	3
8	***EE-315A**	**Microprocessors Lab**	0:0:2	2	1	0	40	60	100	3
9	***EE-317A**	**Control Systems Lab**	0:0:2	2	1	0	40	60	100	3
10	***EE-319A	Industrial Training-II	2:0:0	2	-	-	*100	-	*100	3
		Total		**25**	**20**	**375**	**245**	**180**	**800**	

* Subjects Common with Vth Semester. B.Tech. [Electrical& Electronics Engg.] Scheme, K.U.K.

****The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

***EE-319A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.

****Program Elective-I**	EEP-307A	Electrical Machine Design
	EEP-311A	Electrical Drives
	EEP-315A	Power Management
****Open Elective-I**	EEO-321A	Electronic Device
	EEO-323A	Thermal and Fluid Engineering
	EEO-325A	Computer Networks
	EEO-327	Soft Computing

KURUKSHETRA UNIVERSITYKURUKSHETRA
BachelorofTechnology(ElectricalEngineering)
Scheme of Studies/Examination SemesterVI(w.e.f.Session2018-19 onwards)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	***EE-302A**	**Power Systems – II**	3:1:0	4	4	75	25	0	100	3
2	EEP**	Program Elective-II	3:0:0	3	3	75	25	0	100	3
3	EEP**	Program Elective-III	3:0:0	3	3	75	25	0	100	3
4	EEO**	Open Elective-II	3:0:0	3	3	75	25	0	100	3
5	***EE-310A**	**Electrical Measurements and Measuring Instrumentation**	3:0:0	3	3	75	25	0	100	3
6	***EE-312A**	**Power Systems– II Lab**	0:0:2	2	1	-	40	60	100	3
7	***EE-314A**	**Measurements and Instrumentation Lab**	0:0:2	2	1	-	40	60	100	3
8	***EE-316A**	**Electronic Design Lab**	0:0:6	6	3	-	40	60	100	3
9	**HSMC 302A**	Organizational Behaviour	3:0:0	3	3	75	25	0	100	3
		Total		**29**	**24**	**450**	**270**	**180**	**900**	

* Subjects Common with VIth Semester. B.Tech. [Electrical & Electronics Engg.] Scheme, K.U.K.

**** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section. Note: All the students have to undergo 4 to 6 weeks Industrial Training after 6th semester which will be evaluated in 7th semester.**

****Program Elective-II**	EEP-304A	Power System Protection
	EEP-306A	Electrical Energy Conservation and Auditing
****Program Elective- III**	EEP-308A	Digital Signal Processing
	EEP-318A	Computer Architecture
****Open Elective-II**	EEO-320A	Electrical Materials
	EEO-322A	Strength of Materials

KURUKSHETRA UNIVERSITYKURUKSHETRA
BachelorofTechnology(ElectricalEngineering)
Scheme of Studies/Examination SemesterVII(w.e.f.session2018-19 onwards)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	HSMC-401A	Principles of Management	3:0:0	3	3	75	25	0	100	3
2	EEP*	Program Elective-IV	3:0:0	3	3	75	25	0	100	3
3	EEP*	Program Elective-V	3:0:0	3	3	75	25	0	100	3
4	EEO*	Open Elective-III	3:0:0	3	3	75	25	0	100	3
	EEO*	Open Elective-IV	3:0:0	3	3	75	25	0	100	3
5	EE-401LA	Project Stage-I	0:0:6	6	3	-	40	60	100	3
6	**EE-403A	Industrial Training-II	2:0:0	2	-	-	100	-	100	3
		Total		**23**	**18**	**375**	**165**	**60**	**600**	

***The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

**EE-403A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.

****Program Elective-IV**	EEP-405A	HVDC Transmission System
	EEP-407A	Industrial Electrical System
****Program Elective- V**	EEP-409A	High Voltage Engineering
	EEP-411A	Digital Control System
****Open Elective-III**	EEO-401A	Utilization of Electric Energy
	EEO-415A	Transducers and their Application
****Open Elective-IV**	EEO-417A	Signal and Image Processing
	EEO-419A	Biomedical Instrumentation
	EEO-421A	Fluid Machinery

KURUKSHETRA UNIVERSITYKURUKSHETRA
BachelorofTechnology(Electrical Engineering)
Scheme of Studies/Examination SemesterVIII (w.e.f.Session 2018-19 onwards)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam. (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	EEP*	Program Elective-VI	3:0:0	3	3	75	25	0	100	3
3	EEO*	Open Elective-V	3:0:0	3	3	75	25	0	100	3
4	EEO*	Open Elective-VI	3:0:0	3	3	75	25	0	100	3
5	EE-402LA	Project Stage-II	0:0:12	12	6	-	40	60	100	3
		Total		**21**	**15**	**225**	**115**	**60**	**400**	

****Program Elective-VI**	EEP-402A	Electrical & Hybrid Vehicles
	EEP-404A	Power Quality & FACTS
	EEP-406A	Control System Design
	EEP-408A	Wind and Solar Energy System
****Open Elective-V**	EEO-410A	Power Plant Engineering
	EEO-412A	PLC and their application
****Open Elective-VI**	EEO-414A	Embedded System
	EEO-416A	Automobile Engineering
	EEO-418A	Biomedical Signal & Image Processing

***The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

Total Credits = 160

KURUKSHETRA UNIVERSITYKURUKSHETRA

BachelorofTechnology(Electrical & ElectronicsEngineering)(CreditBased)

Scheme of Studies/Examination

SemesterIII(w.e.f.session2019-2020)

Sr. No.	Course No.	Subject	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	***EE-201A**	**Electrical Circuit Analysis**	3:1:0	4	4	75	25	0	100	3
2	BS-201A	Optics & Waves	3:0:0	3	3	75	25	0	100	3
3	***EE-205A**	**Electrical Machines - I**	3:1:0	4	4	75	25	0	100	3
4	EEN-205A	Analog Electronics	3:0:0	3	3	75	25	0	100	3
5	EEN -209A	Signals and Systems	3:1:0	4	4	75	25	0	100	3
6	***EE-211A**	**Electrical Machines Lab – I**	0:0:2	2	1	-	40	60	100	3
7	EEN -207A	Analog Electronics Lab	0:0:2	2	1	-	40	60	100	3
8	EEN -211A	Signal and Systems Lab	0:0:2	2	1	-	40	60	100	3
9	**EEN-215A	Industrial Training-I	2:0:0	2	-	-	100	-	100	3
10	***MC-901A	Environmental Sciences	3:0:0	3	-	100	-	0	100	3
		Total		**29**	**21**	**375**	**245**	**180**	**800**	

* Subjects Common with III Semester. B.Tech. [Electrical Engg.] Scheme, K.U.K.

**EEN-215A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.

***MC-901A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

KURUKSHETRA UNIVERSITY KURUKSHETRA
Bachelor of Technology (Electrical & Electronics Engineering) (Credit Based)
Scheme of Studies/Examination
Semester IV (w.e.f. session 2019-2020)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	BS-204A	Higher Engineering Mathematics	3:0:0	3	3	75	25	0	100	3
2	HM-903A	Soft Skills & Interpersonal Communication	3:0:0	3	3	75	25	0	100	3
3	***EE- 206A**	**Electrical Machines – II**	3:1:0	4	4	75	25	0	100	3
4	***EE-208A**	**Power Electronics**	3:0:0	3	3	75	25	0	100	3
5	EEN-210A	Digital Electronics	3:0:0	3	3	75	25	0	100	3
6	EEN -202A	Basics of Analog Communication	3:0:0	3	3	75	25	0	100	3
7	***EE-214A**	**Electrical Machines Lab - II**	0:0:2	2	1	-	40	60	100	3
8	***EE-216A**	**Power Electronics Lab**	0:0:2	2	1	0	40	60	100	3
9	EEN-218A	Digital Electronics Lab	0:0:2	2	1	-	40	60	100	3
10	**MC-902A	Constitution of India	3:0:0	3	-	100	-	0	100	3
		Total		**28**	**22**	**450**	**270**	**180**	**900**	

* Subjects Common with IVth Semester. B.Tech. [Electrical Engg.] Scheme, K.U.K.

**MC-202A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

Note: All the students have to undergo 4 to 6 weeks Industrial Training after 4th semester which will be evaluated in 5th semester.

KURUKSHETRA UNIVERSITY KURUKSHETRA

Bachelor of Technology (Electrical & Electronics Engineering) (Credit Based)

Scheme of Studies/Examination

Semester V (w.e.f. session 2020-2021)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	***EE-301A**	**Power Systems – I**	3:1:0	4	4	75	25	0	100	3
2	***EE-305A**	**Control Systems**	3:1:0	4	4	75	25	0	100	3
3	EENP**	Program Elective - I	3:0:0	3	3	75	25	0	100	3
4	***EE-309A**	**Microprocessors**	3:0:0	3	3	75	25	0	100	3
5	EENO**	Open Elective - I	3:0:0	3	3	75	25	0	100	3
6	***EE-313A**	**Power Systems Lab - I**	0:0:2	2	1	-	40	60	100	3
7	***EE-315A**	**Microprocessors Lab**	0:0:2	2	1	0	40	60	100	3
8	***EE-317A**	**Control Systems Lab**	0:0:2	2	1	0	40	60	100	3
9	***EEN-319A	Industrial Training-II	2:0:0	2	-	-	*100	-	*100	3
10	****MC-903A	Essence of Indian Traditional Knowledge	3:0:0	3	-	100	-	0	100	3
		Total		**28**	**20**	**375**	**245**	**180**	**800**	

* Subjects Common with Vth Semester. B.Tech. [Electrical Engg.] Scheme, K.U.K.

****The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

***EEN-319A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.

****MC-903A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

Course No.	Program Elective I
EENP-301A	Digital Signal Processing
EENP-303A	Electrical Machine Design
EENP-305A	Electromagnetic Field Theory
EENP-307A	Computer Architecture

Course No.	Open Elective I
EENO-301A	Computer Networks
EENO-303A	Big Data Analysis
EENO-305A	VLSI Circuits
EENO-307A	Power Plant Engineering

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Bachelor of Technology (Electrical & Electronics Engineering) (Credit Based)
Scheme of Studies/Examination
Semester VI (w.e.f. session 2020-2021)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	***EE-302A**	**Power Systems – II**	3:1:0	4	4	75	25	0	100	3
2	HM-901A	Organizational Behavior	3:0:0	3	3	75	25	0	100	3
3	EENP**	Program Elective - II	3:0:0	3	3	75	25	0	100	3
4	EENO**	Open Elective - II	3:0:0	3	3	75	25	0	100	3
5	***EE-310A**	**Electrical Measurements and Measuring Instrumentation**	3:0:0	3	3	75	25	0	100	3
6	***EE-312A**	**Power Systems Lab - II**	0:0:2	2	1	-	40	60	100	3
7	***EE-314A**	**Measurements and Instrumentation Lab**	0:0:2	2	1	-	40	60	100	3
8	EEN-316A	Electronic Design Lab	0:0:4	4	2	-	40	60	100	3
		Total		**24**	**20**	**375**	**245**	**180**	**800**	

* Subjects Common with VIth Semester. B.Tech. [Electrical Engg.] Scheme, K.U.K.

**** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section. Note: All the students have to undergo 4 to 6 weeks Industrial Training after 6th semester which will be evaluated in 7th semester.**

Course No.	Program Elective II
EENP-302A	Power System Protection
EENP-304A	Electrical Energy Conservation and Auditing
EENP-306A	Electromagnetic Waves and Lines
EENP-308A	Biomedical Signal & Image Processing

Course No.	Open Elective II
EENO-302A	Electrical Materials
EENO-304A	Strength of Materials
EENO-306A	Modern Manufacturing Processes
EENO-308A	Internet of Things

KURUKSHETRA UNIVERSITYKURUKSHETRA

BachelorofTechnology(Electrical & ElectronicsEngineering)(CreditBased)
Scheme of Studies/Examination
SemesterVII(w.e.f.session2021-2022)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	HM- 904A	IntellectualPropertyRightsfor Technology Development& Management	3:0:0	3	3	75	25	0	100	3
2	EENP*	Program Elective - III	3:0:0	3	3	75	25	0	100	3
3	EENP*	Program Elective - IV	3:0:0	3	3	75	25	0	100	3
4	EENO*	Open Elective - III	3:0:0	3	3	75	25	0	100	3
5	EEN-401LA	Project Stage-I	0:0:6	3	3	-	40	60	100	3
6	**EEN-403A	Industrial Training-III	2:0:0	2	-	-	*100	-	*100	3
		Total		**17**	**15**	**300**	**140**	**60**	**500**	

***The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

**EEN-403A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.

Program Elective-III	
Course No.	**Course Name**
EENP-401A	Industrial Electrical System
EENP-403A	Digital Control System
EENP-405A	High Voltage Engineering

Program Elective-IV	
Course No.	**Course Name**
EENP-407A	Electric Drives
EENP-409A	Wind and Solar Energy
EENP-411A	Computational Electromagnetic

Open Electives-III	
Course No.	**Course Name**
EENO-401A	Electronic Devices
EENO-403A	Data Structure & Algorithms
EENO-405A	Signal and Image Processing

Bachelor of Technology (Electrical & Electronics Engineering) (Credit Based)
Scheme of Studies/Examination
Semester VIII (w.e.f. session 2021-2022)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam. (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	EENP*	Program Elective-V	3:0:0	3	3	75	25	0	100	3
2	EENP*	Program Elective-VI	3:0:0	3	3	75	25	0	100	3
3	EENO*	Open Elective-IV	3:0:0	3	3	75	25	0	100	3
4	EENO*	Open Elective-V	3:0:0	3	3	75	25	0	100	3
5	EEN-402LA	Project Stage-II	0:0:12	12	6	-	40	60	100	3
		Total		**26**	**20**	**300**	**140**	**60**	**500**	

Program Elective- V		**Program Elective-VI**	
Course No.	**Course Name**	**Course No.**	**Course Name**
EENP-402A	Power Quality & FACTS	EENP-408A	HVDC Transmission System
EENP-404A	Control System Design	EENP-410A	Power System Dynamics and Control
EENP-406A	Electrical & Hybrid Vehicles	EENP-412A	Advanced Electric Drives

Open Elective- IV		**Open Elective-V**	
Course No.	**Course Name**	**Course No.**	**Course Name**
EENO-402A	Analog & Digital Communication	EENO-408A	Mobile Communication & Networks
EENO-404A	Wavelets Transform	EENO-410A	Thermal and Fluid Engineering
EENO-406A	Embedded System	EENO-412A	Automobile Engineering

***The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

DEPARTMENT OF ELECTRONICS ENGINEERING
Kurukshetra University, Kurukshetra (K.U.K) – 136119, Haryana, INDIA
(Established by the state Legislature Act XII of 1956; 'A+' Grade, NAAC Accredited)
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A. Definition of Credit:

1 Hour Lecture (L) per week	1 credit
1Hour Tutorial (T) per week	1 credit
1 Hour Practical (P) per week	0.5 credit
2 Hours Practical (Lab) per week	1 credit

B. Range of Credits:

A total credit of 160 is required for a student to be eligible to get Under Graduate degree in Electronics Engineering. A student will be eligible to get Under Graduate degree (B.Tech.) with Honours, if he/she completes an additional 20 credits more. These could be acquired through MOOCs at Swayam portal or with in-house examination being conducted. In order to have an Honours degree, a student may choose minimum 20 credits provided that the student must ensure the course is approved by the Competent Authority, Government of India.

Course Code and Definition for Scheme

Course Code	Definitions
BS	Basic Science
ES	Engineering Science
HM	Humanities and Social Sciences including Management

Bachelor of Technology (Electronics Engineering) Kurukshetra University, Kurukshetra

SCHEME OF STUDIES/EXAMINATIONS

***w.e.f.* July 2018 (Batch: 2018-2022)**

Semester–III (Common with B.Tech ECE 3rd Sem as per AICTE Model curriculum)

S. No.	Course No.	Course Title	Teaching Schedule				Examination Schedule Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week	Major Test	Minor Test	Practical (Major Test)	Total	
1	BS – 201A	Optics and Wave	3	0	0	3	75	25	0	100	3
2	EC – 201A	Electronic Devices	3	0	0	3	75	25	0	100	3
3	EC – 203A	Electronic Devices Lab	0	0	2	2	-	40	60	100	3
4	EC-205A	Digital Electronics	3	0	0	3	75	25	0	100	3
5	EC – 207A	Digital Electronics Lab	0	0	2	2	-	40	60	100	3
6	EC – 209A	Signal and System	3	0	0	3	75	25	0	100	3
7	EC – 211A	Signal and System Lab	0	0	2	2	-	40	60	100	3
8	EC – 213A	Network Theory	3	0	0	3	75	25	0	100	3
9	ES – 201A	Essential of Information Theory	3	0	0	3	75	25	0	100	3
10	*EC-215 A	Industrial Training-I	2	0	0	2	-	100	-	100	3
11	**MC-901A	Environmental sciences	3	0	0	3	100	-	0		
		TOTAL	18	0	6	26	450	270	180	900	

**MC-901A is a mandatory course and student has to get passing marks in order to qualify for the award of degree but its marks will not be added in the grand total.*

Students are allowed to use single memory, non-programmable scientific calculator during examination.

Bachelor of Technology (Electronics Engineering) Kurukshetra University, Kurukshetra

SCHEME OF STUDIES/EXAMINATIONS

***w.e.f.* July 2018 (Batch: 2018-2022)**

Semester–IV (Common with B.Tech ECE 4th Sem as per AICTE Model curriculum)

S. No.	Course No.	Course Title	Teaching Schedule				Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week	Major Test	Minor Test	Practical (Major Test)	Total	
1	BS – 204A	Higher Engineering Mathematics	3	0	0	3	75	25	0	100	3
2	HM – 903A	Soft Skills and Interpersonal Communication	3	0	0	3	75	25	0	100	3
3	EC – 202A	Digital Communication	3	0	0	3	75	25	0	100	3
4	EC – 204A	Digital Communication Lab	0	0	2	2	0	40	60	100	3
5	EC – 206A	Analog Circuits	3	0	0	3	75	25	0	100	3
6	EC – 208A	Analog Circuits Lab	0	0	2	2	0	40	60	100	3
7	EC– 210A	Microprocessor and Microcontroller	3	0	0	3	75	25	0	100	3
8	EC – 212A	Microprocessor and Microcontroller Lab	0	0	2	2	0	40	60	100	3
9	ES- 202A	Basic of Analog Communication	3	0	0	3	75	25	0	100	3
10	*MC-902A	Constitution of India	3	0	0	3	100	-	0	100	3
		Total	21	0	6	27	550	270	180	900	

*MC-902 A *is a mandatory course and student has to get passing marks in order to qualify for the award of degree but its marks will not be added in the grand total.*

***Note:** All the students have to undergo six weeks industrial training after IVth semester and it will be evaluated in Vth semester.*

Bachelor of Technology (Electronics Engineering) Kurukshetra University, Kurukshetra

SCHEME OF STUDIES/EXAMINATIONS

***w.e.f.* July 2018 (Batch: 2018-2022)**

Semester–V

S.No	Subject code	Course Title	Teaching Schedule				Marks Allotment				Duration of Exam
			L	T	P	Total	Major Test	Minor Test	Practical (Major Test)	Total	
1	EC-301A#	Electromagnetic Waves	3	0	0	3	75	25	0	100	3
2	EC-303A#	Electromagnetic Waves Lab	0	0	2	2	0	40	60	100	3
3	EL-305A	Stochastic process and Probability Theory	3	0	0	3	75	25	0	100	3
4	EC-307A#	Information Theory and Coding	3	0	0	3	75	25	0	100	3
5	EC-309A#	Digital Signal Processing	3	1	0	4	75	25	0	100	3
6	EC-311A3	Digital Signal Processing Lab	0	0	2	2	0	40	60	100	3
7	ELP	Program Elective-1	3	0	0	3	75	25	0	100	3
8	ELO	Open Elective-1	3	0	0	3	75	25	0	100	3
9	**EC-313A#	Industrial Training-II	2	0	0	2	0		100	*100	3
10	***MC-903A#	Essence of Indian Traditional Knowledge	3	0	0	3	100			100	3
		Total	23	1	2	26	550	230	220	900	27

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

****EC-313 A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.**

*****MC-903A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.**

 # The Subjects are common with B.Tech Electronics & Communication Engineering

	Course Name	Course Title
Program Elective-1	ECP-7A#	CMOS Design
	ECP-11A#	Nano Electronics
	ECP-4A#	Power Electronics
	ECP-3A#	Introduction to MEMS

	Course Name	Course Title
Open Elective-1	ELO-301A	Smart Material and Systems
	ELO-303 A	Intelligent Instrumentation
	ECO-10A#	Electromechanical Energy Conversion
	ECO-3A#	Electronic Measurement and Instrumentation

Bachelor of Technology (Electronics Engineering) Kurukshetra University, Kurukshetra

SCHEME OF STUDIES/EXAMINATIONS

***w.e.f.* July 2018 (Batch: 2018-2022)**

Semester – VI

S. No.	Course No.	Course Title	Teaching Schedule				Marks Allotment				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week	Major Test	Minor Test	Practical (Major Test)	Total	
1	HM 901 A#	Organizational Behavior	3	0	0	3	75	25	0	100	3
2	EC-302A#	Control System Engineering	3	0	0	3	75	25	0	100	3
3	EC-304A#	Control System Lab	0	0	3	3	0	40	60	100	3
4	EC-306A#	Verilog HDL	3	0	0	3	75	25	0	100	3
5	EC-308 A#	Verilog HDL Lab	0	0	3	3	0	40	60	100	3
6	EC-310 A#	Mini Project/Electronic Design Workshop	0	0	4	4	0	40	60	100	3
6	ELP	Program Elective-II	3	0	0	3	75	25	0	100	3
8	ELO	Open Elective-II	3	0	0	3	75	25	0	100	3
		Total	15	0	10	25	375	245	180	800	24

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

 # The Subjects are common with B.Tech Electronics & Communication Engineering

Note: All the students have to undergo 4 to 6 weeks Industrial Training after 6th semester which will be evaluated in 7th semester.

	Course Name	Course Title
Program Elective-II	ECP-2A#	Speech and Audio Processing
	ECP-8A#	Bio Medical Electronics
	ECO-1 A#	Computer Network
Open Elective-II	ECP-22A#	Mobile Communication and network
	ELO -302 A	Quality and Reliability of Electronics System
	ELO-304 A	Electronics Waste Management

Bachelor of Technology (Electronics Engineering) Kurukshetra University, Kurukshetra

SCHEME OF STUDIES/EXAMINATIONS

***w.e.f.* July 2018 (Batch: 2018-2022)**

Semester–VII

Subject code	Course Title	Teaching Schedule			Marks Allotment					Duration of Exam
		L	T	P	Total	Major Test	Minor Test	Practical (Major Test)	Total	
EL-401A	Fuzzy Logics and Neural Network	3	0	0	3	75	25	0	100	3
ELP	Program Elective- III	3	0	0	3	75	25		100	3
ELP	Program Elective- IV	3	0		3	75	25		100	3
ELP	Program Elective- V	3	0	0	3	75	25		100	
ELO	Open Elective- III	3	0		3	75	25		100	3
EC-401A#	Project Stage -I			6	6		50	50	100	3
EC-403A#	Industrial Training-III						100		100	3
	Total	12	0	13	25	300	290	110	700	21

COURSES	Course Name	Course Title
Program Elective-III	ELP-401A	High Speed Electronics
	ECP-19A#	Mixed Signal Design
	ELP-403 A	Electronics System Design
Program Elective-IV	ELP-405 A	Operation Research
	ECO-14A#	Soft computing
	ELP-407 A	Microcontrollers
Program Elective-V	ELP-409A	Microwave Theory and Techniques
	ECO16A#	Software Defined Radio
	ECP-21A#	Digital Image and Video Processing
Open Elective-III	ECO-4A#	Renewable Energy Resources
	ELO-401 A	Industrial Safety Engineering
	ELO-403A	Quality Management

 # The Subjects are common with B.Tech Electronics & Communication Engineering

Bachelor of Technology (Electronics Engineering) Kurukshetra University, Kurukshetra

SCHEME OF STUDIES/EXAMINATIONS

***w.e.f.* July 2018 (Batch: 2018-2022)**

Semester–VIII

Sr. No.	Subject code	Course Title	Teaching Schedule				Marks Allotment				Duration of Exam
			L	T	P	Total	Major Test	Minor Test	Practical (Major Test)	Total	
1	ELO	Open Elective –IV	3	0	0	3	75	25	0	100	3
2	ELO	Open Elective –V	3	0	0	3	75	25	0	100	3
3	ELP	Program Elective – VI	3	0	0	4	75	25	0	100	3
4	ELP	Program Elective-VII	3	0	0	3	75	25	0	100	3
5	EC-402A#	Project stage –II	0	0	14	14		40	60	100	3
		Total	12	0	14	26	300	140	60	500	15

Sr. No.	Program Elective -VI	CODE	Sr. No.	Open Elective -IV	CODE
1	Cyber Law and Security	ELP-402A	1	Wireless Sensor Networks	ECO-20A#
2	Artificial Intelligence and expert system	ELP-404A	2	Mechatronics	ECO-2A#
3	Analog Filter Design	ELP-406A	3	Software Defined Radio	ECO-16A#
Sr. No.	**Program Elective -VII**	**CODE**	**Sr. No.**	**Open Elective -V**	**CODE**
1	Human Resource Management	ELP-408A	1	Wavelets	ECP-17A#
2	Scientific Computing	ECP-9A#	2	Transducers and its Application	ECO-8A#
3	Robotics	ECO-12A#	3	Electronic Switching Theory	ELO-402A

 # The Subjects are common with B.Tech Electronics & Communication Engineering

Kurukshetra University Kurukshetra
(Established by the State Legislature Act XII of 1956; 'A+' Grade, NAAC Accredited)
Model Curriculum for
Bachelor of Technology (B.Tech.) in Bio-Technology
General, Course Structure & Scheme&Semester-Wise Credit Distribution
(Credit-Based Scheme of Studies/Examination ((2018-19 Onwards in Phased Manner)

A. Definition of Credit:

1 Hour Lecture (L) per week	1 credit
1Hour Tutorial (T) per week	1 credit
1 Hour Practical (P) per week	0.5 credit
2 Hours Practical (Lab) per week	1 credit

B. Range of credits:

A total credit of about 160 is required for a student to be eligible to get Under Graduate degree in Biotechnology. A student will be eligible to get Under Graduate degree (B.Tech.) with Honours, if he/she completes an additional 20 credits.These could be acquired through MOOCs at Swayam portal or with in-house examination being conducted. In order to have an Honours degree, a student may choose minimum 20 credits provided that the student must ensure the course is approved by the Competent Authority, Government of India.

Bachelor of Technology (Biotechnology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – III

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/Week		Major Test	Minor Test	Practical	Total	
1	BTE-201A	Cell Biology & Genetics	3	0	0	3	3.0	75	25	0	100	3
2	BTE-203A	Microbiology	3	0	0	3	3.0	75	25	0	100	3
3	BTE-205A	Biochemistry	3	0	0	3	3.0	75	25	0	100	3
4	BTE-207A	Principles of Biostatistics	3	0	0	3	3.0	75	25	0	100	3
5	HM-901A	OrganizationalBehavior	3	0	0	3	3.0	75	25	0	100	3
6	BTE-209LA	Cell Biology & Genetics Lab	0	0	3	3	1.5	0	40	60	100	3
7	BTE-211LA	Microbiology Lab	0	0	3	3	1.5	0	40	60	100	3
8	BTE-213LA	Biochemistry Lab	0	0	3	3	1.5	0	40	60	100	3
		Total	**15**	**0**	**9**	**24**	**19.5**	**375**	**245**	**180**	**800**	
9	BTE-215A	Industrial Training-I	2	0	0	2	-	-	100	-	100	-
10	*MC-902A	Constitution of India	3	0	0	3		75	25	0	100	3

Note: BTE-215A is a mandatory credit less course in which the students tobe evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.

***MC-902A** is a mandatory credit less course in which the student will be required to get passing marks in the major test.

Bachelor of Technology (Biotechnology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – IV

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week		Major Test	Minor Test	Practical	Total	
1	BTE-202A	Molecular Biology	3	0	0	3	3.0	75	25	0	100	3
2	BTE-204A	Bio-analytical Techniques	3	0	0	3	3.0	75	25	0	100	3
3	BTE-206A	Immunology	3	0	0	3	3.0	75	25	0	100	3
4	BTE-208A	Industrial Biotechnology	3	0	0	3	3.0	75	25	0	100	3
5	BS-202A	Organic Chemistry	3	0	0	3	3.0	75	25	0	100	3
6	BTE-212LA	Molecular Biology Lab	0	0	3	3	1.5	0	40	60	100	3
7	BTE-214LA	Bio-analytical Techniques Lab	0	0	3	3	1.5	0	40	60	100	3
8	BTE-216LA	Industrial Microbiology Lab	0	0	3	3	1.5	0	40	60	100	3
9	BTE-218LA	Immunology Lab	0	0	3	3	1.5	0	40	60	100	3
		Total	**15**	**0**	**12**	**27**	**21**	**375**	**285**	**240**	**900**	
10	MC-901A*	Environmental Sciences*	3	0	0	3		75	25	0	100	3

***MC-901A**is a mandatory credit less course in which the student will be required to get passing marks in the major test.
Note: All the students have to undergo 4-6 weeks industrial training after IV semester and to be evaluated in V semester.

Bachelor of Technology (Biotechnology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – V

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam(Hrs.)
			L	T	P	Hours /Week		Major Test	Minor Test	Practical	Total	
1	BTE-301A	Recombinant DNA Tech	3	0	0	3	3.0	75	25	0	100	3
2	BTE-303A	Bioprocess Engineering	3	0	0	3	3.0	75	25	0	100	3
3	BTE-305A	Downstream Processing	3	0	0	3	3.0	75	25	0	100	3
4	BTE-307A	Healthcare Biotechnology	3	0	0	3	3.0	75	25	0	100	3
5	OEC-I*		3	0	0	3	3.0	75	25	0	100	3
6	BTE-307LA	Recombinant DNA Technology Lab	0	0	3	3	1.5	0	40	60	100	3
7	BTE-309LA	Fermentation & Downstream Processing Lab	0	0	3	3	1.5	0	40	60	100	3
8	OEC-ILA		0	0	2	2	1.0	0	40	60	100	3
		Total	**15**	**0**	**10**	**25**	**19**	**375**	**245**	**180**	**800**	
9	**MC-903A	Essence of Indian Traditional Knowledge	3	0	0	3		100		0	100	3
10	*BTE-311A	Industrial Training-II	0	0	2	2	0	0	100		100	

****MC-903A** is a mandatory credit less course in which the student will be required to get passing marks in the major test.

* BTE-311A is a mandatory credit less course in which the students to be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.

The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

The students should select one open Elective Courses (OEC) from the following list.

Course No.	OEC-I*
ES-201A	Essentials of Information Technology
ES-211LA	Information Technology Lab
ES-213A	Python
ES-215LA	Python Lab
MOOC-1A	Any one MOCC course with lab through SWAYAM

Bachelor of Technology (Biotechnology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – VI

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week		Major Test	Minor Test	Practical	Total	
1	OEC-IIA		3	0	0	3	3.0	75	25	0	100	3
2	BTE-304A	Plant Biotechnology	3	0	0	3	3.0	75	25	0	100	3
3	BTE-306A	Animal Biotechnology	3	0	0	3	3.0	75	25	0	100	3
4	BTE-308A	Food Biotechnology	3	0	0	3	3.0	75	25	0	100	3
5	BTE-310A	Environmental Biotechnology& Engineering	3	0	0	3	3.0	75	25	0	100	3
6	HM-902A	Business Intelligence & Entrepreneurship	3	0	0	3	3.0	75	25	0	100	3
7	BTE-312LA	Animal Cell Culture Lab	0	0	3	3	1.5	0	40	60	100	3
8	BTE-314LA	Plant Cell Culture Lab	0	0	3	3	1.5	0	40	60	100	3
9	BTE-316LA	Food & Environmental Biotechnology Lab	0	0	3	3	1.5	0	40	60	100	3
		Total	**18**	**0**	**9**	**27**	**22.5**	**450**	**270**	**180**	**900**	

Note: All the students have to undergo 4-6 weeks industrial training after VI semester and it will be evaluated in VII semester.
The students should select two open Elective Courses (OEC) from the following list.
The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

Course No.	OEC-II		Course No.	OEC-II
OEC-BT-302A	Nano Biotechnology		OEC-BT-322A	Introduction to Arts &Aesthetics
OEC-BT-318A	Introduction to MEMS		MOOC-2A	Anyone MOOC through SWAYAM
OEC-BT-320A	Non Conventional Energy Resources			

Bachelor of Technology (Biotechnology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – VII

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week		Major Test	Minor Test	Practical	Total	
1	BTE-401A	Bioinformatics	2	1	0	3	3.0	75	25	0	100	3
2	BTE-403A	Pharmaceutical Biotechnology	3	0	0	3	3.0	75	25	0	100	3
3	*PE-IA	Program Elective-I*	2	1	0	3	3.0	75	25	0	100	3
4	*PE-IIA	Program Elective-II*	2	1	0	3	3.0	75	25	0	100	3
5	BTE-405LA	Bioinformatics Lab	0	0	3	3	1.5	0	40	60	100	3
7	BTE-407LA	Project-I**	0	0	8	8	4.0	0	100	100	200	3
		Total	**9**	**3**	**11**	**23**	**17.5**	**300**	**240**	**160**	**700**	
8	*BTE-409A	Industrial Training (Viva-Voce)***	0	0	2	2	-	0	0	100	100	

The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

Course No.	***PE-I**		**Course No.**	***PE-II**
BTE-411A	Biosensor and Bioinstrumentation		BTE-417A	Advanced Management Information System and Information Technology
BTE-413A	Biochips and Microarray Technology		BTE-419A	Stem Cell Technology
BTE-415A	Enzyme Technology		BTE-421A	Herbal Drug Technology

**The project should be initiated by the students in the beginning of VII semester and will be evaluated at the end of the semester on the basis of a presentation and report.

*BTE-409Ais a mandatory credit less course in which the students to be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.

Bachelor of Technology (Biotechnology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – VIII

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week		Major Test	Minor Test	Practical	Total	
1	*PE-IIIA		2	1	0	3	3.0	75	25	0	100	3
2	*PE-IVA		2	1	0	3	3.0	75	25	0	100	3
3	BTE-402A	Biocatalysis& Biotransformation	3	0	0	3	3.0	75	25	0	100	3
4	**OEC-IIIA		3	0	0	3	3.0	75	25	0	100	3
5	BTE-416LA	Project-II	0	0	15	15	7.5	0	100	100	200	3
		Total	**10**	**2**	**15**	**27**	**19.5**	**300**	**200**	**100**	**600**	

The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

*The student should select two Program Elective Courses (PEC) from the following list.

Course No.	**PE-III**	**Course No.**	**PE-IV**
BTE-404A	Metagenomics	BTE-410A	Developmental Biology
BTE-406A	Molecular Modeling and Drug Design	BTE-412A	Protein Engineering
BTE-408A	Cancer Biology	BTE-414A	Bioethics, IPR and Bio-safety

*The student should select one Open Elective Courses (OEC) from the following list.

Course No.	**OEC-III**
OEC-BT-418A	Biomedical Electronics
OEC-BT-420A	MATLAB & Simulation
OEC-BT-422A	History of Science
OEC-BT-424A	Internet of things
MOOC-3A	Anyone MOOC through SWAYAM

Open Elective Course for B. Tech. Students of other Departments

Course No.	OEC
BTE 401A	Bioinformatics
BTE-414A	Bioethics, IPR and Biosafety

Kurukshetra UniversityKurukshetra
(Established by the State Legislature Act XII of 1956; 'A+' Grade, NAAC Accredited)
Model Curriculum for
Bachelor of Technology (B.Tech.) in Food Technology
General, Course Structure &Scheme&Semester-Wise Credit Distribution
(Credit-Based Scheme of Studies/Examination ((2018-19 Onwards in Phased Manner))

A. Definition of Credit:

1 Hour Lecture (L) per week	1 credit
1Hour Tutorial (T) per week	1 credit
1 Hour Practical (P) per week	0.5 credit
2 Hours Practical (Lab) per week	1 credit

B. Range of credits:

A total credit of about 160 is required for a student to be eligible to get Under Graduate degree in Food Technology. A student will be eligible to get Under Graduate degree (B.Tech.) with Honours, if he/she completes an additional 20 credits.These could be acquired through MOOCsatSwayam portal or with in-house examination being conducted. In order to have an Honours degree, a student may choose minimum 20 credits provided that the student must ensure the course is approved by the Competent Authority, Government of India.

Bachelor of Technology (Food Technology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – III

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/Week		Major Test	Minor Test	Practical	Total	
1	FTT-201A	Food Microbiology	3	0	0	3	3.0	75	25	0	100	3
2	FTT-203A	Food chemistry	3	0	0	3	3.0	75	25	0	100	3
3	FTT-205A	Unit Operation In Food Engg. – I	3	0	0	3	3.0	75	25	0	100	3
4	FTT-207A	Food processing	3	0	0	3	3.0	75	25	0	100	3
5	FTT -211L A	Food Microbiology Lab	3	0	0	3	3.0	75	25	0	100	3
6	FTT – 213LA	Food chemistry Lab	0	0	3	3	1.5	0	40	60	100	3
7	FTT – 215 LA	Unit Operation In Food Engg. - I Lab	0	0	3	3	1.5	0	40	60	100	3
8	FTT – 217 LA	Food processing Lab	0	0	3	3	1.5	0	40	60	100	3
		Total	**15**	**0**	**9**	**24**	**19.5**	**375**	**245**	**180**	**800**	
9	FTT-219A	Industrial Training-I	2	0	0	2	-	-	100	-	100	-
10	*MC-902LA	Constitution of India	3	0	0	3		75	25	0	100	3

Note: FTT-219 A is a mandatory credit less course in which the studentstobeevaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.

***MC-902A** is a mandatory credit less course in which the student will be required to get passing marks in the major test.

Bachelor of Technology (Food Technology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – IV

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week		Major Test	Minor Test	Practical	Total	
1	FTT-202A	Human Nutrition	3	0	0	3	3.0	75	25	0	100	3
2	FTT- 204A	Thermal Processing	3	0	0	3	3.0	75	25	0	100	3
3	FTT – 206A	Unit Operation In Food Engg. – II	3	0	0	3	3.0	75	25	0	100	3
4	FTT- 208 A	Dairy Technology	3	0	0	3	3.0	75	25	0	100	3
5	FTT-210A	Fruit and Vegetable Processing	3	0	0	3	3.0	75	25	0	100	3
6	FTT- 214LA	Thermal Processing Lab	0	0	3	3	1.5	0	40	60	100	3
7	FTT -216LA	Unit Operation In Food Engg. - II Lab	0	0	3	3	1.5	0	40	60	100	3
8	FTT-218LA	Dairy Technology Lab	0	0	3	3	1.5	0	40	60	100	3
9	FTT-220LA	Fruit and Vegetable Processing Lab	0	0	3	3	1.5	0	40	60	100	3
		Total	**15**	**0**	**12**	**27**	**21**	**375**	**285**	**240**	**900**	
10	MC-901A*	Environmental Sciences*	3	0	0	3		75	25	0	100	3

***MC-901A**is a mandatory credit less course in which the student will be required to get passing marks in the major test.
Note: All the students have to undergo 4-6 weeks industrial training after IV semester and to be evaluated in V semester.

Bachelor of Technology (Food Technology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – V

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam(Hrs.)
			L	T	P	Hours /Week		Major Test	Minor Test	Practical	Total	
1	FTT – 301A	Dairy product Technology	3	0	0	3	3.0	75	25	0	100	3
2	FTT – 303A	Fruit and Vegetable Technology	3	0	0	3	3.0	75	25	0	100	3
3	FTT – 307A	Food Engg.	3	0	0	3	3.0	75	25	0	100	3
4	FTT – 309A	Industrial Pollution Control	3	0	0	3	3.0	75	25	0	100	3
5	FTT – 305A	Food Analysis and Quality Control	3	0	0	3	3.0	75	25	0	100	3
6	FTT – 311LA	Dairy product Technology Lab	0	0	3	3	1.5	0	40	60	100	3
7	FTT – 313LA	Fruit and Vegetable Technology Lab	0	0	3	3	1.5	0	40	60	100	3
8	FTT – 317LA	Food Engg. Lab	0	0	2	2	1.0	0	40	60	100	3
	FTT – 315LA	Food Analysis and Quality Control Lab										
		Total	**15**	**0**	**10**	**23**	**19**	**375**	**245**	**180**	**800**	
9	**MC-903A	Essence of Indian Traditional Knowledge	3	0	0	3		100		0	100	3
10	*FTT-319A	Industrial Training-II	0	0	2	2	0	0	100		100	

****MC-903A** is a mandatory credit less course in which the student will be required to get passing marks in the major test.

* FTT-319A is a mandatory credit less course in which the students to be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.

The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

The students should select one open Elective Courses (OEC) from the following list.

Course No.	OEC-I*
ES-201A	Essentials of Information Technology
ES-211LA	Information Technology Lab
ES-213A	Technology Of Plantation Crops
ES-215LA	Technology Of Plantation Crops Lab

MOOC-1A	Any one MOCC course with lab through SWAYAM

Bachelor of Technology (Food technology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – VI

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week		Major Test	Minor Test	Practical	Total	
1	FTT-302A	Technology Of Cereals, Pulses, & Oil Seeds	3	0	0	3	3.0	75	25	0	100	3
2	FTT-304A	Meat, Fish, Poultry Technology	3	0	0	3	3.0	75	25	0	100	3
3	FTT-306A	Packaging Technology	3	0	0	3	3.0	75	25	0	100	3
4	FTT-308A	Food Biotechnology	3	0	0	3	3.0	75	25	0	100	3
5	FTT-310A	Bio Chemical Engg.	3	0	0	3	3.0	75	25	0	100	3
6	FTT-312LA	Technology Of Cereals, Pulses, & Oil Seeds Lab	3	0	0	3	3.0	75	25	0	100	3
7	FTT- 314LA	Meat, Fish, Poultry Technology Lab	0	0	3	3	1.5	0	40	60	100	3
8	FTT- 318LA	Food Biotechnology Lab	0	0	3	3	1.5	0	40	60	100	3
9	FTT- 320LA	Bio Chemical Engg Lab.	0	0	3	3	1.5	0	40	60	100	3
		Total	**18**	**0**	**9**	**27**	**22.5**	**450**	**270**	**180**	**900**	

Note: All the students have to undergo 4-6 weeks industrial training after VI semester and it will be evaluated in VII semester.
The students should select two open Elective Courses (OEC) from the following list.
The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

Course No.	OEC-II		Course No.	OEC-II
OEC-FT-302A	Health Foods		OEC-FT-322A	Types Of Fats and Oils

OEC-FT-318A	Plant Maintain Safety and Hygeine		MOOC-2A	Anyone MOOC through SWAYAM
OEC-FT-320A	Food Marketing, Branding and Advertising			

Bachelor of Technology (Food Technology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – VII

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week		Major Test	Minor Test	Practical	Total	
1	FTT-401A	Utilization Of Industrial Waste and By Products	2	1	0	3	3.0	75	25	0	100	3
2	FTT -403A	Food Processing Plant Layout and Design	3	0	0	3	3.0	75	25	0	100	3
3	FTT- 405A	Tech. Of Spices, Herbs and Food Additives	2	1	0	3	3.0	75	25	0	100	3
4	FTT- 407 A	Bakery Confectionay Technology	2	1	0	3	3.0	75	25	0	100	3
5	FTT- 411LA	Utilization Of Industrial Waste and By Products Lab	0	0	3	3	1.5	0	40	60	100	3
6	FTT 413LA	Tech. Of Spices, Herbs and Food Additives Lab	0	0	8	3	4.0	0	100	100	200	3
7	FTT- 415LA	Bakery Confectionay Technology Lab	0	0	8	3	4.0	0	100	100	200	3
		Total	**9**	**3**	**11**	**21**	**17.5**	**300**	**240**	**160**	**700**	
8	*FTT-409A	Industrial Training (Viva-Voce)***	0	0	2	2	-	0	0	100	100	

The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

Course No.	***PE-I**		**Course No.**	***PE-II**
FTT-411A	Heat & Mass Transfer		FTT-417A	Technologies Of Beverages
FTT-413A	Grains Handling & Storage Technology		FTT-419A	Tech. of Snacks Foods
FTT-415A	Food Toxicology		FTT-421A	Statistical Quality Control For Food Industry

**The project should be initiated by the students in the beginning of VII semester and will be evaluated at the end of the semester on the basis of a presentation and report.

*FTT-409Ais a mandatory credit less course in which the students to be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.

Bachelor of Technology (Food Technology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – VIII

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week		Major Test	Minor Test	Practical	Total	
1	*PE-IIIA		2	1	0	3	3.0	75	25	0	100	3
2	*PE-IVA		2	1	0	3	3.0	75	25	0	100	3
3	FTT-412A	Food Storage Engg.	3	0	0	3	3.0	75	25	0	100	3
4	**OEC-IIIA		3	0	0	3	3.0	75	25	0	100	3
5	FTT-416A	Project-II	0	0	15	11	7.5	0	100	100	200	3
		Total	**10**	**2**	**15**	**25**	**19.5**	**300**	**200**	**100**	**600**	

The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

*The student should select two Program Elective Courses (PEC) from the following list.

Course No.	**PE-III**	**Course No.**	**PE-IV**
BTE-404A	Cold Chain Management	BTE-410A	Food Supply Chain Management
BTE-406A	Innovative Techniques In Food Processing	BTE-412A	Enterpreunership Development & Management
BTE-408A	Products and Design Development	BTE-414A	Computer Application In Food Technology

*The student should select one Open Elective Courses (OEC) from the following list.

Course No.	**OEC-III**
OEC-FT-418A	Biomedical Electronics
OEC-FT-420A	MATLAB & Simulation
OEC-FT-422A	History of Science
OEC-FT-424A	Internet of things
MOOC-3A	Anyone MOOC through SWAYAM

Additional Courses for B.Tech. (Honours Degree)
Branch/Course: Food Technology

In order to have an Honours degree, a student may choose 20credits from the following professional electives courses or MOOC through SWAYAM in addition. The student can opt courses offered under MOOCs at Swayam portal from time to time

Open Elective Course for B. Tech. Students of other Departments

Course No.	OEC
BTE 401A	Bioinformatics
BTE-414A	Bioethics, IPR and Biosafety

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of Technology in Mechanical Engineering(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagneticTheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-135A	Multi-variableCalculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of TechnologyMechanical Engineering(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagnetictheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-136A	Calculus&OrdinaryDifferentialEquations	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-119A	Introduction to Electromagnetic Theory						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of electromagnetic theory to the students for applications in Engineering field.
	Course Outcomes
CO 1	Introduce the basic concepts of Electrostatics in vacuum.
CO 2	Introduce the basic concepts of Magnetostatics in vacuum.
CO 3	Discuss electrostatics and magnetostatics in linear dielectric medium.
CO 4	Basics of Maxwell's equations and electromagnetic waves.

Unit - I

Electrostatics in Vacuum: Calculation of Electric Field: Coulomb's law, Continuous charge distribution; Divergence and Curl of Electrostatic Fields: Field lines, flux, Gauss's law, Applications of Gauss's law; Electrostatic Potential: Comments on potential, Poisson's and Laplace's Equation, the potential of a localized charge distribution; Electrostatic Boundary Conditions; Work and Energy in Electrostatics: the work done to move a charge, the energy of a point and continuous charge distribution.

Unit - II

Electrostatics in a Linear Dielectric Medium: Polarization:dielectrics, induced dipoles, alignments of polar molecules; The field of a Polarized Object: bound charges and its physical interpretation; The Filed Inside a Dielectric; The Electric Displacement: Gauss's law in the presence of dielectrics, A deceptive parallel, Boundary conditions; Linear Dielectrics: Susceptibility, Permittivity, dielectric constant, Boundary value problems with linear dielectrics, Energy in dielectric systems, Forces in dielectrics.

Unit - III

Magnetostatics: The Lorentz Force Law: magnetic fields, magnetic forces, currents; Biot- Savart law, Divergence and Curl of magnetic field, Magnetic Vector Potential: vector potential, magnetostatic boundary conditions, multiple expansion of vector potential.

Magnetostatics in a linear magnetic: Magnetization: Effect of magnetic field on atomic orbits; The Field of a Magnetized Object: Bound currents, Physical interpretation of bound currents; The Auxiliary Magnetic Field: Ampere's law in magnetized materials, A deceptive parallel, Boundary conditions; Linear and Nonlinear Media: magnetic susceptibility and permeability, ferromagnetism.

Unit - IV

Faraday's law: Electromotive Force: Ohm's law, Motional emf; Electromagnetic Induction: Faraday's law, The induced electric field, inductance, energy in magnetic fields.

Maxwell's Equations: Electrodynamics before Maxwell, How Maxwell fixed Ampere's law, Maxwell's equations, Maxwell's equations in matter.

Electromagnetic Waves: Electromagnetic Waves in Vacuum: the wave equation for electric and magnetic field; Electromagnetic Waves in Matter: propagation in linear media.

Suggested Books:

1. David J. Griffiths, Introduction to Electrodynamics, Pearson Education.
2. Halliday and Resnick, Physics
3. W. Saslow, Electricity, Magnetism and Light

Note: The paper setter will set the paper as per the question paper templates provided.

BS-121LA	Electromagnetics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Electromagnetic Theory.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
2. To study induced e.m.f. as a function of velocity of magnet.
3. To study the growth and decay of current in a LR circuit using magnetic core inductor.
4. To find the coefficient of self-inductance by Rayleigh's method.
5. To find the coefficient of mutual inductance of two coils.
6. To determine the magnetic induction field between the pole pieces of an electromagnet.
7. To study Bio-Savart's law.
8. To study the dependency of magnetic field on coil diameter and number of turns.
9. To investigate the equipotential liens of electric fields.
10. To draw the equipotential lines of bar electrode.
11. To draw the equipotential lines for ring electrode.
12. Verification of Farady and Lenz's law of induction by measuring the induced voltage as function of time.
13. Measurement of induced voltage impulse as a function of the velocity of magnet.
14. To determine the dielectric constant of different dielectric materials.
15. To measure the spatial distribution of the magnetic field between a pair of identical coils in Helmholtz arrangement.
16. To investigate the spacing between coils at which magnetic field is uniform and to measure its spatial distribution.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. Subrata Saha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-135A	Multivariable Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.						
CO 4	To familiarize the student with functions of several variables that is essential in most branches of engineering.						
CO 5	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						

UNIT-I (12 hrs)

Calculus: Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II **(**12 hrs)

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, D'Alembert's Ratio test, Logarithmic test, Cauchy root test, Raabe's test); Power series.

Fourier series: Introduction, Fourier-Euler Formula, Dirichlet's conditions, Change of intervals, Fourier series for even and odd functions, Half range sine and cosine series.

UNIT-III (09 hrs)

Multivariable Calculus (differentiation): Taylor's series (for one and more variables), series for exponential, trigonometric and logarithm functions.

Partial derivatives, Total differential, Chain rule for differentiation, Homogeneous functions, Euler's theorem, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers.

UNIT-IV (07 hrs)

Matrices: Rank of a matrix, elementary transformations, elementary matrices, Gauss Jordon method to find inverse using elementary transformations, normal form of a matrix, linear dependence and independence of vectors, consistency of linear system of equations, linear and orthogonal transformations, eigenvalues and eigenvectors, properties of eigenvalues, Cayley – Hamilton theorem and its applications.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-136A	Calculus and Ordinary Differential Equations						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques inmultivariate integration, ordinary and partial differential equations and complex variables.						
Course Outcomes							
CO1	To introduce effective mathematical tools for the solutions of differential equations that model physical processes.						
CO 2	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.						
CO 3	To introduce the tools of differentiation and integration of functions of complex variable thatare used in various techniques dealing engineering problems.						

UNIT-I (10 hrs)

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree:equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy and Legendre's linear differential equations.

UNIT-II **(**10 hrs)

Multivariable Calculus (Integration): Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar)

Applications: areas and volumes; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

UNIT-III (10hrs)

Vector Calculus: Introduction, Scalar and Vector point functions, Gradient, divergence & Curl and their properties, Directional derivative.

Line integrals, surface integrals, volume integrals, Theorems of Green, Gauss and Stokes (without proof).

UNIT-IV (10 hrs)

Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, findingharmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) andtheir properties;

Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (withoutproof), Taylor's series,zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).

Suggested Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Erwin kreyszig and SanjeevAhuja, Applied Mathematics- II, Wiley India Publication, 2015.
4. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary ValueProblems, 9th Edn., Wiley India, 2009.
5. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
6. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice HallIndia, 1995.
7. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
8. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill,2004.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
10. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-109A							
Coursetitle	EngineeringGraphics&Design							
Scheme and Credits	L	T	P	Credits	Major Test	Minor Test	Total	Time
	1	2	0	3	75	25	100	3h

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing, graphics and Projections.	
CO-1	To learn about construction of various types of curves and scales.
CO-2	To learn about orthographic projections of points, lines and planes.
CO-3	To Learn about the sectional views and development of Right regular solids
CO-4	To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular solids like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. Corresponding'stoCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-113LA							
Coursetitle	EngineeringGraphics&Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3h
Pre-requisites(if any)	-							

Aim: To make student practice on engineering graphics and design softwares and provide exposure to the visual aspects of engineering design.	
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1: Overview of Computer Graphics:
Listing the computer technologies that impact on graphical communication,Demonstrating Knowledge ofthetheory of CAD software[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];
Module2:Customization &CAD Drawing:
Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvariou swaysofdrawingcircles;
Module3:Annotations,layering&other functions:
Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multiview,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancing techniques; dimensioningandscalemulti viewsofdwelling;
Module4:Demonstration ofasimpleteamdesign project:
Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).
Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.

Course code	**ES-111LA**							
Coursetitle	**ManufacturingProcessesWorkshop**							
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Practical**	**Minor Test**	**Total**	**Time**
	0	**0**	**3**	**1.5**	**60**	**40**	**100**	**3h**
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	**To familiarize with different manufacturing methods in industries and work on CNC machine.**
CO-2	**To learn working in Fitting shop and Electrical and Electronics shops,**
CO-3	**To practice working on Carpentry and Plastic moulding/glass cutting jobs.**
CO-4	**To gain hands on practice experience on Metal casting and Welding jobs.**

ManufacturingProcessesWorkshop
Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry

6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	**Biology**						
L	**T**	**P**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**-**	**3**	**75**	**25**	**100**	**3h**
Purpose	**To familiarize the students with the basics of Biotechnology**						
Course Outcomes							
CO1	**Introduction to essentials of life and macromolecules essential for growth and Development**						
CO2	**Defining the basic concepts of cell division, genes and Immune system**						
CO3	**Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry**						
CO4	**Introduction of basic Concept of Microbiology & Role of Biology in Different Fields**						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1273ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation. Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance. Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, Dhanpat Rai Publications N.A
2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.
3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.
4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.
3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit. Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts. including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phase emf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon. Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutator action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena& Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3

Purpose	To familiarize the students with the Electrical TechnologyPracticals

Course Outcomes	
CO1	Understand basic concepts of Network theorems
CO 2	Deals with steady state frequency response of RLC circuit parameters solution techniques
CO 3	Deals with introductory Single Phase Transformer practicals
CO 4	Explains the constructional features and practicals of various types of Electrical Machines

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of Technology in Aeronautical Engineering(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagneticTheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-135A	Multi-variableCalculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of TechnologyAeronautical Engineering(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagnetictheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-136A	Calculus&OrdinaryDifferentialEquations	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Programme (Three Weeks Duration) is a part of scheme of first year in 1st semester for all branches

BS-119A	Introduction to Electromagnetic Theory						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of electromagnetic theory to the students for applications in Engineering field.
	Course Outcomes
CO 1	Introduce the basic concepts of Electrostatics in vacuum.
CO 2	Introduce the basic concepts of Magnetostatics in vacuum.
CO 3	Discuss electrostatics and magnetostatics in linear dielectric medium.
CO 4	Basics of Maxwell's equations and electromagnetic waves.

Unit - I

Electrostatics in Vacuum: Calculation of Electric Field: Coulomb's law, Continuous charge distribution; Divergence and Curl of Electrostatic Fields: Field lines, flux, Gauss's law, Applications of Gauss's law; Electrostatic Potential: Comments on potential, Poisson's and Laplace's Equation, the potential of a localized charge distribution; Electrostatic Boundary Conditions; Work and Energy in Electrostatics: the work done to move a charge, the energy of a point and continuous charge distribution.

Unit - II

Electrostatics in a Linear Dielectric Medium: Polarization:dielectrics, induced dipoles, alignments of polar molecules; The field of a Polarized Object: bound charges and its physical interpretation; The Filed Inside a Dielectric; The Electric Displacement: Gauss's law in the presence of dielectrics, A deceptive parallel, Boundary conditions; Linear Dielectrics: Susceptibility, Permittivity, dielectric constant, Boundary value problems with linear dielectrics, Energy in dielectric systems, Forces in dielectrics.

Unit - III

Magnetostatics: The Lorentz Force Law: magnetic fields, magnetic forces, currents; Biot- Savart law, Divergence and Curl of magnetic field, Magnetic Vector Potential: vector potential, magnetostatic boundary conditions, multiple expansion of vector potential.

Magnetostatics in a linear magnetic: Magnetization: Effect of magnetic field on atomic orbits; The Field of a Magnetized Object: Bound currents, Physical interpretation of bound currents; The Auxiliary Magnetic Field: Ampere's law in magnetized materials, A deceptive parallel, Boundary conditions; Linear and Nonlinear Media: magnetic susceptibility and permeability, ferromagnetism.

Unit - IV

Faraday's law: Electromotive Force: Ohm's law, Motional emf; Electromagnetic Induction: Faraday's law, The induced electric field, inductance, energy in magnetic fields.

Maxwell's Equations: Electrodynamics before Maxwell, How Maxwell fixed Ampere's law, Maxwell's equations, Maxwell's equations in matter.

Electromagnetic Waves: Electromagnetic Waves in Vacuum: the wave equation for electric and magnetic field; Electromagnetic Waves in Matter: propagation in linear media.

Suggested Books:

1. David J. Griffiths, Introduction to Electrodynamics, Pearson Education.
2. Halliday and Resnick, Physics
3. W. Saslow, Electricity, Magnetism and Light

Note: The paper setter will set the paper as per the question paper templates provided.

BS-121LA	Electromagnetics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Electromagnetic Theory.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
2. To study induced e.m.f. as a function of velocity of magnet.
3. To study the growth and decay of current in a LR circuit using magnetic core inductor.
4. To find the coefficient of self-inductance by Rayleigh's method.
5. To find the coefficient of mutual inductance of two coils.
6. To determine the magnetic induction field between the pole pieces of an electromagnet.
7. To study Bio-Savart's law.
8. To study the dependency of magnetic field on coil diameter and number of turns.
9. To investigate the equipotential liens of electric fields.
10. To draw the equipotential lines of bar electrode.
11. To draw the equipotential lines for ring electrode.
12. Verification of Farady and Lenz's law of induction by measuring the induced voltage as function of time.
13. Measurement of induced voltage impulse as a function of the velocity of magnet.
14. To determine the dielectric constant of different dielectric materials.
15. To measure the spatial distribution of the magnetic field between a pair of identical coils in Helmholtz arrangement.
16. To investigate the spacing between coils at which magnetic field is uniform and to measure its spatial distribution.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. Subrata Saha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-135A	Multivariable Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.						
CO 4	To familiarize the student with functions of several variables that is essential in most branches of engineering.						
CO 5	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						

UNIT-I (12 hrs)

Calculus: Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II **(**12 hrs)

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, D'Alembert's Ratio test, Logarithmic test, Cauchy root test, Raabe's test); Power series.

Fourier series: Introduction, Fourier-Euler Formula, Dirichlet's conditions, Change of intervals, Fourier series for even and odd functions, Half range sine and cosine series.

UNIT-III (09 hrs)

Multivariable Calculus (differentiation): Taylor's series (for one and more variables), series for exponential, trigonometric and logarithm functions.

Partial derivatives, Total differential, Chain rule for differentiation, Homogeneous functions, Euler's theorem, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers.

UNIT-IV (07 hrs)

Matrices: Rank of a matrix, elementary transformations, elementary matrices, Gauss Jordon method to find inverse using elementary transformations, normal form of a matrix, linear dependence and independence of vectors, consistency of linear system of equations, linear and orthogonal transformations, eigenvalues and eigenvectors, properties of eigenvalues, Cayley – Hamilton theorem and its applications.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-136A	Calculus and Ordinary Differential Equations						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques inmultivariate integration, ordinary and partial differential equations and complex variables.						
Course Outcomes							
CO1	To introduce effective mathematical tools for the solutions of differential equations that model physical processes.						
CO 2	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.						
CO 3	To introduce the tools of differentiation and integration of functions of complex variable thatare used in various techniques dealing engineering problems.						

UNIT-I (10 hrs)

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree:equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy and Legendre's linear differential equations.

UNIT-II **(**10 hrs)

Multivariable Calculus (Integration): Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar)

Applications: areas and volumes; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

UNIT-III (10hrs)

Vector Calculus: Introduction, Scalar and Vector point functions, Gradient, divergence & Curl and their properties, Directional derivative.

Line integrals, surface integrals, volume integrals, Theorems of Green, Gauss and Stokes (without proof).

UNIT-IV (10 hrs)

Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, findingharmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) andtheir properties;

Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (withoutproof), Taylor's series,zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).

Suggested Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Erwin kreyszig and SanjeevAhuja, Applied Mathematics- II, Wiley India Publication, 2015.
4. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary ValueProblems, 9th Edn., Wiley India, 2009.
5. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
6. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice HallIndia, 1995.
7. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
8. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill,2004.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
10. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-109A							
Coursetitle	EngineeringGraphics&Design							
Scheme and Credits	L	T	P	Credits	Major Test	Minor Test	Total	Time
	1	2	0	3	75	25	100	3h

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing, graphics and Projections.	
CO-1	To learn about construction of various types of curves and scales.
CO-2	To learn about orthographic projections of points, lines and planes.
CO-3	To Learn about the sectional views and development of Right regular solids
CO-4	To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular solids like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. Corresponding'stoCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-113LA							
Coursetitle	EngineeringGraphics&Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3h
Pre-requisites(if any)	-							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1:OverviewofComputerGraphics:
Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];
Module2:Customization &CAD Drawing:
Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;
Module3:Annotations,layering&other functions:
Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multiview,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancing techniques; dimensioningandscalemulti viewsofdwelling;
Module4:Demonstration ofasimpleteamdesign project:
Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).
Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1293ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation. Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance. Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, Dhanpat Rai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.
3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit. Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts. including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phase emf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon. Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutator action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena& Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3
Purpose	**To familiarize the students with the Electrical TechnologyPracticals**						
Course Outcomes							
CO1	**Understand basic concepts of Network theorems**						
CO 2	**Deals with steady state frequency response of RLC circuit parameters solution techniques**						
CO 3	**Deals with introductory Single Phase Transformer practicals**						
CO 4	**Explains the constructional features and practicals of various types of Electrical Machines**						

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of Technology in Automobile Engineering(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagneticTheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-135A	Multi-variableCalculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of TechnologyAutomobile Engineering(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagnetictheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-136A	Calculus&OrdinaryDifferentialEquations	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-119A	Introduction to Electromagnetic Theory						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of electromagnetic theory to the students for applications in Engineering field.
	Course Outcomes
CO 1	Introduce the basic concepts of Electrostatics in vacuum.
CO 2	Introduce the basic concepts of Magnetostatics in vacuum.
CO 3	Discuss electrostatics and magnetostatics in linear dielectric medium.
CO 4	Basics of Maxwell's equations and electromagnetic waves.

Unit - I

Electrostatics in Vacuum: Calculation of Electric Field: Coulomb's law, Continuous charge distribution; Divergence and Curl of Electrostatic Fields: Field lines, flux, Gauss's law, Applications of Gauss's law; Electrostatic Potential: Comments on potential, Poisson's and Laplace's Equation, the potential of a localized charge distribution; Electrostatic Boundary Conditions; Work and Energy in Electrostatics: the work done to move a charge, the energy of a point and continuous charge distribution.

Unit - II

Electrostatics in a Linear Dielectric Medium: Polarization:dielectrics, induced dipoles, alignments of polar molecules; The field of a Polarized Object: bound charges and its physical interpretation; The Filed Inside a Dielectric; The Electric Displacement: Gauss's law in the presence of dielectrics, A deceptive parallel, Boundary conditions; Linear Dielectrics: Susceptibility, Permittivity, dielectric constant, Boundary value problems with linear dielectrics, Energy in dielectric systems, Forces in dielectrics.

Unit - III

Magnetostatics: The Lorentz Force Law: magnetic fields, magnetic forces, currents; Biot- Savart law, Divergence and Curl of magnetic field, Magnetic Vector Potential: vector potential, magnetostatic boundary conditions, multiple expansion of vector potential.

Magnetostatics in a linear magnetic: Magnetization: Effect of magnetic field on atomic orbits; The Field of a Magnetized Object: Bound currents, Physical interpretation of bound currents; The Auxiliary Magnetic Field: Ampere's law in magnetized materials, A deceptive parallel, Boundary conditions; Linear and Nonlinear Media: magnetic susceptibility and permeability, ferromagnetism.

Unit - IV

Faraday's law: Electromotive Force: Ohm's law, Motional emf; Electromagnetic Induction: Faraday's law, The induced electric field, inductance, energy in magnetic fields.

Maxwell's Equations: Electrodynamics before Maxwell, How Maxwell fixed Ampere's law, Maxwell's equations, Maxwell's equations in matter.

Electromagnetic Waves: Electromagnetic Waves in Vacuum: the wave equation for electric and magnetic field; Electromagnetic Waves in Matter: propagation in linear media.

Suggested Books:

1. David J. Griffiths, Introduction to Electrodynamics, Pearson Education.
2. Halliday and Resnick, Physics
3. W. Saslow, Electricity, Magnetism and Light

Note: The paper setter will set the paper as per the question paper templates provided.

BS-121LA	Electromagnetics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Electromagnetic Theory.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
2. To study induced e.m.f. as a function of velocity of magnet.
3. To study the growth and decay of current in a LR circuit using magnetic core inductor.
4. To find the coefficient of self-inductance by Rayleigh's method.
5. To find the coefficient of mutual inductance of two coils.
6. To determine the magnetic induction field between the pole pieces of an electromagnet.
7. To study Bio-Savart's law.
8. To study the dependency of magnetic field on coil diameter and number of turns.
9. To investigate the equipotential liens of electric fields.
10. To draw the equipotential lines of bar electrode.
11. To draw the equipotential lines for ring electrode.
12. Verification of Farady and Lenz's law of induction by measuring the induced voltage as function of time.
13. Measurement of induced voltage impulse as a function of the velocity of magnet.
14. To determine the dielectric constant of different dielectric materials.
15. To measure the spatial distribution of the magnetic field between a pair of identical coils in Helmholtz arrangement.
16. To investigate the spacing between coils at which magnetic field is uniform and to measure its spatial distribution.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-135A	Multivariable Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.						
CO 4	To familiarize the student with functions of several variables that is essential in most branches of engineering.						
CO 5	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						

UNIT-I (12 hrs)

Calculus: Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II **(**12 hrs)

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, D'Alembert's Ratio test, Logarithmic test, Cauchy root test, Raabe's test); Power series.

Fourier series: Introduction, Fourier-Euler Formula, Dirichlet's conditions, Change of intervals, Fourier series for even and odd functions, Half range sine and cosine series.

UNIT-III (09 hrs)

Multivariable Calculus (differentiation): Taylor's series (for one and more variables), series for exponential, trigonometric and logarithm functions.

Partial derivatives, Total differential, Chain rule for differentiation, Homogeneous functions, Euler's theorem, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers.

UNIT-IV (07 hrs)

Matrices: Rank of a matrix, elementary transformations, elementary matrices, Gauss Jordon method to find inverse using elementary transformations, normal form of a matrix, linear dependence and independence of vectors, consistency of linear system of equations, linear and orthogonal transformations, eigenvalues and eigenvectors, properties of eigenvalues, Cayley – Hamilton theorem and its applications.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-136A	Calculus and Ordinary Differential Equations						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques inmultivariate integration, ordinary and partial differential equations and complex variables.						
Course Outcomes							
CO1	To introduce effective mathematical tools for the solutions of differential equations that model physical processes.						
CO 2	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.						
CO 3	To introduce the tools of differentiation and integration of functions of complex variable thatare used in various techniques dealing engineering problems.						

UNIT-I (10 hrs)

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree:equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy and Legendre's linear differential equations.

UNIT-II **(**10 hrs)

Multivariable Calculus (Integration): Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar)

Applications: areas and volumes; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

UNIT-III (10hrs)

Vector Calculus: Introduction, Scalar and Vector point functions, Gradient, divergence & Curl and their properties, Directional derivative.

Line integrals, surface integrals, volume integrals, Theorems of Green, Gauss and Stokes (without proof).

UNIT-IV (10 hrs)

Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions,

harmonic functions, findingharmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) andtheir properties;

Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (withoutproof), Taylor's series,zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).

Suggested Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Erwin kreyszig and SanjeevAhuja, Applied Mathematics- II, Wiley India Publication, 2015.
4. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary ValueProblems, 9th Edn., Wiley India, 2009.
5. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
6. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice HallIndia, 1995.
7. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
8. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill,2004.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
10. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	**ES-109A**							
Coursetitle	**EngineeringGraphics&Design**							
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
	1	**2**	**0**	**3**	**75**	**25**	**100**	**3h**

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing, graphics and Projections.	
CO-1	**To learn about construction of various types of curves and scales.**
CO-2	**To learn about orthographic projections of points, lines and planes.**
CO-3	**To Learn about the sectional views and development of Right regular solids**
CO-4	**To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.**

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular solids like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. Corresponding'stoCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	**ES-113LA**							
Coursetitle	**EngineeringGraphics&Design Practice**							
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Practical**	**Minor Test**	**Total**	**Time**
	-	**-**	**3**	**1.5**	**30**	**20**	**50**	**3h**
Pre-requisites(if any)	**-**							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	**To give an overview of the user interface and toolboxes in a CAD software.**
CO-2	**To understand to customize settings of CAD software and produce CAD drawing.**
CO-3	**To practice performing various functions in CAD softwares.**
CO-4	**To Learn about solid modelling and demonstration of a simple team design project.**

Module 1:OverviewofComputerGraphics:

Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];

Module2:Customization &CAD Drawing:

Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;

Module3:Annotations,layering&other functions:

Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline

lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multiview,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;

Module4:Demonstration ofasimpleteamdesign project:

Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).

Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1312ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.
3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutator action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3
Purpose	**To familiarize the students with the Electrical TechnologyPracticals**						
Course Outcomes							
CO1	**Understand basic concepts of Network theorems**						
CO 2	**Deals with steady state frequency response of RLC circuit parameters solution techniques**						
CO 3	**Deals with introductory Single Phase Transformer practicals**						
CO 4	**Explains the constructional features and practicals of various types of Electrical Machines**						

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of Technology in Civil Engineering(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagneticTheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-135A	Multi-variableCalculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of TechnologyCivil Engineering(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagnetictheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-136A	Calculus&OrdinaryDifferentialEquations	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-119A	Introduction to Electromagnetic Theory						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of electromagnetic theory to the students for applications in Engineering field.
	Course Outcomes
CO 1	Introduce the basic concepts of Electrostatics in vacuum.
CO 2	Introduce the basic concepts of Magnetostatics in vacuum.
CO 3	Discuss electrostatics and magnetostatics in linear dielectric medium.
CO 4	Basics of Maxwell's equations and electromagnetic waves.

Unit - I

Electrostatics in Vacuum: Calculation of Electric Field: Coulomb's law, Continuous charge distribution; Divergence and Curl of Electrostatic Fields: Field lines, flux, Gauss's law, Applications of Gauss's law; Electrostatic Potential: Comments on potential, Poisson's and Laplace's Equation, the potential of a localized charge distribution; Electrostatic Boundary Conditions; Work and Energy in Electrostatics: the work done to move a charge, the energy of a point and continuous charge distribution.

Unit - II

Electrostatics in a Linear Dielectric Medium: Polarization:dielectrics, induced dipoles, alignments of polar molecules; The field of a Polarized Object: bound charges and its physical interpretation; The Filed Inside a Dielectric; The Electric Displacement: Gauss's law in the presence of dielectrics, A deceptive parallel, Boundary conditions; Linear Dielectrics: Susceptibility, Permittivity, dielectric constant, Boundary value problems with linear dielectrics, Energy in dielectric systems, Forces in dielectrics.

Unit - III

Magnetostatics: The Lorentz Force Law: magnetic fields, magnetic forces, currents; Biot- Savart law, Divergence and Curl of magnetic field, Magnetic Vector Potential: vector potential, magnetostatic boundary conditions, multiple expansion of vector potential.

Magnetostatics in a linear magnetic: Magnetization: Effect of magnetic field on atomic orbits; The Field of a Magnetized Object: Bound currents, Physical interpretation of bound currents; The Auxiliary Magnetic Field: Ampere's law in magnetized materials, A deceptive parallel, Boundary conditions; Linear and Nonlinear Media: magnetic susceptibility and permeability, ferromagnetism.

Unit - IV

Faraday's law: Electromotive Force: Ohm's law, Motional emf; Electromagnetic Induction: Faraday's law, The induced electric field, inductance, energy in magnetic fields.

Maxwell's Equations: Electrodynamics before Maxwell, How Maxwell fixed Ampere's law, Maxwell's equations, Maxwell's equations in matter.

Electromagnetic Waves: Electromagnetic Waves in Vacuum: the wave equation for electric and magnetic field; Electromagnetic Waves in Matter: propagation in linear media.

Suggested Books:

1. David J. Griffiths, Introduction to Electrodynamics, Pearson Education.
2. Halliday and Resnick, Physics
3. W. Saslow, Electricity, Magnetism and Light

Note: The paper setter will set the paper as per the question paper templates provided.

BS-121LA	Electromagnetics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Electromagnetic Theory.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
2. To study induced e.m.f. as a function of velocity of magnet.
3. To study the growth and decay of current in a LR circuit using magnetic core inductor.
4. To find the coefficient of self-inductance by Rayleigh's method.
5. To find the coefficient of mutual inductance of two coils.
6. To determine the magnetic induction field between the pole pieces of an electromagnet.
7. To study Bio-Savart's law.
8. To study the dependency of magnetic field on coil diameter and number of turns.
9. To investigate the equipotential liens of electric fields.
10. To draw the equipotential lines of bar electrode.
11. To draw the equipotential lines for ring electrode.
12. Verification of Farady and Lenz's law of induction by measuring the induced voltage as function of time.
13. Measurement of induced voltage impulse as a function of the velocity of magnet.
14. To determine the dielectric constant of different dielectric materials.
15. To measure the spatial distribution of the magnetic field between a pair of identical coils in Helmholtz arrangement.
16. To investigate the spacing between coils at which magnetic field is uniform and to measure its spatial distribution.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-135A	Multivariable Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.						
CO 4	To familiarize the student with functions of several variables that is essential in most branches of engineering.						
CO 5	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						

UNIT-I (12 hrs)

Calculus: Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II **(**12 hrs)

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, D'Alembert's Ratio test, Logarithmic test, Cauchy root test, Raabe's test); Power series.

Fourier series: Introduction, Fourier-Euler Formula, Dirichlet's conditions, Change of intervals, Fourier series for even and odd functions, Half range sine and cosine series.

UNIT-III (09 hrs)

Multivariable Calculus (differentiation): Taylor's series (for one and more variables), series for exponential, trigonometric and logarithm functions.

Partial derivatives, Total differential, Chain rule for differentiation, Homogeneous functions, Euler's theorem, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers.

UNIT-IV (07 hrs)

Matrices: Rank of a matrix, elementary transformations, elementary matrices, Gauss Jordon method to find inverse using elementary transformations, normal form of a matrix, linear dependence and independence of vectors, consistency of linear system of equations, linear and orthogonal transformations, eigenvalues and eigenvectors, properties of eigenvalues, Cayley – Hamilton theorem and its applications.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-136A	Calculus and Ordinary Differential Equations						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques inmultivariate integration, ordinary and partial differential equations and complex variables.						
Course Outcomes							
CO1	To introduce effective mathematical tools for the solutions of differential equations that model physical processes.						
CO 2	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.						
CO 3	To introduce the tools of differentiation and integration of functions of complex variable thatare used in various techniques dealing engineering problems.						

UNIT-I (10 hrs)

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree:equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy and Legendre's linear differential equations.

UNIT-II **(**10 hrs)

Multivariable Calculus (Integration): Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar)

Applications: areas and volumes; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

UNIT-III (10hrs)

Vector Calculus: Introduction, Scalar and Vector point functions, Gradient, divergence & Curl and their properties, Directional derivative.

Line integrals, surface integrals, volume integrals, Theorems of Green, Gauss and Stokes (without proof).

UNIT-IV (10 hrs)

Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions,

harmonic functions, findingharmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) andtheir properties;

Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (withoutproof), Taylor's series,zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).

Suggested Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Erwin kreyszig and SanjeevAhuja, Applied Mathematics- II, Wiley India Publication, 2015.
4. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary ValueProblems, 9th Edn., Wiley India, 2009.
5. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
6. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice HallIndia, 1995.
7. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
8. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill,2004.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
10. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	**ES-109A**							
Coursetitle	**EngineeringGraphics&Design**							
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
	1	**2**	**0**	**3**	**75**	**25**	**100**	**3h**

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing, graphics and Projections.	
CO-1	**To learn about construction of various types of curves and scales.**
CO-2	**To learn about orthographic projections of points, lines and planes.**
CO-3	**To Learn about the sectional views and development of Right regular solids**
CO-4	**To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.**

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular solids like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. Corresponding'stoCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	**ES-113LA**							
Coursetitle	**EngineeringGraphics&Design Practice**							
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Practical**	**Minor Test**	**Total**	**Time**
	-	**-**	**3**	**1.5**	**30**	**20**	**50**	**3h**
Pre-requisites(if any)	**-**							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	**To give an overview of the user interface and toolboxes in a CAD software.**
CO-2	**To understand to customize settings of CAD software and produce CAD drawing.**
CO-3	**To practice performing various functions in CAD softwares.**
CO-4	**To Learn about solid modelling and demonstration of a simple team design project.**

Module 1:OverviewofComputerGraphics:

Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];

Module2:Customization &CAD Drawing:

Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;

Module3:Annotations,layering&other functions:

Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline

lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multiview,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;

Module4:Demonstration ofasimpleteamdesign project:

Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).

Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1331ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.
3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutator action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3
Purpose	**To familiarize the students with the Electrical TechnologyPracticals**						
Course Outcomes							
CO1	**Understand basic concepts of Network theorems**						
CO 2	**Deals with steady state frequency response of RLC circuit parameters solution techniques**						
CO 3	**Deals with introductory Single Phase Transformer practicals**						
CO 4	**Explains the constructional features and practicals of various types of Electrical Machines**						

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of Technology in Mechatronics Engineering(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagneticTheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-135A	Multi-variableCalculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of TechnologyMechatronics Engineering(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagnetictheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-136A	Calculus&OrdinaryDifferentialEquations	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-119A	Introduction to Electromagnetic Theory						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of electromagnetic theory to the students for applications in Engineering field.
	Course Outcomes
CO 1	Introduce the basic concepts of Electrostatics in vacuum.
CO 2	Introduce the basic concepts of Magnetostatics in vacuum.
CO 3	Discuss electrostatics and magnetostatics in linear dielectric medium.
CO 4	Basics of Maxwell's equations and electromagnetic waves.

Unit - I

Electrostatics in Vacuum: Calculation of Electric Field: Coulomb's law, Continuous charge distribution; Divergence and Curl of Electrostatic Fields: Field lines, flux, Gauss's law, Applications of Gauss's law; Electrostatic Potential: Comments on potential, Poisson's and Laplace's Equation, the potential of a localized charge distribution; Electrostatic Boundary Conditions; Work and Energy in Electrostatics: the work done to move a charge, the energy of a point and continuous charge distribution.

Unit - II

Electrostatics in a Linear Dielectric Medium: Polarization:dielectrics, induced dipoles, alignments of polar molecules; The field of a Polarized Object: bound charges and its physical interpretation; The Filed Inside a Dielectric; The Electric Displacement: Gauss's law in the presence of dielectrics, A deceptive parallel, Boundary conditions; Linear Dielectrics: Susceptibility, Permittivity, dielectric constant, Boundary value problems with linear dielectrics, Energy in dielectric systems, Forces in dielectrics.

Unit - III

Magnetostatics: The Lorentz Force Law: magnetic fields, magnetic forces, currents; Biot- Savart law, Divergence and Curl of magnetic field, Magnetic Vector Potential: vector potential, magnetostatic boundary conditions, multiple expansion of vector potential.

Magnetostatics in a linear magnetic: Magnetization: Effect of magnetic field on atomic orbits; The Field of a Magnetized Object: Bound currents, Physical interpretation of bound currents; The Auxiliary Magnetic Field: Ampere's law in magnetized materials, A deceptive parallel, Boundary conditions; Linear and Nonlinear Media: magnetic susceptibility and permeability, ferromagnetism.

Unit - IV

Faraday's law: Electromotive Force: Ohm's law, Motional emf; Electromagnetic Induction: Faraday's law, The induced electric field, inductance, energy in magnetic fields.

Maxwell's Equations: Electrodynamics before Maxwell, How Maxwell fixed Ampere's law, Maxwell's equations, Maxwell's equations in matter.

Electromagnetic Waves: Electromagnetic Waves in Vacuum: the wave equation for electric and magnetic field; Electromagnetic Waves in Matter: propagation in linear media.

Suggested Books:

1. David J. Griffiths, Introduction to Electrodynamics, Pearson Education.
2. Halliday and Resnick, Physics
3. W. Saslow, Electricity, Magnetism and Light

Note: The paper setter will set the paper as per the question paper templates provided.

BS-121LA	Electromagnetics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Electromagnetic Theory.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
2. To study induced e.m.f. as a function of velocity of magnet.
3. To study the growth and decay of current in a LR circuit using magnetic core inductor.
4. To find the coefficient of self-inductance by Rayleigh's method.
5. To find the coefficient of mutual inductance of two coils.
6. To determine the magnetic induction field between the pole pieces of an electromagnet.
7. To study Bio-Savart's law.
8. To study the dependency of magnetic field on coil diameter and number of turns.
9. To investigate the equipotential liens of electric fields.
10. To draw the equipotential lines of bar electrode.
11. To draw the equipotential lines for ring electrode.
12. Verification of Farady and Lenz's law of induction by measuring the induced voltage as function of time.
13. Measurement of induced voltage impulse as a function of the velocity of magnet.
14. To determine the dielectric constant of different dielectric materials.
15. To measure the spatial distribution of the magnetic field between a pair of identical coils in Helmholtz arrangement.
16. To investigate the spacing between coils at which magnetic field is uniform and to measure its spatial distribution.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-135A	Multivariable Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.						
CO 4	To familiarize the student with functions of several variables that is essential in most branches of engineering.						
CO 5	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						

UNIT-I (12 hrs)

Calculus: Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II **(**12 hrs)

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, D'Alembert's Ratio test, Logarithmic test, Cauchy root test, Raabe's test); Power series.

Fourier series: Introduction, Fourier-Euler Formula, Dirichlet's conditions, Change of intervals, Fourier series for even and odd functions, Half range sine and cosine series.

UNIT-III (09 hrs)

Multivariable Calculus (differentiation): Taylor's series (for one and more variables), series for exponential, trigonometric and logarithm functions.

Partial derivatives, Total differential, Chain rule for differentiation, Homogeneous functions, Euler's theorem, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers.

UNIT-IV (07 hrs)

Matrices: Rank of a matrix, elementary transformations, elementary matrices, Gauss Jordon method to find inverse using elementary transformations, normal form of a matrix, linear dependence and independence of vectors, consistency of linear system of equations, linear and orthogonal transformations, eigenvalues and eigenvectors, properties of eigenvalues, Cayley – Hamilton theorem and its applications.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-136A	Calculus and Ordinary Differential Equations						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques inmultivariate integration, ordinary and partial differential equations and complex variables.						
Course Outcomes							
CO1	To introduce effective mathematical tools for the solutions of differential equations that model physical processes.						
CO 2	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.						
CO 3	To introduce the tools of differentiation and integration of functions of complex variable thatare used in various techniques dealing engineering problems.						

UNIT-I (10 hrs)

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree:equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy and Legendre's linear differential equations.

UNIT-II **(**10 hrs)

Multivariable Calculus (Integration): Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar)

Applications: areas and volumes; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

UNIT-III (10hrs)

Vector Calculus: Introduction, Scalar and Vector point functions, Gradient, divergence & Curl and their properties, Directional derivative.

Line integrals, surface integrals, volume integrals, Theorems of Green, Gauss and Stokes (without proof).

UNIT-IV (10 hrs)

Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, findingharmonic conjugate; elementary analytic functions (exponential,

trigonometric, logarithm) andtheir properties;

Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (withoutproof), Taylor's series,zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).

Suggested Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Erwin kreyszig and SanjeevAhuja, Applied Mathematics- II, Wiley India Publication, 2015.
4. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary ValueProblems, 9th Edn., Wiley India, 2009.
5. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
6. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice HallIndia, 1995.
7. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
8. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill,2004.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
10. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	**ES-109A**							
Coursetitle	**EngineeringGraphics&Design**							
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
	1	**2**	**0**	**3**	**75**	**25**	**100**	**3h**

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing, graphics and Projections.	
CO-1	**To learn about construction of various types of curves and scales.**
CO-2	**To learn about orthographic projections of points, lines and planes.**
CO-3	**To Learn about the sectional views and development of Right regular solids**
CO-4	**To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.**

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular solids like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. Corresponding'stoCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	**ES-113LA**							
Coursetitle	**EngineeringGraphics&Design Practice**							
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Practical**	**Minor Test**	**Total**	**Time**
	-	**-**	**3**	**1.5**	**30**	**20**	**50**	**3h**
Pre-requisites(if any)	**-**							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	**To give an overview of the user interface and toolboxes in a CAD software.**
CO-2	**To understand to customize settings of CAD software and produce CAD drawing.**
CO-3	**To practice performing various functions in CAD softwares.**
CO-4	**To Learn about solid modelling and demonstration of a simple team design project.**

Module 1:OverviewofComputerGraphics:

Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];

Module2:Customization &CAD Drawing:

Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;

Module3:Annotations,layering&other functions:

Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper

usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multiview,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;

Module4:Demonstration ofasimpleteamdesign project:

Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).

Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1350ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.
3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutator action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3

Purpose	To familiarize the students with the Electrical TechnologyPracticals

Course Outcomes	
CO1	Understand basic concepts of Network theorems
CO 2	Deals with steady state frequency response of RLC circuit parameters solution techniques
CO 3	Deals with introductory Single Phase Transformer practicals
CO 4	Explains the constructional features and practicals of various types of Electrical Machines

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of Technology in Textile Engineering(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagneticTheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-135A	Multi-variableCalculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of TechnologyTextile Engineering(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagnetictheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-136A	Calculus&OrdinaryDifferentialEquations	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-119A	Introduction to Electromagnetic Theory						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of electromagnetic theory to the students for applications in Engineering field.
	Course Outcomes
CO 1	Introduce the basic concepts of Electrostatics in vacuum.
CO 2	Introduce the basic concepts of Magnetostatics in vacuum.
CO 3	Discuss electrostatics and magnetostatics in linear dielectric medium.
CO 4	Basics of Maxwell's equations and electromagnetic waves.

Unit - I

Electrostatics in Vacuum: Calculation of Electric Field: Coulomb's law, Continuous charge distribution; Divergence and Curl of Electrostatic Fields: Field lines, flux, Gauss's law, Applications of Gauss's law; Electrostatic Potential: Comments on potential, Poisson's and Laplace's Equation, the potential of a localized charge distribution; Electrostatic Boundary Conditions; Work and Energy in Electrostatics: the work done to move a charge, the energy of a point and continuous charge distribution.

Unit - II

Electrostatics in a Linear Dielectric Medium: Polarization:dielectrics, induced dipoles, alignments of polar molecules; The field of a Polarized Object: bound charges and its physical interpretation; The Filed Inside a Dielectric; The Electric Displacement: Gauss's law in the presence of dielectrics, A deceptive parallel, Boundary conditions; Linear Dielectrics: Susceptibility, Permittivity, dielectric constant, Boundary value problems with linear dielectrics, Energy in dielectric systems, Forces in dielectrics.

Unit - III

Magnetostatics: The Lorentz Force Law: magnetic fields, magnetic forces, currents; Biot- Savart law, Divergence and Curl of magnetic field, Magnetic Vector Potential: vector potential, magnetostatic boundary conditions, multiple expansion of vector potential.

Magnetostatics in a linear magnetic: Magnetization: Effect of magnetic field on atomic orbits; The Field of a Magnetized Object: Bound currents, Physical interpretation of bound currents; The Auxiliary Magnetic Field: Ampere's law in magnetized materials, A deceptive parallel, Boundary conditions; Linear and Nonlinear Media: magnetic susceptibility and permeability, ferromagnetism.

Unit - IV

Faraday's law: Electromotive Force: Ohm's law, Motional emf; Electromagnetic Induction: Faraday's law, The induced electric field, inductance, energy in magnetic fields.

Maxwell's Equations: Electrodynamics before Maxwell, How Maxwell fixed Ampere's law, Maxwell's equations, Maxwell's equations in matter.

Electromagnetic Waves: Electromagnetic Waves in Vacuum: the wave equation for electric and magnetic field; Electromagnetic Waves in Matter: propagation in linear media.

Suggested Books:

1. David J. Griffiths, Introduction to Electrodynamics, Pearson Education.
2. Halliday and Resnick, Physics
3. W. Saslow, Electricity, Magnetism and Light

Note: The paper setter will set the paper as per the question paper templates provided.

BS-121LA	Electromagnetics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Electromagnetic Theory.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
2. To study induced e.m.f. as a function of velocity of magnet.
3. To study the growth and decay of current in a LR circuit using magnetic core inductor.
4. To find the coefficient of self-inductance by Rayleigh's method.
5. To find the coefficient of mutual inductance of two coils.
6. To determine the magnetic induction field between the pole pieces of an electromagnet.
7. To study Bio-Savart's law.
8. To study the dependency of magnetic field on coil diameter and number of turns.
9. To investigate the equipotential liens of electric fields.
10. To draw the equipotential lines of bar electrode.
11. To draw the equipotential lines for ring electrode.
12. Verification of Farady and Lenz's law of induction by measuring the induced voltage as function of time.
13. Measurement of induced voltage impulse as a function of the velocity of magnet.
14. To determine the dielectric constant of different dielectric materials.
15. To measure the spatial distribution of the magnetic field between a pair of identical coils in Helmholtz arrangement.
16. To investigate the spacing between coils at which magnetic field is uniform and to measure its spatial distribution.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-135A	Multivariable Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.						
CO 4	To familiarize the student with functions of several variables that is essential in most branches of engineering.						
CO 5	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						

UNIT-I (12 hrs)

Calculus: Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II **(**12 hrs)

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, D'Alembert's Ratio test, Logarithmic test, Cauchy root test, Raabe's test); Power series.

Fourier series: Introduction, Fourier-Euler Formula, Dirichlet's conditions, Change of intervals, Fourier series for even and odd functions, Half range sine and cosine series.

UNIT-III (09 hrs)

Multivariable Calculus (differentiation): Taylor's series (for one and more variables), series for exponential, trigonometric and logarithm functions.

Partial derivatives, Total differential, Chain rule for differentiation, Homogeneous functions, Euler's

theorem, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers.

UNIT-IV (07 hrs)

Matrices: Rank of a matrix, elementary transformations, elementary matrices, Gauss Jordon method to find inverse using elementary transformations, normal form of a matrix, linear dependence and independence of vectors, consistency of linear system of equations, linear and orthogonal transformations, eigenvalues and eigenvectors, properties of eigenvalues, Cayley – Hamilton theorem and its applications.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-136A	**Calculus and Ordinary Differential Equations**						
L	**T**	**P**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**1**	**-**	**4**	**75**	**25**	**100**	**3 h**
Purpose	**To familiarize the prospective engineers with techniques inmultivariate integration, ordinary and partial differential equations and complex variables.**						
Course Outcomes							
CO1	**To introduce effective mathematical tools for the solutions of differential equations that model physical processes.**						
CO 2	**To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.**						
CO 3	**To introduce the tools of differentiation and integration of functions of complex variable thatare used in various techniques dealing engineering problems.**						

UNIT-I (10 hrs)

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree:equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy and Legendre's linear differential equations.

UNIT-II **(**10 hrs)

Multivariable Calculus (Integration): Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar)

Applications: areas and volumes; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

UNIT-III (10hrs)

Vector Calculus: Introduction, Scalar and Vector point functions, Gradient, divergence & Curl and their properties, Directional derivative.

Line integrals, surface integrals, volume integrals, Theorems of Green, Gauss and Stokes (without proof).

UNIT-IV (10 hrs)

Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, findingharmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) andtheir properties;

Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (withoutproof), Taylor's series,zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).

Suggested Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Erwin kreyszig and SanjeevAhuja, Applied Mathematics- II, Wiley India Publication, 2015.
4. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary ValueProblems, 9th Edn., Wiley India, 2009.
5. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
6. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice HallIndia, 1995.
7. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
8. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill,2004.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
10. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	**ES-109A**							
Coursetitle	**EngineeringGraphics&Design**							
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
	1	**2**	**0**	**3**	**75**	**25**	**100**	**3h**

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing, graphics and Projections.	
CO-1	**To learn about construction of various types of curves and scales.**
CO-2	**To learn about orthographic projections of points, lines and planes.**
CO-3	**To Learn about the sectional views and development of Right regular solids**
CO-4	**To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.**

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular solids like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. Corresponding'stoCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	**ES-113LA**							
Coursetitle	**EngineeringGraphics&Design Practice**							
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Practical**	**Minor Test**	**Total**	**Time**
	-	**-**	**3**	**1.5**	**30**	**20**	**50**	**3h**
Pre-requisites(if any)	**-**							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	**To give an overview of the user interface and toolboxes in a CAD software.**
CO-2	**To understand to customize settings of CAD software and produce CAD drawing.**
CO-3	**To practice performing various functions in CAD softwares.**
CO-4	**To Learn about solid modelling and demonstration of a simple team design project.**

Module 1:OverviewofComputerGraphics:

Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];

Module2:Customization &CAD Drawing:

Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;

Module3:Annotations,layering&other functions:

Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multiview,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;

Module4:Demonstration ofasimpleteamdesign project:

Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).

Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1369ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.
3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutator action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3
Purpose	**To familiarize the students with the Electrical TechnologyPracticals**						
Course Outcomes							
CO1	**Understand basic concepts of Network theorems**						
CO 2	**Deals with steady state frequency response of RLC circuit parameters solution techniques**						
CO 3	**Deals with introductory Single Phase Transformer practicals**						
CO 4	**Explains the constructional features and practicals of various types of Electrical Machines**						

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of Technology in Chemical Engineering(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagneticTheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-135A	Multi-variableCalculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –I: Common with B.Tech in (a) Mechanical Engineering, (b) Aeronautical Engineering (c) Automobile Engineering (d) Civil Engineering (e) Mechatronics Engg. (f) Textile Engineering (g) Chemical Engg.

Bachelor of TechnologyChemical Engineering(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-119A	IntroductiontoElectromagnetictheory	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-136A	Calculus&OrdinaryDifferentialEquations	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-121LA	ElectromagneticsLab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-119A	Introduction to Electromagnetic Theory						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of electromagnetic theory to the students for applications in Engineering field.
	Course Outcomes
CO 1	Introduce the basic concepts of Electrostatics in vacuum.
CO 2	Introduce the basic concepts of Magnetostatics in vacuum.
CO 3	Discuss electrostatics and magnetostatics in linear dielectric medium.
CO 4	Basics of Maxwell's equations and electromagnetic waves.

Unit - I

Electrostatics in Vacuum: Calculation of Electric Field: Coulomb's law, Continuous charge distribution; Divergence and Curl of Electrostatic Fields: Field lines, flux, Gauss's law, Applications of Gauss's law; Electrostatic Potential: Comments on potential, Poisson's and Laplace's Equation, the potential of a localized charge distribution; Electrostatic Boundary Conditions; Work and Energy in Electrostatics: the work done to move a charge, the energy of a point and continuous charge distribution.

Unit - II

Electrostatics in a Linear Dielectric Medium: Polarization:dielectrics, induced dipoles, alignments of polar molecules; The field of a Polarized Object: bound charges and its physical interpretation; The Filed Inside a Dielectric; The Electric Displacement: Gauss's law in the presence of dielectrics, A deceptive parallel, Boundary conditions; Linear Dielectrics: Susceptibility, Permittivity, dielectric constant, Boundary value problems with linear dielectrics, Energy in dielectric systems, Forces in dielectrics.

Unit - III

Magnetostatics: The Lorentz Force Law: magnetic fields, magnetic forces, currents; Biot- Savart law, Divergence and Curl of magnetic field, Magnetic Vector Potential: vector potential, magnetostatic boundary conditions, multiple expansion of vector potential.

Magnetostatics in a linear magnetic: Magnetization: Effect of magnetic field on atomic orbits; The Field of a Magnetized Object: Bound currents, Physical interpretation of bound currents; The Auxiliary Magnetic Field: Ampere's law in magnetized materials, A deceptive parallel, Boundary conditions; Linear and Nonlinear Media: magnetic susceptibility and permeability, ferromagnetism.

Unit - IV

Faraday's law: Electromotive Force: Ohm's law, Motional emf; Electromagnetic Induction: Faraday's law, The induced electric field, inductance, energy in magnetic fields.

Maxwell's Equations: Electrodynamics before Maxwell, How Maxwell fixed Ampere's law, Maxwell's equations, Maxwell's equations in matter.

Electromagnetic Waves: Electromagnetic Waves in Vacuum: the wave equation for electric and magnetic field; Electromagnetic Waves in Matter: propagation in linear media.

Suggested Books:

1. David J. Griffiths, Introduction to Electrodynamics, Pearson Education.
2. Halliday and Resnick, Physics
3. W. Saslow, Electricity, Magnetism and Light

Note: The paper setter will set the paper as per the question paper templates provided.

BS-121LA	Electromagnetics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Electromagnetic Theory.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
2. To study induced e.m.f. as a function of velocity of magnet.
3. To study the growth and decay of current in a LR circuit using magnetic core inductor.
4. To find the coefficient of self-inductance by Rayleigh's method.
5. To find the coefficient of mutual inductance of two coils.
6. To determine the magnetic induction field between the pole pieces of an electromagnet.
7. To study Bio-Savart's law.
8. To study the dependency of magnetic field on coil diameter and number of turns.
9. To investigate the equipotential liens of electric fields.
10. To draw the equipotential lines of bar electrode.
11. To draw the equipotential lines for ring electrode.
12. Verification of Farady and Lenz's law of induction by measuring the induced voltage as function of time.
13. Measurement of induced voltage impulse as a function of the velocity of magnet.
14. To determine the dielectric constant of different dielectric materials.
15. To measure the spatial distribution of the magnetic field between a pair of identical coils in Helmholtz arrangement.
16. To investigate the spacing between coils at which magnetic field is uniform and to measure its spatial distribution.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-135A	Multivariable Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.						
CO 4	To familiarize the student with functions of several variables that is essential in most branches of engineering.						
CO 5	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						

UNIT-I (12 hrs)

Calculus: Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.
Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II **(**12 hrs)

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, D'Alembert's Ratio test, Logarithmic test, Cauchy root test, Raabe's test); Power series.
Fourier series: Introduction, Fourier-Euler Formula, Dirichlet's conditions, Change of intervals, Fourier series for even and odd functions, Half range sine and cosine series.

UNIT-III (09 hrs)

Multivariable Calculus (differentiation): Taylor's series (for one and more variables), series for exponential, trigonometric and logarithm functions.
Partial derivatives, Total differential, Chain rule for differentiation, Homogeneous functions, Euler's

theorem, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers.

UNIT-IV (07 hrs)

Matrices: Rank of a matrix, elementary transformations, elementary matrices, Gauss Jordon method to find inverse using elementary transformations, normal form of a matrix, linear dependence and independence of vectors, consistency of linear system of equations, linear and orthogonal transformations, eigenvalues and eigenvectors, properties of eigenvalues, Cayley – Hamilton theorem and its applications.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-136A	**Calculus and Ordinary Differential Equations**						
L	**T**	**P**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**1**	**-**	**4**	**75**	**25**	**100**	**3 h**
Purpose	**To familiarize the prospective engineers with techniques inmultivariate integration, ordinary and partial differential equations and complex variables.**						
Course Outcomes							
CO1	**To introduce effective mathematical tools for the solutions of differential equations that model physical processes.**						
CO 2	**To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.**						
CO 3	**To introduce the tools of differentiation and integration of functions of complex variable thatare used in various techniques dealing engineering problems.**						

UNIT-I (10 hrs)

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree:equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy and Legendre's linear differential equations.

UNIT-II **(**10 hrs)

Multivariable Calculus (Integration): Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar)

Applications: areas and volumes; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

UNIT-III (10hrs)

Vector Calculus: Introduction, Scalar and Vector point functions, Gradient, divergence & Curl and their properties, Directional derivative.

Line integrals, surface integrals, volume integrals, Theorems of Green, Gauss and Stokes (without proof).

UNIT-IV (10 hrs)

Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, findingharmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) andtheir properties;

Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (withoutproof), Taylor's series,zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).

Suggested Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Erwin kreyszig and SanjeevAhuja, Applied Mathematics- II, Wiley India Publication, 2015.
4. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary ValueProblems, 9th Edn., Wiley India, 2009.
5. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
6. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice HallIndia, 1995.
7. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
8. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill,2004.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
10. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	**ES-109A**							
Coursetitle	**EngineeringGraphics&Design**							
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
	1	**2**	**0**	**3**	**75**	**25**	**100**	**3h**

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing, graphics and Projections.	
CO-1	**To learn about construction of various types of curves and scales.**
CO-2	**To learn about orthographic projections of points, lines and planes.**
CO-3	**To Learn about the sectional views and development of Right regular solids**
CO-4	**To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.**

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular solids like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. Corresponding'stoCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	**ES-113LA**							
Coursetitle	**EngineeringGraphics&Design Practice**							
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Practical**	**Minor Test**	**Total**	**Time**
	-	**-**	**3**	**1.5**	**30**	**20**	**50**	**3h**
Pre-requisites(if any)	**-**							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	**To give an overview of the user interface and toolboxes in a CAD software.**
CO-2	**To understand to customize settings of CAD software and produce CAD drawing.**
CO-3	**To practice performing various functions in CAD softwares.**
CO-4	**To Learn about solid modelling and demonstration of a simple team design project.**

Module 1:OverviewofComputerGraphics:

Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];

Module2:Customization &CAD Drawing:

Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;

Module3:Annotations,layering&other functions:

Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multiview,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;

Module4:Demonstration ofasimpleteamdesign project:

Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).

Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1388ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.
3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutator action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3
Purpose	**To familiarize the students with the Electrical TechnologyPracticals**						
Course Outcomes							
CO1	**Understand basic concepts of Network theorems**						
CO 2	**Deals with steady state frequency response of RLC circuit parameters solution techniques**						
CO 3	**Deals with introductory Single Phase Transformer practicals**						
CO 4	**Explains the constructional features and practicals of various types of Electrical Machines**						

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.

Bachelor of Technology inComputerSci. & Engg.(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-133A	Calculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.

Bachelor of Technology in ComputerSci. &Engg.(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-134A	Probablity& Statistics	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-115 A	Semiconductor Physics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of solid state physics and its applications to the students.
	Course Outcomes
CO1	To make the students aware of basic terminology of crystal structure.
CO 2	Introduce the elementary quantum mechanics, which will be useful in understanding the concepts of solid state physics.
CO 3	Discussion of classical free electron theory, quantum theory and Band theory of solids.
CO 4	Basics and applications of semiconductors.

Unit - I

Crystal Structure: Crystalline and Amorphous solids, Crystal Structure: lattice translation vector, symmetry operations, space lattice, basis; Unit cell and Primitive cell, Fundamental types of lattices: two-dimensional and three dimensional Bravais lattices; Characteristics of Unit cells: Simple Cubic (SC), Body Centred Cubic (BCC), Face Centred Cubic (FCC), Hexagonal Close Packed (HCP) structure; Simple crystal structures: Sodium Chloride, Cesium Chloride, Diamond, Cubic Zinc Sulfide; Miller Indices, Bonding in Solids, Point defects in crystals: Schottky and Frenkel defects.

Unit – II

Quantum Theory: Need and origin of Quantum concept, Wave-particle duality, Phase velocity and group velocity, Uncertainty Principle and Applications; Schrodinger's wave equation: time-dependent and time –independent; Physical Significance of wave function ψ.

Unit – III

Free Electron Theory: Classical free electron theory: electrical conductivity in metals, thermal conductivity in metals, Wiedemann-Franz law, success and drawbacks of free electron theory; Quantum free electron theory: wave function, eigen values; Fermi-Dirac distribution function, Density of states, Fermi energy and its importance, Thermionic Emission (qualitative).

Band theory of Solids: Bloch theorem, Kronig-Penney Model (qualitative), E versus k diagram, Brillouin Zones, Concept of effective mass of electron, Energy levels and energy bands, Distinction between metals, insulators and semiconductors, Hall effect and its Applications.

Unit –IV

Semiconductors: Conduction in Semiconductors, Intrinsic Semiconductors: Conductivity of charge carriers, Carrier concentration in intrinsic semiconductors; Extrinsic Semiconductors: n-type semiconductors, p-type semiconductors, charge carrier concentration in extrinsic semiconductors.

Semiconductor Devices: The p-n junction, Current-voltage characteristics of p-n junction; The Transistor: Bipolar Junction Transistor (BJT), Field Effect Transistor (FET), Metal-Semiconductor Junction (Ohmic and Schottky); Semiconductor Laser.

Suggested Books:

1. Applied Physics for Engineers, Wiley India Pvt. Ltd.
2. Introduction to Solid State Physics, John Wiley & Sons. .
3. Concepts of Modern Physics (5th edition), Tata McGraw-Hill Publishing Company Limited.
4. Solid State Physics, New Age International (P) Limited.
5. A Textbook of Quantum Mechanics, McGraw Hill Education (India) Private Limited.
   Introduction to Nanotechnology, John Wiley & Sons.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-117LA	Semiconductor Physics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the sophisticated instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Semiconductor Physics.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the V-I characteristics of a p-n diode.
2. To find the flashing and quenching potential of Argon and to find the capacitance of unknown capacitor.
3. To find the value of Planck's constant by using photoelectric cell.
4. To find the temperature coefficient of resistance by using Pt resistance thermometer by post office box.
5. To find the ionization potential of Argon/Mercury using a thyratron tube.
6. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
7. To study the characteristics of (Cu-Fe, Cu-Constantan) thermocouple.
8. To find the value of Hall Coefficient of semiconductor.
9. To find the value of e/m for electrons by Helical method.
10. To find the band gap of intrinsic semiconductor using four probe method.
11. To calculate the hysteresis loss by tracing a B-H curve.
12. To find the frequency of ultrasonic waves by piezoelectric methods.
13. To verify Richerdson thermionic equation.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-133 A	Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						
CO 4	To familiarize the student with vector space as an essential tool in most branches of engineering.						

UNIT-I (12 hrs)

Calculus:

Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II (8 hrs)

Matrices

Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

UNIT-III (10 hrs)

Vector spaces

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank nullity theorem, composition of linear maps.

UNIT-IV (10 hrs)

Vector spaces

Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization; Inner product spaces.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.

3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

9. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

10. S. Lipschutz and M. Lipson, Schaum's outline of Linear Algebra,, McGraw Hill Education; 3 edition (1 July 17).

Note: The paper setter will set the paper as per the question paper templates provided.

BS-134 A	Probability & Statistics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
4	1	-	4.5	75	25	100	3 h
Purpose	To familiarize the prospective students with techniques of probability and statistics.						
Course Outcomes							
CO1	Probability theory provides models of probability distributions(theoretical models of the observable reality involving chance effects) to be tested by statistical methods which has various engineering applications, for instance, in testing materials, control of production processes, robotics, and automatization in general, production planning and so on.						
CO 2	To develop the essential tool of statistics in a comprehensive manner.						
CO 3	To familiarize the student with the problem of discussing universe of which they in which complete enumeration is impractical, tests of significance plays a vital role in their hypothesis testing.						

UNIT-I (10 Hrs)

Basic Probability: Introduction, additive law of probability, Conditional Probability, Independent Events, Bayes' Theorem.

Random Variables: Discrete random variables, probability distribution, Probability mass function and distribution function, Expectation, Moments, Variance and standard deviation of discrete random variables.

UNIT-II (10 Hrs)

Continuous Probability distribution:

Continuous random variables, probability distribution, Probability density function and distribution function, Expectation, Moments, Variance and standard deviation of Continuous random variables.

Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions.

UNIT-III (10 hrs)

Basic Statistics:

Measures of Central tendency: Mean, median, quartiles, mode, Geometric mean, Harmonic mean, Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, Skewness and Kurtosis, Correlation, Coefficient of correlation, methods of calculations, Lines of regression, Rank correlation.

UNIT-IV (10 hrs)

Applied Statistics:

Curve fitting by the method of least squares: Introduction, Fitting of a straight line, fitting of second degree curve, fitting of a polynomial of degree m, fitting of a geometric or power curve of the form $y = ax^b$, fitting of an exponential curve of the form $y = ab^x$.

Test of significance: Basic terminology, Large sample test for single proportion, difference of proportions, single mean, difference of means, Small samples test for single mean, difference of means, Chi-square test for goodness of fit.

Suggested Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed.,Wiley, 1968.
5. N.P. Bali and and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
8.Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-109A							
Coursetitle	EngineeringGraphics&Design							
Scheme and Credits	L	T	P	Credits	Major Test	Minor Test	Total	Time
	1	2	0	3	75	25	100	3h

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing , graphics and Projections.	
CO-1	To learn about construction of various types of curves and scales.
CO-2	To learn about orthographic projections of points, lines and planes.
CO-3	To Learn about the sectional views and development of Right regular solids
CO-4	To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular soilds like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. CorrespondingsetofCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-113LA							
Coursetitle	EngineeringGraphics&Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3h
Pre-requisites(if any)	-							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1:OverviewofComputerGraphics:
Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];
Module2:Customization &CAD Drawing:
Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;
Module3:Annotations,layering&other functions:
Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multi-view,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;
Module4:Demonstration ofasimpleteamdesign project:
Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).
Suggested Books(ES-113L):

Course code	ES-113LA							
Coursetitle	EngineeringGraphics&Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3h
Pre-requisites(if any)	-							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1:OverviewofComputerGraphics:
Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];
Module2:Customization &CAD Drawing:
Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;
Module3:Annotations,layering&other functions:
Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multi-view,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;
Module4:Demonstration ofasimpleteamdesign project:
Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).

Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.

Course code	**ES-111LA**							
Coursetitle	**ManufacturingProcessesWorkshop**							
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Practical**	**Minor Test**	**Total**	**Time**
	0	**0**	**3**	**1.5**	**60**	**40**	**100**	**3h**
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	**To familiarize with different manufacturing methods in industries and work on CNC machine.**
CO-2	**To learn working in Fitting shop and Electrical and Electronics shops,**
CO-3	**To practice working on Carpentry and Plastic moulding/glass cutting jobs.**
CO-4	**To gain hands on practice experience on Metal casting and Welding jobs.**

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools

4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., "Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
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CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., "Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1410ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.
3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutateor action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic.

Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3

Purpose	To familiarize the students with the Electrical Technology Practicals

Course Outcomes	
CO1	Understand basic concepts of Network theorems
CO 2	Deals with steady state frequency response of RLC circuit parameters solution techniques
CO 3	Deals with introductory Single Phase Transformer practicals
CO 4	Explains the constructional features and practicals of various types of Electrical Machines

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.

Bachelor of Technology inInformation Technology(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-133A	Calculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.

Bachelor of Technology in Information Technology(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-134A	Probablity& Statistics	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-115 A	Semiconductor Physics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of solid state physics and its applications to the students.
	Course Outcomes
CO1	To make the students aware of basic terminology of crystal structure.
CO 2	Introduce the elementary quantum mechanics, which will be useful in understanding the concepts of solid state physics.
CO 3	Discussion of classical free electron theory, quantum theory and Band theory of solids.
CO 4	Basics and applications of semiconductors.

Unit - I

Crystal Structure: Crystalline and Amorphous solids, Crystal Structure: lattice translation vector, symmetry operations, space lattice, basis; Unit cell and Primitive cell, Fundamental types of lattices: two-dimensional and three dimensional Bravais lattices; Characteristics of Unit cells: Simple Cubic (SC), Body Centred Cubic (BCC), Face Centred Cubic (FCC), Hexagonal Close Packed (HCP) structure; Simple crystal structures: Sodium Chloride, Cesium Chloride, Diamond, Cubic Zinc Sulfide; Miller Indices, Bonding in Solids, Point defects in crystals: Schottky and Frenkel defects.

Unit – II

Quantum Theory: Need and origin of Quantum concept, Wave-particle duality, Phase velocity and group velocity, Uncertainty Principle and Applications; Schrodinger's wave equation: time-dependent and time –independent; Physical Significance of wave function ψ.

Unit – III

Free Electron Theory: Classical free electron theory: electrical conductivity in metals, thermal conductivity in metals, Wiedemann-Franz law, success and drawbacks of free electron theory; Quantum free electron theory: wave function, eigen values; Fermi-Dirac distribution function, Density of states, Fermi energy and its importance, Thermionic Emission (qualitative).

Band theory of Solids: Bloch theorem, Kronig-Penney Model (qualitative), E versus k diagram, Brillouin Zones, Concept of effective mass of electron, Energy levels and energy bands, Distinction between metals, insulators and semiconductors, Hall effect and its Applications.

Unit –IV

Semiconductors: Conduction in Semiconductors, Intrinsic Semiconductors: Conductivity of charge carriers, Carrier concentration in intrinsic semiconductors; Extrinsic Semiconductors: n-type semiconductors, p-type semiconductors, charge carrier concentration in extrinsic semiconductors.

Semiconductor Devices: The p-n junction, Current-voltage characteristics of p-n junction; The Transistor: Bipolar Junction Transistor (BJT), Field Effect Transistor (FET), Metal-Semiconductor Junction (Ohmic and Schottky); Semiconductor Laser.

Suggested Books:

1. Applied Physics for Engineers, Wiley India Pvt. Ltd.
2. Introduction to Solid State Physics, John Wiley & Sons. .
3. Concepts of Modern Physics (5th edition), Tata McGraw-Hill Publishing Company Limited.
4. Solid State Physics, New Age International (P) Limited.
5. A Textbook of Quantum Mechanics, McGraw Hill Education (India) Private Limited.
   Introduction to Nanotechnology, John Wiley & Sons.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-117LA	Semiconductor Physics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the sophisticated instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Semiconductor Physics.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the V-I characteristics of a p-n diode.
2. To find the flashing and quenching potential of Argon and to find the capacitance of unknown capacitor.
3. To find the value of Planck's constant by using photoelectric cell.
4. To find the temperature coefficient of resistance by using Pt resistance thermometer by post office box.
5. To find the ionization potential of Argon/Mercury using a thyratron tube.
6. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
7. To study the characteristics of (Cu-Fe, Cu-Constantan) thermocouple.
8. To find the value of Hall Coefficient of semiconductor.
9. To find the value of e/m for electrons by Helical method.
10. To find the band gap of intrinsic semiconductor using four probe method.
11. To calculate the hysteresis loss by tracing a B-H curve.
12. To find the frequency of ultrasonic waves by piezoelectric methods.
13. To verify Richerdson thermionic equation.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-133 A	Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						
CO 4	To familiarize the student with vector space as an essential tool in most branches of engineering.						

UNIT-I (12 hrs)

Calculus:

Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II (8 hrs)

Matrices

Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

UNIT-III (10 hrs)

Vector spaces

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank nullity theorem, composition of linear maps.

UNIT-IV (10 hrs)

Vector spaces

Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization; Inner product spaces.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.

3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

9. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

10. S. Lipschutz and M. Lipson, Schaum's outline of Linear Algebra,, McGraw Hill Education; 3 edition (1 July 17).

Note: The paper setter will set the paper as per the question paper templates provided.

BS-134 A	Probability & Statistics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
4	1	-	4.5	75	25	100	3 h
Purpose	To familiarize the prospective students with techniques of probability and statistics.						
Course Outcomes							
CO1	Probability theory provides models of probability distributions(theoretical models of the observable reality involving chance effects) to be tested by statistical methods which has various engineering applications, for instance, in testing materials, control of production processes, robotics, and automatization in general, production planning and so on.						
CO 2	To develop the essential tool of statistics in a comprehensive manner.						
CO 3	To familiarize the student with the problem of discussing universe of which they in which complete enumeration is impractical, tests of significance plays a vital role in their hypothesis testing.						

UNIT-I (10 Hrs)

Basic Probability: Introduction, additive law of probability, Conditional Probability, Independent Events, Bayes' Theorem.

Random Variables: Discrete random variables, probability distribution, Probability mass function and distribution function, Expectation, Moments, Variance and standard deviation of discrete random variables.

UNIT-II (10 Hrs)

Continuous Probability distribution:

Continuous random variables, probability distribution, Probability density function and distribution function, Expectation, Moments, Variance and standard deviation of Continuous random variables.

Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions.

UNIT-III (10 hrs)

Basic Statistics:

Measures of Central tendency: Mean, median, quartiles, mode, Geometric mean, Harmonic mean, Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, Skewness and Kurtosis, Correlation, Coefficient of correlation, methods of calculations, Lines of regression, Rank correlation.

UNIT-IV (10 hrs)

Applied Statistics:

Curve fitting by the method of least squares: Introduction, Fitting of a straight line, fitting of second degree curve, fitting of a polynomial of degree m, fitting of a geometric or power curve of the form $y = ax^b$, fitting of an exponential curve of the form $y = ab^x$.

Test of significance: Basic terminology, Large sample test for single proportion, difference of proportions, single mean, difference of means, Small samples test for single mean, difference of means, Chi-square test for goodness of fit.

Suggested Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed.,Wiley, 1968.
5. N.P. Bali and and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
8.Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-109A							
Coursetitle	EngineeringGraphics&Design							
Scheme and Credits	L	T	P	Credits	Major Test	Minor Test	Total	Time
	1	2	0	3	75	25	100	3h

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing , graphics and Projections.	
CO-1	To learn about construction of various types of curves and scales.
CO-2	To learn about orthographic projections of points, lines and planes.
CO-3	To Learn about the sectional views and development of Right regular solids
CO-4	To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular soilds like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. CorrespondingsetofCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-113LA							
Coursetitle	EngineeringGraphics&Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3h
Pre-requisites(if any)	-							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1:OverviewofComputerGraphics:
Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];
Module2:Customization &CAD Drawing:
Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;
Module3:Annotations,layering&other functions:
Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multi-view,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;
Module4:Demonstration ofasimpleteamdesign project:
Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).
Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., "Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1430ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A
2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.
3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.
4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.

3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutateor action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3

Purpose	To familiarize the students with the Electrical Technology Practicals

Course Outcomes	
CO1	Understand basic concepts of Network theorems
CO 2	Deals with steady state frequency response of RLC circuit parameters solution techniques
CO 3	Deals with introductory Single Phase Transformer practicals
CO 4	Explains the constructional features and practicals of various types of Electrical Machines

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.

Bachelor of Technology inElectronics & Communication Engg.(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-133A	Calculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.

Bachelor of Technology in IElectronics & Communication Engg.(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-134A	Probablity& Statistics	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-115 A	Semiconductor Physics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of solid state physics and its applications to the students.
	Course Outcomes
CO1	To make the students aware of basic terminology of crystal structure.
CO 2	Introduce the elementary quantum mechanics, which will be useful in understanding the concepts of solid state physics.
CO 3	Discussion of classical free electron theory, quantum theory and Band theory of solids.
CO 4	Basics and applications of semiconductors.

Unit - I

Crystal Structure: Crystalline and Amorphous solids, Crystal Structure: lattice translation vector, symmetry operations, space lattice, basis; Unit cell and Primitive cell, Fundamental types of lattices: two-dimensional and three dimensional Bravais lattices; Characteristics of Unit cells: Simple Cubic (SC), Body Centred Cubic (BCC), Face Centred Cubic (FCC), Hexagonal Close Packed (HCP) structure; Simple crystal structures: Sodium Chloride, Cesium Chloride, Diamond, Cubic Zinc Sulfide; Miller Indices, Bonding in Solids, Point defects in crystals: Schottky and Frenkel defects.

Unit – II

Quantum Theory: Need and origin of Quantum concept, Wave-particle duality, Phase velocity and group velocity, Uncertainty Principle and Applications; Schrodinger's wave equation: time-dependent and time –independent; Physical Significance of wave function ψ.

Unit – III

Free Electron Theory: Classical free electron theory: electrical conductivity in metals, thermal conductivity in metals, Wiedemann-Franz law, success and drawbacks of free electron theory; Quantum free electron theory: wave function, eigen values; Fermi-Dirac distribution function, Density of states, Fermi energy and its importance, Thermionic Emission (qualitative).

Band theory of Solids: Bloch theorem, Kronig-Penney Model (qualitative), E versus k diagram, Brillouin Zones, Concept of effective mass of electron, Energy levels and energy bands, Distinction between metals, insulators and semiconductors, Hall effect and its Applications.

Unit –IV

Semiconductors: Conduction in Semiconductors, Intrinsic Semiconductors: Conductivity of charge carriers, Carrier concentration in intrinsic semiconductors; Extrinsic Semiconductors: n-type semiconductors, p-type semiconductors, charge carrier concentration in extrinsic semiconductors.

Semiconductor Devices: The p-n junction, Current-voltage characteristics of p-n junction; The Transistor: Bipolar Junction Transistor (BJT), Field Effect Transistor (FET), Metal-Semiconductor Junction (Ohmic and Schottky); Semiconductor Laser.

Suggested Books:

1. Applied Physics for Engineers, Wiley India Pvt. Ltd.
2. Introduction to Solid State Physics, John Wiley & Sons. .
3. Concepts of Modern Physics (5th edition), Tata McGraw-Hill Publishing Company Limited.
4. Solid State Physics, New Age International (P) Limited.
5. A Textbook of Quantum Mechanics, McGraw Hill Education (India) Private Limited.
   Introduction to Nanotechnology, John Wiley & Sons.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-117LA	Semiconductor Physics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the sophisticated instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Semiconductor Physics.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the V-I characteristics of a p-n diode.
2. To find the flashing and quenching potential of Argon and to find the capacitance of unknown capacitor.
3. To find the value of Planck's constant by using photoelectric cell.
4. To find the temperature coefficient of resistance by using Pt resistance thermometer by post office box.
5. To find the ionization potential of Argon/Mercury using a thyratron tube.
6. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
7. To study the characteristics of (Cu-Fe, Cu-Constantan) thermocouple.
8. To find the value of Hall Coefficient of semiconductor.
9. To find the value of e/m for electrons by Helical method.
10. To find the band gap of intrinsic semiconductor using four probe method.
11. To calculate the hysteresis loss by tracing a B-H curve.
12. To find the frequency of ultrasonic waves by piezoelectric methods.
13. To verify Richerdson thermionic equation.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-133 A	Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						
CO 4	To familiarize the student with vector space as an essential tool in most branches of engineering.						

UNIT-I (12 hrs)

Calculus:

Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II (8 hrs)

Matrices

Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

UNIT-III (10 hrs)

Vector spaces

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank nullity theorem, composition of linear maps.

UNIT-IV (10 hrs)

Vector spaces

Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization; Inner product spaces.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.

3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

9. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

10. S. Lipschutz and M. Lipson, Schaum's outline of Linear Algebra,, McGraw Hill Education; 3 edition (1 July 17).

Note: The paper setter will set the paper as per the question paper templates provided.

BS-134 A	Probability & Statistics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
4	1	-	4.5	75	25	100	3 h
Purpose	To familiarize the prospective students with techniques of probability and statistics.						
Course Outcomes							
CO1	Probability theory provides models of probability distributions(theoretical models of the observable reality involving chance effects) to be tested by statistical methods which has various engineering applications, for instance, in testing materials, control of production processes, robotics, and automatization in general, production planning and so on.						
CO 2	To develop the essential tool of statistics in a comprehensive manner.						
CO 3	To familiarize the student with the problem of discussing universe of which they in which complete enumeration is impractical, tests of significance plays a vital role in their hypothesis testing.						

UNIT-I (10 Hrs)

Basic Probability: Introduction, additive law of probability, Conditional Probability, Independent Events, Bayes' Theorem.

Random Variables: Discrete random variables, probability distribution, Probability mass function and distribution function, Expectation, Moments, Variance and standard deviation of discrete random variables.

UNIT-II (10 Hrs)

Continuous Probability distribution:

Continuous random variables, probability distribution, Probability density function and distribution function, Expectation, Moments, Variance and standard deviation of Continuous random variables.

Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions.

UNIT-III (10 hrs)

Basic Statistics:

Measures of Central tendency: Mean, median, quartiles, mode, Geometric mean, Harmonic mean, Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, Skewness and Kurtosis, Correlation, Coefficient of correlation, methods of calculations, Lines of regression, Rank correlation.

UNIT-IV (10 hrs)

Applied Statistics:

Curve fitting by the method of least squares: Introduction, Fitting of a straight line, fitting of second degree curve, fitting of a polynomial of degree m, fitting of a geometric or power curve of the form $y = ax^b$, fitting of an exponential curve of the form $y = ab^x$.

Test of significance: Basic terminology, Large sample test for single proportion, difference of proportions, single mean, difference of means, Small samples test for single mean, difference of means, Chi-square test for goodness of fit.

Suggested Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed.,Wiley, 1968.
5. N.P. Bali and and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
8.Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-109A							
Coursetitle	EngineeringGraphics&Design							
Scheme and Credits	L	T	P	Credits	Major Test	Minor Test	Total	Time
	1	2	0	3	75	25	100	3h

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing , graphics and Projections.	
CO-1	To learn about construction of various types of curves and scales.
CO-2	To learn about orthographic projections of points, lines and planes.
CO-3	To Learn about the sectional views and development of Right regular solids
CO-4	To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular soilds like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. CorrespondingsetofCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-113LA							
Coursetitle	EngineeringGraphics&Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3h
Pre-requisites(if any)	-							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1:OverviewofComputerGraphics:
Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];
Module2:Customization &CAD Drawing:
Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;
Module3:Annotations,layering&other functions:
Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multi-view,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;
Module4:Demonstration ofasimpleteamdesign project:
Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).
Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., "Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1450ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A
2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.
3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.
4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.

3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutateor action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3

Purpose	To familiarize the students with the Electrical Technology Practicals

Course Outcomes	
CO1	Understand basic concepts of Network theorems
CO 2	Deals with steady state frequency response of RLC circuit parameters solution techniques
CO 3	Deals with introductory Single Phase Transformer practicals
CO 4	Explains the constructional features and practicals of various types of Electrical Machines

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.

Bachelor of Technology inElectrical Engineering(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-133A	Calculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.

Bachelor of Technology inElectrical Engineering(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-134A	Probablity& Statistics	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-115 A	Semiconductor Physics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of solid state physics and its applications to the students.
	Course Outcomes
CO1	To make the students aware of basic terminology of crystal structure.
CO 2	Introduce the elementary quantum mechanics, which will be useful in understanding the concepts of solid state physics.
CO 3	Discussion of classical free electron theory, quantum theory and Band theory of solids.
CO 4	Basics and applications of semiconductors.

Unit - I

Crystal Structure: Crystalline and Amorphous solids, Crystal Structure: lattice translation vector, symmetry operations, space lattice, basis; Unit cell and Primitive cell, Fundamental types of lattices: two-dimensional and three dimensional Bravais lattices; Characteristics of Unit cells: Simple Cubic (SC), Body Centred Cubic (BCC), Face Centred Cubic (FCC), Hexagonal Close Packed (HCP) structure; Simple crystal structures: Sodium Chloride, Cesium Chloride, Diamond, Cubic Zinc Sulfide; Miller Indices, Bonding in Solids, Point defects in crystals: Schottky and Frenkel defects.

Unit – II

Quantum Theory: Need and origin of Quantum concept, Wave-particle duality, Phase velocity and group velocity, Uncertainty Principle and Applications; Schrodinger's wave equation: time-dependent and time –independent; Physical Significance of wave function ψ.

Unit – III

Free Electron Theory: Classical free electron theory: electrical conductivity in metals, thermal conductivity in metals, Wiedemann-Franz law, success and drawbacks of free electron theory; Quantum free electron theory: wave function, eigen values; Fermi-Dirac distribution function, Density of states, Fermi energy and its importance, Thermionic Emission (qualitative).

Band theory of Solids: Bloch theorem, Kronig-Penney Model (qualitative), E versus k diagram, Brillouin Zones, Concept of effective mass of electron, Energy levels and energy bands, Distinction between metals, insulators and semiconductors, Hall effect and its Applications.

Unit –IV

Semiconductors: Conduction in Semiconductors, Intrinsic Semiconductors: Conductivity of charge carriers, Carrier concentration in intrinsic semiconductors; Extrinsic Semiconductors: n-type semiconductors, p-type semiconductors, charge carrier concentration in extrinsic semiconductors.

Semiconductor Devices: The p-n junction, Current-voltage characteristics of p-n junction; The Transistor: Bipolar Junction Transistor (BJT), Field Effect Transistor (FET), Metal-Semiconductor Junction (Ohmic and Schottky); Semiconductor Laser.

Suggested Books:

1. Applied Physics for Engineers, Wiley India Pvt. Ltd.
2. Introduction to Solid State Physics, John Wiley & Sons. .
3. Concepts of Modern Physics (5th edition), Tata McGraw-Hill Publishing Company Limited.
4. Solid State Physics, New Age International (P) Limited.
5. A Textbook of Quantum Mechanics, McGraw Hill Education (India) Private Limited.
   Introduction to Nanotechnology, John Wiley & Sons.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-117LA	Semiconductor Physics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the sophisticated instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Semiconductor Physics.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the V-I characteristics of a p-n diode.
2. To find the flashing and quenching potential of Argon and to find the capacitance of unknown capacitor.
3. To find the value of Planck's constant by using photoelectric cell.
4. To find the temperature coefficient of resistance by using Pt resistance thermometer by post office box.
5. To find the ionization potential of Argon/Mercury using a thyratron tube.
6. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
7. To study the characteristics of (Cu-Fe, Cu-Constantan) thermocouple.
8. To find the value of Hall Coefficient of semiconductor.
9. To find the value of e/m for electrons by Helical method.
10. To find the band gap of intrinsic semiconductor using four probe method.
11. To calculate the hysteresis loss by tracing a B-H curve.
12. To find the frequency of ultrasonic waves by piezoelectric methods.
13. To verify Richerdson thermionic equation.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-133 A	Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						
CO 4	To familiarize the student with vector space as an essential tool in most branches of engineering.						

UNIT-I (12 hrs)

Calculus:

Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II (8 hrs)

Matrices

Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

UNIT-III (10 hrs)

Vector spaces

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank nullity theorem, composition of linear maps.

UNIT-IV (10 hrs)

Vector spaces

Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization; Inner product spaces.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.

3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

9. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

10. S. Lipschutz and M. Lipson, Schaum's outline of Linear Algebra,, McGraw Hill Education; 3 edition (1 July 17).

Note: The paper setter will set the paper as per the question paper templates provided.

BS-134 A	Probability & Statistics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
4	1	-	4.5	75	25	100	3 h
Purpose	To familiarize the prospective students with techniques of probability and statistics.						
Course Outcomes							
CO1	Probability theory provides models of probability distributions(theoretical models of the observable reality involving chance effects) to be tested by statistical methods which has various engineering applications, for instance, in testing materials, control of production processes, robotics, and automatization in general, production planning and so on.						
CO 2	To develop the essential tool of statistics in a comprehensive manner.						
CO 3	To familiarize the student with the problem of discussing universe of which they in which complete enumeration is impractical, tests of significance plays a vital role in their hypothesis testing.						

UNIT-I (10 Hrs)

Basic Probability: Introduction, additive law of probability, Conditional Probability, Independent Events, Bayes' Theorem.

Random Variables: Discrete random variables, probability distribution, Probability mass function and distribution function, Expectation, Moments, Variance and standard deviation of discrete random variables.

UNIT-II (10 Hrs)

Continuous Probability distribution:

Continuous random variables, probability distribution, Probability density function and distribution function, Expectation, Moments, Variance and standard deviation of Continuous random variables.

Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions.

UNIT-III (10 hrs)

Basic Statistics:

Measures of Central tendency: Mean, median, quartiles, mode, Geometric mean, Harmonic mean, Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, Skewness and Kurtosis, Correlation, Coefficient of correlation, methods of calculations, Lines of regression, Rank correlation.

UNIT-IV (10 hrs)

Applied Statistics:

Curve fitting by the method of least squares: Introduction, Fitting of a straight line, fitting of second degree curve, fitting of a polynomial of degree m, fitting of a geometric or power curve of the form $y = ax^b$, fitting of an exponential curve of the form $y = ab^x$.

Test of significance: Basic terminology, Large sample test for single proportion, difference of proportions, single mean, difference of means, Small samples test for single mean, difference of means, Chi-square test for goodness of fit.

Suggested Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed.,Wiley, 1968.
5. N.P. Bali and and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
8.Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-109A							
Coursetitle	EngineeringGraphics&Design							
Scheme and Credits	L	T	P	Credits	Major Test	Minor Test	Total	Time
	1	2	0	3	75	25	100	3h

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing , graphics and Projections.	
CO-1	To learn about construction of various types of curves and scales.
CO-2	To learn about orthographic projections of points, lines and planes.
CO-3	To Learn about the sectional views and development of Right regular solids
CO-4	To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular soilds like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. CorrespondingsetofCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-113LA							
Coursetitle	EngineeringGraphics&Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3h
Pre-requisites(if any)	-							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1:OverviewofComputerGraphics:
Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];
Module2:Customization &CAD Drawing:
Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;
Module3:Annotations,layering&other functions:
Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multi-view,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;
Module4:Demonstration ofasimpleteamdesign project:
Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).
Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., "Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1470ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.

2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.

3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutateor action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3

Purpose	To familiarize the students with the Electrical Technology Practicals

Course Outcomes	
CO1	Understand basic concepts of Network theorems
CO 2	Deals with steady state frequency response of RLC circuit parameters solution techniques
CO 3	Deals with introductory Single Phase Transformer practicals
CO 4	Explains the constructional features and practicals of various types of Electrical Machines

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.

Bachelor of Technology inElectrical & Electronics Engineering(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-133A	Calculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.

Bachelor of Technology inElectrical & Electronics Engineering(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-134A	Probablity& Statistics	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-115 A	Semiconductor Physics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of solid state physics and its applications to the students.
	Course Outcomes
CO1	To make the students aware of basic terminology of crystal structure.
CO 2	Introduce the elementary quantum mechanics, which will be useful in understanding the concepts of solid state physics.
CO 3	Discussion of classical free electron theory, quantum theory and Band theory of solids.
CO 4	Basics and applications of semiconductors.

Unit - I

Crystal Structure: Crystalline and Amorphous solids, Crystal Structure: lattice translation vector, symmetry operations, space lattice, basis; Unit cell and Primitive cell, Fundamental types of lattices: two-dimensional and three dimensional Bravais lattices; Characteristics of Unit cells: Simple Cubic (SC), Body Centred Cubic (BCC), Face Centred Cubic (FCC), Hexagonal Close Packed (HCP) structure; Simple crystal structures: Sodium Chloride, Cesium Chloride, Diamond, Cubic Zinc Sulfide; Miller Indices, Bonding in Solids, Point defects in crystals: Schottky and Frenkel defects.

Unit – II

Quantum Theory: Need and origin of Quantum concept, Wave-particle duality, Phase velocity and group velocity, Uncertainty Principle and Applications; Schrodinger's wave equation: time-dependent and time –independent; Physical Significance of wave function ψ.

Unit – III

Free Electron Theory: Classical free electron theory: electrical conductivity in metals, thermal conductivity in metals, Wiedemann-Franz law, success and drawbacks of free electron theory; Quantum free electron theory: wave function, eigen values; Fermi-Dirac distribution function, Density of states, Fermi energy and its importance, Thermionic Emission (qualitative).

Band theory of Solids: Bloch theorem, Kronig-Penney Model (qualitative), E versus k diagram, Brillouin Zones, Concept of effective mass of electron, Energy levels and energy bands, Distinction between metals, insulators and semiconductors, Hall effect and its Applications.

Unit –IV

Semiconductors: Conduction in Semiconductors, Intrinsic Semiconductors: Conductivity of charge carriers, Carrier concentration in intrinsic semiconductors; Extrinsic Semiconductors: n-type semiconductors, p-type semiconductors, charge carrier concentration in extrinsic semiconductors.

Semiconductor Devices: The p-n junction, Current-voltage characteristics of p-n junction; The Transistor: Bipolar Junction Transistor (BJT), Field Effect Transistor (FET), Metal-Semiconductor Junction (Ohmic and Schottky); Semiconductor Laser.

Suggested Books:

1. Applied Physics for Engineers, Wiley India Pvt. Ltd.
2. Introduction to Solid State Physics, John Wiley & Sons. .
3. Concepts of Modern Physics (5th edition), Tata McGraw-Hill Publishing Company Limited.
4. Solid State Physics, New Age International (P) Limited.
5. A Textbook of Quantum Mechanics, McGraw Hill Education (India) Private Limited.
   Introduction to Nanotechnology, John Wiley & Sons.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-117LA	Semiconductor Physics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the sophisticated instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Semiconductor Physics.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the V-I characteristics of a p-n diode.
2. To find the flashing and quenching potential of Argon and to find the capacitance of unknown capacitor.
3. To find the value of Planck's constant by using photoelectric cell.
4. To find the temperature coefficient of resistance by using Pt resistance thermometer by post office box.
5. To find the ionization potential of Argon/Mercury using a thyratron tube.
6. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
7. To study the characteristics of (Cu-Fe, Cu-Constantan) thermocouple.
8. To find the value of Hall Coefficient of semiconductor.
9. To find the value of e/m for electrons by Helical method.
10. To find the band gap of intrinsic semiconductor using four probe method.
11. To calculate the hysteresis loss by tracing a B-H curve.
12. To find the frequency of ultrasonic waves by piezoelectric methods.
13. To verify Richerdson thermionic equation.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-133 A	Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						
CO 4	To familiarize the student with vector space as an essential tool in most branches of engineering.						

UNIT-I (12 hrs)

Calculus:

Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II (8 hrs)

Matrices

Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

UNIT-III (10 hrs)

Vector spaces

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank nullity theorem, composition of linear maps.

UNIT-IV (10 hrs)

Vector spaces

Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization; Inner product spaces.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.

3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

9. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

10. S. Lipschutz and M. Lipson, Schaum's outline of Linear Algebra,, McGraw Hill Education; 3 edition (1 July 17).

Note: The paper setter will set the paper as per the question paper templates provided.

BS-134 A	Probability & Statistics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
4	1	-	4.5	75	25	100	3 h
Purpose	To familiarize the prospective students with techniques of probability and statistics.						
Course Outcomes							
CO1	Probability theory provides models of probability distributions(theoretical models of the observable reality involving chance effects) to be tested by statistical methods which has various engineering applications, for instance, in testing materials, control of production processes, robotics, and automatization in general, production planning and so on.						
CO 2	To develop the essential tool of statistics in a comprehensive manner.						
CO 3	To familiarize the student with the problem of discussing universe of which they in which complete enumeration is impractical, tests of significance plays a vital role in their hypothesis testing.						

UNIT-I (10 Hrs)

Basic Probability: Introduction, additive law of probability, Conditional Probability, Independent Events, Bayes' Theorem.

Random Variables: Discrete random variables, probability distribution, Probability mass function and distribution function, Expectation, Moments, Variance and standard deviation of discrete random variables.

UNIT-II (10 Hrs)

Continuous Probability distribution:

Continuous random variables, probability distribution, Probability density function and distribution function, Expectation, Moments, Variance and standard deviation of Continuous random variables.

Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions.

UNIT-III (10 hrs)

Basic Statistics:

Measures of Central tendency: Mean, median, quartiles, mode, Geometric mean, Harmonic mean, Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, Skewness and Kurtosis, Correlation, Coefficient of correlation, methods of calculations, Lines of regression, Rank correlation.

UNIT-IV (10 hrs)

Applied Statistics:

Curve fitting by the method of least squares: Introduction, Fitting of a straight line, fitting of second degree curve, fitting of a polynomial of degree m, fitting of a geometric or power curve of the form $y = ax^b$, fitting of an exponential curve of the form $y = ab^x$.

Test of significance: Basic terminology, Large sample test for single proportion, difference of proportions, single mean, difference of means, Small samples test for single mean, difference of means, Chi-square test for goodness of fit.

Suggested Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed.,Wiley, 1968.
5. N.P. Bali and and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
8.Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-109A							
Coursetitle	EngineeringGraphics&Design							
Scheme and Credits	L	T	P	Credits	Major Test	Minor Test	Total	Time
	1	2	0	3	75	25	100	3h

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing , graphics and Projections.	
CO-1	To learn about construction of various types of curves and scales.
CO-2	To learn about orthographic projections of points, lines and planes.
CO-3	To Learn about the sectional views and development of Right regular solids
CO-4	To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular soilds like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. CorrespondingsetofCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-113LA							
Coursetitle	EngineeringGraphics&Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3h
Pre-requisites(if any)	-							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1:OverviewofComputerGraphics:
Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];
Module2:Customization &CAD Drawing:
Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;
Module3:Annotations,layering&other functions:
Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multi-view,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;
Module4:Demonstration ofasimpleteamdesign project:
Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).
Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., "Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1490ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A
2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.
3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.
4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.

3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutateor action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3

Purpose	To familiarize the students with the Electrical Technology Practicals

Course Outcomes	
CO1	Understand basic concepts of Network theorems
CO 2	Deals with steady state frequency response of RLC circuit parameters solution techniques
CO 3	Deals with introductory Single Phase Transformer practicals
CO 4	Explains the constructional features and practicals of various types of Electrical Machines

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.

Bachelor of Technology in Electronics Engineering(Credit Based)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Studies/Examination

Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-133A	Calculus&LinearAlgebra	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.

Bachelor of Technology inElectronics Engineering(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam(Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-134A	Probablity& Statistics	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-115 A	Semiconductor Physics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the fundamentals of solid state physics and its applications to the students.
	Course Outcomes
CO1	To make the students aware of basic terminology of crystal structure.
CO 2	Introduce the elementary quantum mechanics, which will be useful in understanding the concepts of solid state physics.
CO 3	Discussion of classical free electron theory, quantum theory and Band theory of solids.
CO 4	Basics and applications of semiconductors.

Unit - I

Crystal Structure: Crystalline and Amorphous solids, Crystal Structure: lattice translation vector, symmetry operations, space lattice, basis; Unit cell and Primitive cell, Fundamental types of lattices: two-dimensional and three dimensional Bravais lattices; Characteristics of Unit cells: Simple Cubic (SC), Body Centred Cubic (BCC), Face Centred Cubic (FCC), Hexagonal Close Packed (HCP) structure; Simple crystal structures: Sodium Chloride, Cesium Chloride, Diamond, Cubic Zinc Sulfide; Miller Indices, Bonding in Solids, Point defects in crystals: Schottky and Frenkel defects.

Unit – II

Quantum Theory: Need and origin of Quantum concept, Wave-particle duality, Phase velocity and group velocity, Uncertainty Principle and Applications; Schrodinger's wave equation: time-dependent and time –independent; Physical Significance of wave function ψ.

Unit – III

Free Electron Theory: Classical free electron theory: electrical conductivity in metals, thermal conductivity in metals, Wiedemann-Franz law, success and drawbacks of free electron theory; Quantum free electron theory: wave function, eigen values; Fermi-Dirac distribution function, Density of states, Fermi energy and its importance, Thermionic Emission (qualitative).

Band theory of Solids: Bloch theorem, Kronig-Penney Model (qualitative), E versus k diagram, Brillouin Zones, Concept of effective mass of electron, Energy levels and energy bands, Distinction between metals, insulators and semiconductors, Hall effect and its Applications.

Unit –IV

Semiconductors: Conduction in Semiconductors, Intrinsic Semiconductors: Conductivity of charge carriers, Carrier concentration in intrinsic semiconductors; Extrinsic Semiconductors: n-type semiconductors, p-type semiconductors, charge carrier concentration in extrinsic semiconductors.

Semiconductor Devices: The p-n junction, Current-voltage characteristics of p-n junction; The Transistor: Bipolar Junction Transistor (BJT), Field Effect Transistor (FET), Metal-Semiconductor Junction (Ohmic and Schottky); Semiconductor Laser.

Suggested Books:

1. Applied Physics for Engineers, Wiley India Pvt. Ltd.
2. Introduction to Solid State Physics, John Wiley & Sons. .
3. Concepts of Modern Physics (5th edition), Tata McGraw-Hill Publishing Company Limited.
4. Solid State Physics, New Age International (P) Limited.
5. A Textbook of Quantum Mechanics, McGraw Hill Education (India) Private Limited.
   Introduction to Nanotechnology, John Wiley & Sons.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-117LA	Semiconductor Physics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	To give the practical knowledge of handling the sophisticated instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Semiconductor Physics.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the V-I characteristics of a p-n diode.
2. To find the flashing and quenching potential of Argon and to find the capacitance of unknown capacitor.
3. To find the value of Planck's constant by using photoelectric cell.
4. To find the temperature coefficient of resistance by using Pt resistance thermometer by post office box.
5. To find the ionization potential of Argon/Mercury using a thyratron tube.
6. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
7. To study the characteristics of (Cu-Fe, Cu-Constantan) thermocouple.
8. To find the value of Hall Coefficient of semiconductor.
9. To find the value of e/m for electrons by Helical method.
10. To find the band gap of intrinsic semiconductor using four probe method.
11. To calculate the hysteresis loss by tracing a B-H curve.
12. To find the frequency of ultrasonic waves by piezoelectric methods.
13. To verify Richerdson thermionic equation.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-133 A	Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						
CO 4	To familiarize the student with vector space as an essential tool in most branches of engineering.						

UNIT-I (12 hrs)

Calculus:

Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II (8 hrs)

Matrices

Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

UNIT-III (10 hrs)

Vector spaces

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank nullity theorem, composition of linear maps.

UNIT-IV (10 hrs)

Vector spaces

Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization; Inner product spaces.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.

3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

9. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

10. S. Lipschutz and M. Lipson, Schaum's outline of Linear Algebra,, McGraw Hill Education; 3 edition (1 July 17).

Note: The paper setter will set the paper as per the question paper templates provided.

BS-134 A	Probability & Statistics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
4	1	-	4.5	75	25	100	3 h
Purpose	To familiarize the prospective students with techniques of probability and statistics.						
Course Outcomes							
CO1	Probability theory provides models of probability distributions(theoretical models of the observable reality involving chance effects) to be tested by statistical methods which has various engineering applications, for instance, in testing materials, control of production processes, robotics, and automatization in general, production planning and so on.						
CO 2	To develop the essential tool of statistics in a comprehensive manner.						
CO 3	To familiarize the student with the problem of discussing universe of which they in which complete enumeration is impractical, tests of significance plays a vital role in their hypothesis testing.						

UNIT-I (10 Hrs)

Basic Probability: Introduction, additive law of probability, Conditional Probability, Independent Events, Bayes' Theorem.

Random Variables: Discrete random variables, probability distribution, Probability mass function and distribution function, Expectation, Moments, Variance and standard deviation of discrete random variables.

UNIT-II (10 Hrs)

Continuous Probability distribution:

Continuous random variables, probability distribution, Probability density function and distribution function, Expectation, Moments, Variance and standard deviation of Continuous random variables.

Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions.

UNIT-III (10 hrs)

Basic Statistics:

Measures of Central tendency: Mean, median, quartiles, mode, Geometric mean, Harmonic mean, Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, Skewness and Kurtosis, Correlation, Coefficient of correlation, methods of calculations, Lines of regression, Rank correlation.

UNIT-IV (10 hrs)

Applied Statistics:

Curve fitting by the method of least squares: Introduction, Fitting of a straight line, fitting of second degree curve, fitting of a polynomial of degree m, fitting of a geometric or power curve of the form $y = ax^b$, fitting of an exponential curve of the form $y = ab^x$.

Test of significance: Basic terminology, Large sample test for single proportion, difference of proportions, single mean, difference of means, Small samples test for single mean, difference of means, Chi-square test for goodness of fit.

Suggested Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed.,Wiley, 1968.
5. N.P. Bali and and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
8.Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-109A							
Coursetitle	EngineeringGraphics&Design							
Scheme and Credits	L	T	P	Credits	Major Test	Minor Test	Total	Time
	1	2	0	3	75	25	100	3h

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing , graphics and Projections.	
CO-1	To learn about construction of various types of curves and scales.
CO-2	To learn about orthographic projections of points, lines and planes.
CO-3	To Learn about the sectional views and development of Right regular solids
CO-4	To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular soilds like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. CorrespondingsetofCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-113LA							
Coursetitle	EngineeringGraphics&Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3h
Pre-requisites(if any)	-							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1:OverviewofComputerGraphics:
Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];
Module2:Customization &CAD Drawing:
Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;
Module3:Annotations,layering&other functions:
Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multi-view,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;
Module4:Demonstration ofasimpleteamdesign project:
Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).
Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., "Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1510ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.

2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.

3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutateor action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3

Purpose	To familiarize the students with the Electrical Technology Practicals

Course Outcomes	
CO1	Understand basic concepts of Network theorems
CO 2	Deals with steady state frequency response of RLC circuit parameters solution techniques
CO 3	Deals with introductory Single Phase Transformer practicals
CO 4	Explains the constructional features and practicals of various types of Electrical Machines

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –III: Common with B.Tech in (a) Biotechnology (b) Food Technology
Bachelor of Technology in Biotechnology(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam (Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-111A	Applied Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-131A	Applied Mathematics-I	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-113LA	Applied Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –III: Common with B.Tech in (a) Biotechnology (b) Food Technology
Bachelor of Technology in Biotechnology(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration ofexam (Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-111A	Applied Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-132A	Applied Mathematics-II	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	Engineering Graphics & Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	Manufacturing Processes Workshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	Basic Electrical Engineering	4:1:0	5	5	75	25	0	100	3
6A	BS-113LA	Applied Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	Chemistry Lab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	Programming for Problem Solving Lab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	Basic Electrical Engineering Lab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	Engineering Graphics & Design Practice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-111A	Applied Physics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the basics of physics to the students for applications in Engineering field.
Course Outcomes	
CO 1	Introduce the fundamentals of interference and diffraction and their applications.
CO 2	To make the students aware of the importance of polarization and Laser in technology.
CO 3	Applications of optical fiber and ultrasonics in various fields.
CO 4	Introduce the nuclear radiations and its biological effects.

Unit - I

Interference: Principle of Superposition, Conditions for interference, Division of wave-front: Fresnel's Biprism and Applications, Division of amplitude: Wedge-shaped film, Newton's rings, Michelson Interferometer and Applications.

Diffraction: Types of diffraction, Fraunhofer diffraction at a single slit, Plane transmission diffraction grating: theory, secondary maxima and minima, width of principal maxima, absent spectra, overlapping of spectral lines, determination of wavelength; Dispersive power and resolving power of diffraction grating.

Unit – II

Polarization: Polarization of transverse waves, Plane of polarization, Polarization by reflection, Double refraction, Nicol Prism, Quarter and half wave plate, Specific Rotation, Laurent 's half shade polarimeter, Biquartzpolarimeter.

Laser: Introduction, Stimulated Absorption, Spontaneous and Stimulated Emission; Einstein's Coefficients and its derivation, Population Inversion, Direct and Indirect pumping, Pumping schemes, Main components of Laser, He-Ne Laser, Semiconductor Laser, Characteristics of Laser, Applications of Laser.

Unit – III

Optical Fiber: Introduction, Principle of propagation of light waves in optical fibers: total internal reflection, acceptance angle, numerical aperture, V- number; Modes of propagation, Types of optical fibers: single mode fiber, multimode fibers; Fiber optics communication system, Advantages of optical fiber communication, Applications of optical fibers.

Ultrasonics: Ultrasonic waves, Properties of ultrasonic waves, Production of ultrasonic waves: Magnetostriction and Piezoelectric methods, Detection of ultrasonic waves, Measurement of velocity of ultrasonic waves, Applications of ultrasonic waves.

Unit – IV

Nuclear radiations and its Biological Effects: Classification of nuclear radiations, Interaction of charged particle (light and heavy) and gamma radiations with matter (basic concepts), Dosimetric units, Relative Biological Effectiveness (RBE), Typical doses from commons sources in the environment, Biological Effects, Maximum Permissible Dose, (MPD), Shielding, Radiation safety in the nuclear radiation laboratory.

Biomaterials: Introduction, Classification of biomaterials, Applications.

Suggested Books:

1. Applied Physics for Engineers, Wiley India Pvt. Ltd.
2. Concepts of Modern Physics (5th edition), Tata McGraw-Hill Publishing Company Limited.
3. A Textbook of Optics, S. Chand & Company Ltd.
4. Techniques for Nuclear and Particle Physics Experiments: A How-to Approach, Springer-Verlag.
5. Introduction to Nuclear and Particle Physics, PHI Learning Private Limited.
6. Biomaterials: The intersection of Biology and Materials Science, Pearson, New Delhi.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-113LA	Applied Physics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	Give the knowledge of basic practicals of Physics in Engineering.						
Course Outcomes							
CO1	To make the students familiar with the experiments related with optics.						
CO2	To give the knowledge of handling of the experiments related with resistance using different methods.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To verify Newton's formula and hence to find the focal length of the given convex lens.
2. To find the frequency of A.C. mains by using Sonometer and horse shoe magnet.
3. To find the resistance of a galvanometer by post office box.
4. To find low resistance by Carrey-Foster bridge.
5. To find the value of high resistance by substitution method.
6. To compare the capacitances of two capacitors by De-Sauty's bridge and hence to find the dielectric constant of a medium.
7. To convert a galvanometer into an ammeter of desired range and verify the same.
8. To find the wavelength of monochromatic light by Newton's ring experiment.
9. To find the wavelength of sodium light by Michelson's interferometer.
10. To find the resolving power of telescope.
11. To find the wavelength of sodium light using Fresnel bi-prism.
12. To find the wavelength of various colours of white light with the help of plane transmission diffraction grating.
13. To find the specific rotation of sugar solution by using a Polarimeter.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-131A	APPLIED MATHEMATICS-I						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	The objective of this course is to familiarize the prospective Biotechnology Engineers with techniques in Limit, Continuity, Differential & Integral Calculus and Complex Numbers. It aims to equip the students with standard concepts and tools at a beginner to intermediate and then at advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. More precisely, the objectives are as under:						

Course Outcomes	
CO1	To introduce the idea of sets, relations, functions, trigonometric functions, inverse trigonometric functions, these concepts are prerequisite to learn the concepts of differentiation and integration.
CO 2	To introduce the Complex numbers which is fundamental to solve any kind of quadratic equations, Limit is precondition to understand the concept of rate of change and derivative.
CO 3	To develop the essential tool of Continuity and Differentiability needed in evaluating higher order derivatives of functions.
CO 4	To introduce the tools of Indefinite and Definite integrals of functions in a comprehensive manner that are used in various techniques dealing engineering problems.

UNIT-I (12 hrs)

Sets, Relations, Functions

Sets and its types: Operations on sets, complement of a set, Cartesian Product of sets, relations , functions, types of functions,

Trigonometric functions: Introduction, Angles, Trigonometric functions, Trigonometric functions of sum and difference of two angles, Trigonometric equations,

Inverse Trigonometric functions: Introduction, basic concepts and its properties.

UNIT-II (12 hrs)

Pre-Calculus

Complex Numbers: Introduction, Algebra of Complex Numbers, Modulus and the conjugate of a complex number, quadratic equations,

Limits and Derivatives: Introduction, Limits, Limits of Trigonometric Functions, Derivatives (single variable).

UNIT-III (12 hrs)

Differential Calculus

Continuity and Differentiability: Introduction, Continuity, Differentiability, Exponential and Logarithmic functions, Logarithmic differentiation, Derivatives of functions in parametric forms, second order derivatives,

Application of Derivatives (single variable): Increasing and decreasing functions, Maxima and Minima.

UNIT-IV (12 hrs)

Integral Calculus

Integrals: Introduction, Integration as an Inverse process of Differentiation, Method of Integration, Integration by Partial Fractions, Integration by Parts,

Definite Integrals: Fundamental theorem of Calculus, Evaluation of Definite Integrals by Substitution, properties of Definite Integrals.

Suggested Books:

1. G. B. Thomas, R. L. Finney: Calculus and Analytic Geometry, Pearson Education.
2. Mathematics Textbook for Class 11th& 12th by NCERT.
3. Howard Anton: Calculus, Wiley Publication.
4. E. Kreyszig: Advanced Engineering Mathematics, Wiley India.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-132A	APPLIED MATHEMATICS-II						
L	T	P	Credit	Major Test	Minor Test	Total	Time
4	1	-	4.5	75	25	100	3 h
Purpose	The objective of this course is to familiarize the prospective Biotechnology Engineers with techniques in essential tool of linear algebra, how to solve a differential equation, utility of higher order derivatives in engineering domain, and fitting of a curve to given data. It aims to equip the students with standard concepts and tools at a beginner to intermediate and then at advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. More precisely, the objectives are as under:						
Course Outcomes							
CO1	To introduce the essential tool of matrices and linear algebra in a comprehensive manner to solve the large system of linear equations.						
CO 2	To introduce the statistical process used for estimating the parameters of a given curve or function to fit to a given data set using various degrees and types of curve fitting techniques.						
CO 3	To introduce effective mathematical tools for the solutions of differential equations that model physical processes.						
CO 4	To extend some concept of differential calculus for more than one variables.						

UNIT-I (10 Hrs)

Linear Algebra:

Introduction to matrices, its types, algebraic operations, transpose, determinant, minors and adjoint of a matrix. Elementary transformations, Inverse of a square matrix: Cramer's rule, Rank of a matrix, elementary matrices, Gauss Jordon method to find inverse using elementary transformations.

System of Linear equations: General representation, Homogeneous and Non-homogeneous system of linear equations, Consistency of linear system of equations, Gauss Elimination method to solve the system of linear equations.

UNIT-II (12 Hrs)

Theory of Equations:

Introduction, formation of equations, Relation between roots and coefficients, Reciprocal Equations, Transformation of equations.

Curve Fitting:

Introduction, Fitting of a straight line, fitting of second degree curve, fitting of a polynomial of degree m, fitting of a geometric or power curve of the form $y = ax^b$, fitting of an exponential curve of the form $y = ab^x$.

UNIT-III (10 hrs)

Ordinary differential equations:

Introduction, order and degree of the differential equation, Formation of differential equation, Solution of the differential equation, Solution of the differential equation with variables separable and differential equations reducible to variable separable form, exact differential equation, and equations reducible to exact differential equations, linear and Bernoulli's equations, Euler's equations.

UNIT-IV (08 hrs)

Multivariable Calculus:

Partial derivatives, Total differential, Chain rule for differentiation, Partial derivatives of higher orders, Homogeneous functions, Euler's theorem on homogeneous functions, differentiation of an implicit function, Jacobian, Maxima and minima of a function of two variables, Lagrange's method of undetermined multipliers.

Suggested Books:

1. G. B. Thomas, R. L. Finney: Calculus and Analytic Geometry, Pearson Education.
2. H. Anton, Irl C Bivens, Stephen Davis: Calculus 10th Edition, John Wiley & Sons.
3. E. Kreyszig: Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. E. Kreyszig and S. Ahuja, Applied Mathematics-II, Wiley India Publication, Reprint 2015.
5. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press.
6. Mathematics Textbook for Class 11th& 12th by NCERT.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-109A							
Coursetitle	Engineering Graphics&Design							
Scheme and Credits	L	T	P	Credits	Major Test	Minor Test	Total	Time
	1	2	0	3	75	25	100	3h

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing, graphics and Projections.	
CO-1	To learn about construction of various types of curves and scales.
CO-2	To learn about orthographic projections of points, lines and planes.
CO-3	To Learn about the sectional views and development of Right regular solids
CO-4	To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular soilds like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. CorrespondingsetofCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-113LA							
Coursetitle	EngineeringGraphics&Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3h
Pre-requisites(if any)	-							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1:OverviewofComputerGraphics:

Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];

Module2:Customization &CAD Drawing:

Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;

Module3:Annotations,layering&other functions:

Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multi-view,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;

Module4:Demonstration ofasimpleteamdesign project:

Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).

Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., "Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1530ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.

2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.

3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF &Reluctance.Hysteresis& Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation.OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutator action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3

Purpose	To familiarize the students with the Electrical Technology Practicals

Course Outcomes	
CO1	Understand basic concepts of Network theorems
CO 2	Deals with steady state frequency response of RLC circuit parameters solution techniques
CO 3	Deals with introductory Single Phase Transformer practicals
CO 4	Explains the constructional features and practicals of various types of Electrical Machines

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

Cluster –III: Common with B.Tech in (a) Biotechnology (b) Food Technology
Bachelor of Technology in Food Technology(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester I (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of exam (Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-111A	Applied Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-131A	Applied Mathematics-I	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	EngineeringGraphics&Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	ManufacturingProcessesWorkshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	BasicElectricalEngineering	4:1:0	5	5	75	25	0	100	3
6A	BS-113LA	Applied Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	ChemistryLab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	ProgrammingforProblemSolvingLab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	BasicElectricalEngineeringLab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	EngineeringGraphics&DesignPractice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	LanguageLab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.
Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.

Cluster –III: Common with B.Tech in (a) Biotechnology (b) Food Technology
Bachelor of Technology in Food Technology(Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2018-2019)

S.No.	CourseNo./ Code	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration ofexam (Hours)
						Major Test	MinorTest	Practical	Total	
1A	BS-111A	Applied Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105A	ProgrammingforProblemSolving	3:0:0	3	3	75	25	0	100	3
2B	HM-101A	English	2:0:0	2	2	75	25	0	100	3
3	BS-132A	Applied Mathematics-II	3:1:0	4	4	75	25	0	100	3
4A	ES-109A	Engineering Graphics & Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111LA	Manufacturing Processes Workshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141A	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101A	Basic Electrical Engineering	4:1:0	5	5	75	25	0	100	3
6A	BS-113LA	Applied Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103LA	Chemistry Lab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107LA	Programming for Problem Solving Lab	0:0:2	2	1	--	20	30	50	3
7B	ES-103LA	Basic Electrical Engineering Lab	0:0:2	2	1	--	20	30	50	3
8A	ES-113LA	Engineering Graphics & Design Practice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.

BS-111A	Applied Physics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To introduce the basics of physics to the students for applications in Engineering field.
Course Outcomes	
CO 1	Introduce the fundamentals of interference and diffraction and their applications.
CO 2	To make the students aware of the importance of polarization and Laser in technology.
CO 3	Applications of optical fiber and ultrasonics in various fields.
CO 4	Introduce the nuclear radiations and its biological effects.

Unit - I

Interference: Principle of Superposition, Conditions for interference, Division of wave-front: Fresnel's Biprism and Applications, Division of amplitude: Wedge-shaped film, Newton's rings, Michelson Interferometer and Applications.

Diffraction: Types of diffraction, Fraunhofer diffraction at a single slit, Plane transmission diffraction grating: theory, secondary maxima and minima, width of principal maxima, absent spectra, overlapping of spectral lines, determination of wavelength; Dispersive power and resolving power of diffraction grating.

Unit – II

Polarization: Polarization of transverse waves, Plane of polarization, Polarization by reflection, Double refraction, Nicol Prism, Quarter and half wave plate, Specific Rotation, Laurent 's half shade polarimeter, Biquartzpolarimeter.

Laser: Introduction, Stimulated Absorption, Spontaneous and Stimulated Emission; Einstein's Coefficients and its derivation, Population Inversion, Direct and Indirect pumping, Pumping schemes, Main components of Laser, He-Ne Laser, Semiconductor Laser, Characteristics of Laser, Applications of Laser.

Unit – III

Optical Fiber: Introduction, Principle of propagation of light waves in optical fibers: total internal reflection, acceptance angle, numerical aperture, V- number; Modes of propagation, Types of optical fibers: single mode fiber, multimode fibers; Fiber optics communication system, Advantages of optical fiber communication, Applications of optical fibers.

Ultrasonics: Ultrasonic waves, Properties of ultrasonic waves, Production of ultrasonic waves: Magnetostriction and Piezoelectric methods, Detection of ultrasonic waves, Measurement of velocity of ultrasonic waves, Applications of ultrasonic waves.

Unit – IV

Nuclear radiations and its Biological Effects: Classification of nuclear radiations, Interaction of charged particle (light and heavy) and gamma radiations with matter (basic concepts), Dosimetric units, Relative Biological Effectiveness (RBE), Typical doses from commons sources in the environment, Biological Effects, Maximum Permissible Dose, (MPD), Shielding, Radiation safety in the nuclear radiation laboratory.

Biomaterials: Introduction, Classification of biomaterials, Applications.

Suggested Books:

1. Applied Physics for Engineers, Wiley India Pvt. Ltd.
2. Concepts of Modern Physics (5th edition), Tata McGraw-Hill Publishing Company Limited.
3. A Textbook of Optics, S. Chand & Company Ltd.
4. Techniques for Nuclear and Particle Physics Experiments: A How-to Approach, Springer-Verlag.
5. Introduction to Nuclear and Particle Physics, PHI Learning Private Limited.
6. Biomaterials: The intersection of Biology and Materials Science, Pearson, New Delhi.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-113LA	Applied Physics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose	Give the knowledge of basic practicals of Physics in Engineering.						
Course Outcomes							
CO1	To make the students familiar with the experiments related with optics.						
CO2	To give the knowledge of handling of the experiments related with resistance using different methods.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To verify Newton's formula and hence to find the focal length of the given convex lens.
2. To find the frequency of A.C. mains by using Sonometer and horse shoe magnet.
3. To find the resistance of a galvanometer by post office box.
4. To find low resistance by Carrey-Foster bridge.
5. To find the value of high resistance by substitution method.
6. To compare the capacitances of two capacitors by De-Sauty's bridge and hence to find the dielectric constant of a medium.
7. To convert a galvanometer into an ammeter of desired range and verify the same.
8. To find the wavelength of monochromatic light by Newton's ring experiment.
9. To find the wavelength of sodium light by Michelson's interferometer.
10. To find the resolving power of telescope.
11. To find the wavelength of sodium light using Fresnel bi-prism.
12. To find the wavelength of various colours of white light with the help of plane transmission diffraction grating.
13. To find the specific rotation of sugar solution by using a Polarimeter.

Suggested Books:

1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with basic and applied concept in chemistry
CO1	An insight into the atomic and molecular structure
CO2	Analytical techniques used in identification of molecules
CO3	To understand Periodic properties
CO4	To understand the spatial arrangement of molecules

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-131A	APPLIED MATHEMATICS-I						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	The objective of this course is to familiarize the prospective Biotechnology Engineers with techniques in Limit, Continuity, Differential & Integral Calculus and Complex Numbers. It aims to equip the students with standard concepts and tools at a beginner to intermediate and then at advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. More precisely, the objectives are as under:						

Course Outcomes	
CO1	To introduce the idea of sets, relations, functions, trigonometric functions, inverse trigonometric functions, these concepts are prerequisite to learn the concepts of differentiation and integration.
CO 2	To introduce the Complex numbers which is fundamental to solve any kind of quadratic equations, Limit is precondition to understand the concept of rate of change and derivative.
CO 3	To develop the essential tool of Continuity and Differentiability needed in evaluating higher order derivatives of functions.
CO 4	To introduce the tools of Indefinite and Definite integrals of functions in a comprehensive manner that are used in various techniques dealing engineering problems.

UNIT-I (12 hrs)

Sets, Relations, Functions

Sets and its types: Operations on sets, complement of a set, Cartesian Product of sets, relations , functions, types of functions,

Trigonometric functions: Introduction, Angles, Trigonometric functions, Trigonometric functions of sum and difference of two angles, Trigonometric equations,

Inverse Trigonometric functions: Introduction, basic concepts and its properties.

UNIT-II (12 hrs)

Pre-Calculus

Complex Numbers: Introduction, Algebra of Complex Numbers, Modulus and the conjugate of a complex number, quadratic equations,

Limits and Derivatives: Introduction, Limits, Limits of Trigonometric Functions, Derivatives (single variable).

UNIT-III (12 hrs)

Differential Calculus

Continuity and Differentiability: Introduction, Continuity, Differentiability, Exponential and Logarithmic functions, Logarithmic differentiation, Derivatives of functions in parametric forms, second order derivatives,

Application of Derivatives (single variable): Increasing and decreasing functions, Maxima and Minima.

UNIT-IV (12 hrs)

Integral Calculus

Integrals: Introduction, Integration as an Inverse process of Differentiation, Method of Integration, Integration by Partial Fractions, Integration by Parts,

Definite Integrals: Fundamental theorem of Calculus, Evaluation of Definite Integrals by Substitution, properties of Definite Integrals.

Suggested Books:

1. G. B. Thomas, R. L. Finney: Calculus and Analytic Geometry, Pearson Education.
2. Mathematics Textbook for Class 11th& 12th by NCERT.
3. Howard Anton: Calculus, Wiley Publication.
4. E. Kreyszig: Advanced Engineering Mathematics, Wiley India.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-132A	APPLIED MATHEMATICS-II						
L	T	P	Credit	Major Test	Minor Test	Total	Time
4	1	-	4.5	75	25	100	3 h
Purpose	The objective of this course is to familiarize the prospective Biotechnology Engineers with techniques in essential tool of linear algebra, how to solve a differential equation, utility of higher order derivatives in engineering domain, and fitting of a curve to given data. It aims to equip the students with standard concepts and tools at a beginner to intermediate and then at advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. More precisely, the objectives are as under:						
Course Outcomes							
CO1	To introduce the essential tool of matrices and linear algebra in a comprehensive manner to solve the large system of linear equations.						
CO 2	To introduce the statistical process used for estimating the parameters of a given curve or function to fit to a given data set using various degrees and types of curve fitting techniques.						
CO 3	To introduce effective mathematical tools for the solutions of differential equations that model physical processes.						
CO 4	To extend some concept of differential calculus for more than one variables.						

UNIT-I (10 Hrs)

Linear Algebra:

Introduction to matrices, its types, algebraic operations, transpose, determinant, minors and adjoint of a matrix. Elementary transformations, Inverse of a square matrix: Cramer's rule, Rank of a matrix, elementary matrices, Gauss Jordon method to find inverse using elementary transformations.

System of Linear equations: General representation, Homogeneous and Non-homogeneous system of linear equations, Consistency of linear system of equations, Gauss Elimination method to solve the system of linear equations.

UNIT-II (12 Hrs)

Theory of Equations:

Introduction, formation of equations, Relation between roots and coefficients, Reciprocal Equations, Transformation of equations.

Curve Fitting:

Introduction, Fitting of a straight line, fitting of second degree curve, fitting of a polynomial of degree m, fitting of a geometric or power curve of the form $y = ax^b$, fitting of an exponential curve of the form $y = ab^x$.

UNIT-III (10 hrs)

Ordinary differential equations:

Introduction, order and degree of the differential equation, Formation of differential equation, Solution of the differential equation, Solution of the differential equation with variables separable and differential equations reducible to variable separable form, exact differential equation, and equations reducible to exact differential equations, linear and Bernoulli's equations, Euler's equations.

UNIT-IV (08 hrs)

Multivariable Calculus:

Partial derivatives, Total differential, Chain rule for differentiation, Partial derivatives of higher orders, Homogeneous functions, Euler's theorem on homogeneous functions, differentiation of an implicit function, Jacobian, Maxima and minima of a function of two variables, Lagrange's method of undetermined multipliers.

Suggested Books:

1. G. B. Thomas, R. L. Finney: Calculus and Analytic Geometry, Pearson Education.
2. H. Anton, Irl C Bivens, Stephen Davis: Calculus 10th Edition, John Wiley & Sons.
3. E. Kreyszig: Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. E. Kreyszig and S. Ahuja, Applied Mathematics-II, Wiley India Publication, Reprint 2015.
5. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press.
6. Mathematics Textbook for Class 11th& 12th by NCERT.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-109A							
Coursetitle	Engineering Graphics&Design							
Scheme and Credits	L	T	P	Credits	Major Test	Minor Test	Total	Time
	1	2	0	3	75	25	100	3h

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing, graphics and Projections.	
CO-1	To learn about construction of various types of curves and scales.
CO-2	To learn about orthographic projections of points, lines and planes.
CO-3	To Learn about the sectional views and development of Right regular solids
CO-4	To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.

UNIT - I

IntroductiontoEngineeringDrawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

ProjectionsofRegular Solids:

Solid with axis inclinedtobothePlanes;

UNIT - III

Sections andSectionalViewsofRightRegular Solids:

Sectional views of simple right regular soilds like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. CorrespondingsetofCADSoftwareTheoryandUserManuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-113LA							
Coursetitle	EngineeringGraphics&Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3h
Pre-requisites(if any)	-							

Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign.	
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1:OverviewofComputerGraphics:

Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];

Module2:Customization &CAD Drawing:

Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;

Module3:Annotations,layering&other functions:

Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multi-view,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;

Module4:Demonstration ofasimpleteamdesign project:

Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).

Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111LA							
Coursetitle	ManufacturingProcessesWorkshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop

Contents

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., "Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141A	Biology						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	1	-	3	75	25	100	3h
Purpose	To familiarize the students with the basics of Biotechnology						
Course Outcomes							
CO1	Introduction to essentials of life and macromolecules essential for growth and Development						
CO2	Defining the basic concepts of cell division, genes and Immune system						
CO3	Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry						
CO4	Introduction of basic Concept of Microbiology & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

Classification of organisms: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 1550ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Enzymes as biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

Cell Division:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

4. Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Metabolism:-Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

Microbiology: Concept of species and strains, sterilization and media compositions, growth kinetics.

Role of Biology : Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Note: The paper setter will set the paper as per the question paper templates provided

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.

2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.

3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

ES-101A	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

Network Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits.Relation between MMF &Reluctance.Hysteresis& Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation.OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only)**:** Construction and working of dc machine with commutator action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103LA	BASIC ELECTRICAL ENGINEERING LAB						
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3

Purpose	To familiarize the students with the Electrical Technology Practicals

Course Outcomes	
CO1	Understand basic concepts of Network theorems
CO 2	Deals with steady state frequency response of RLC circuit parameters solution techniques
CO 3	Deals with introductory Single Phase Transformer practicals
CO 4	Explains the constructional features and practicals of various types of Electrical Machines

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.

KURUKSHETRA UNIVERSITY, KURUKSHETRA

('A+' Grade, NAAC Accredited)

SCHEME OF EXAMINATIONS FOR
Master of Technology (Civil Engineering) Specialization: Geo-technical Engineering
(w.e.f. SESSION: 2018-19)

SEMESTER- I

S. No.	Course Code	SUBJECT	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MCG-101 A	Advanced Soil Mechanics	3	-	-	3	40	60	3	3
2	MCG-103 A	Advanced Foundation Engineering	3	-	-	3	40	60	3	3
3	*	Program Elective –I	3	-	-	3	40	60	3	3
4	**	Program Elective-II	3	-	-	3	40	60	3	3
5	MCG-117 A	lab I – Soil mechanics-1	-	-	2	2	40	60	2	3
6	MCG-119 A	lab II-Soilmechanics-2	-	-	2	2	40	60	2	3
7	MTRM-111 A	Research Methodology and IPR	2	-	-	2	40	60	2	3
8	***	Audit Course-I	2	-	-	0	100	-	0	0
	TOTAL		**16**	**0**	**4**	**18**	**280**	**420**	**18**	
							700			

***Program Elective - I**		****Program Elective- II**	
MCG-105 A	Soil Structure Interaction	MCG-111 A	FEM in Geomechanics
MCG-107 A	Ground Improvement Techniques	MCG-113 A	Environmental Geotechnology
MCG-109 A	Pavement Analysis and Design	MCG-115 A	Critical Soil Mechanics

*****Audit Course-I**	
MTAD-101 A	English for Research Paper Writing
MTAD-103 A	Disaster Management
MTAD-105 A	Sanskrit for Technical Knowledge
MTAD-107 A	Value Education

Note: 1.The course of program elective will be offered at 4 numbers of students (whichever is smaller) strength of the class.

Note:2.*** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

SEMESTER-II

S. No.	Course code	Subject	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MCG- 102 A	Dynamics of soils and foundations	3	-	-	3	40	60	3	3
2	MCG-104A	Subsurface investigations and instrumentation	3	-	-	3	40	60	3	3
3	*	Program Elective-III	3	-	-	3	40	60	3	3
4	**	Program Elective-IV	3	-	-	3	40	60	3	3
5	MCG-118 A	Lab III –Sub soil exploration		-	2	2	40	60	2	3
6	MCG- 120 A	Lab IV- Soil dynamics	-	-	2	2	40	60	2	3
7	MCG- 122 A	Mini Project	-	-	4	2	40	60	2	3
8	***	Audit Course-II	2			0	100		0	3
	TOTAL		**14**		**8**	**18**	**280**	**420**	**18**	
							700			

***Program Elective - III**		****Program Elective –IV**	
MCG-106 A	Offshore Geotechnical Engineering/marine Geotechniques	MCG-112A	Earth Retaining Structures
		MCG-114A	Design of underground excavations
MCG-108 A	Computational Geomechanics	MCG-116A	Physical and Constitutive Modelling on Geomechanics
MCG-110 A	Engineering rock mechanics		

*****Audit Course - II**	
MTAD-102 A	Constitution of India
MTAD-104 A	Pedagogy Studies
MTAD-106 A	Stress Management by Yoga
MTAD-108 A	Personality Development through Life Enlightenment Skills.

Note: 1.The course of program elective will be offered at 4 numbers of students (whichever is smaller) strength of the class.

Note: ***Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be

mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

SEMESTER-Ⅲ

S. No.	Course Code	Subject	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	*	Program Elective-V	3	-	-	3	40	60	3	3
2	**	Open Elective	3	-	-	3	40	60	3	3
3	MCG-207 A	Dissertation Phase-I	-	-	20	20	100	-	10	3
		TOTAL	**6**		**20**	**26**	**180**	**120**	**16**	
							300			

***Program Elective –V**	
MCG-201 A	Stability analysis of slopes
MCG-203 A	Foundation and Weak Rocks
MCG-205 A	Geotechnical earthquake engineering

****Open Elective**		
1.	MTOE-201A	Business Analytics
2.	MTOE-203A	Industrial Safety
3.	MTOE-205A	Operations Research
4.	MTOE-207A	Cost Management of Engineering Projects
5.	MTOE-209A	Composite Materials
6.	MTOE-211A	Waste to Energy

SEMESTER-IV

S. No.	Course Code		L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MCG-202 A	Dissertation Phase-II	-	-	32	32	100	200	16	3
	TOTAL						**300**		**16**	

Total Credits – 68

Note: 1.The course of program elective/ open elective will be offered at 4 numbers of students (whichever is smaller) strength of the class.

MCG-101A ADVANCED SOIL MECHANICS

Teaching Scheme

Lectures: 3 hrs. /Week

COURSE OUTCOME

- The students obtain the complete knowledge on strength of soil mass
- The students are able to develop mathematical models for solving different problems in soil mechanics

Syllabus Contents:

Unit I

Compressibility of soils: consolidation theory (one, two, and three dimensional consolidation theories), consolidation in layered soil and consolidation for time dependent loading, determination of coefficient of consolidation (Casagrande method and Taylors method)

Unit II

Strength behavior of soils; Mohr Circle of Stress; UU, CU, CD tests, drained and undrained behavior of sand and clay, significance of pore pressure parameters; determination of shear strength of soil; Interpretation of triaxial test results.

Unit III

Stress path; Drained and undrained stress path; Stress path with respect to different initial state of the soil; Stress path for different practical situations.

Unit IV

Critical state soil mechanics ;Critical state parameters ;Critical state fornormally consolidated and over consolidated soil; Significance of Roscoe and Hvorslev state boundary surface; drained and undrained plane. critical void ratio; effect of dilation in sands; different dilation models.

Elastic and plastic deformations: elastic wall; introduction to yielding and hardening; yield curve and yield surface, associated and non-associated flow rule.

References:

Atkinson, J.H. and Bransby, P.L, The Mechanics of Soils: An introduction to Critical soil mechanics, McGraw Hill, 1978.

Atkinson J.H, An introduction to the Mechanics of soils and Foundation, McGraw- Hill Co., 1993. Das, B.M., Advanced Soil Mechanics, Taylor and Francis, 2nd Edition, 1997.

Wood, D.M., Soil Behavior and Critical State Soil Mechanics, Cambridge University Press, 1990.

Craig, R.F., Soil Mechanics, Van No strand Reinhold Co. Ltd., 1987.

Terzaghi, K., and Peck, R.B., Soil Mechanics in Engineering Practice, John Wiley & Sons, 1967.
Lambe, T.W. and Whitman, R.V., Soil Mechanics, John Wiley & Sons, 1979.

MCG-103A ADVANCED FOUNDATION ENGINEERING

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- The students will be able to decide the type of foundations to be recommended for construction of different engineering structures
- The students will be able to design different types of foundations

Syllabus Contents:

Unit I

Planning of soil exploration for different projects, methods of subsurface exploration, methods of borings along with various penetration tests

Unit II

Shallow foundations, requirements for satisfactory performance of foundations, methods of estimating bearing capacity, settlements of footings and rafts, proportioning of foundations using field test data, IS codes.

Well foundation, IS and IRC codal provisions, elastic theory and ultimate resistance methods

Unit III

Pile foundations, methods of estimating load transfer of piles, settlements of pile foundations, pile group capacity and settlement, negative skin friction of piles, laterally loaded piles, pile load tests, analytical estimation of load- settlement behavior of piles, proportioning of pile foundations, lateral and uplift capacity of piles

.

Unit IV

Foundations on problematic soils: Foundations for collapsible and expansive soil

Coffer dams, various types, analysis and design Foundations under uplifting loads

References:

- Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.
- Das B.M., Shallow Foundations: Bearing capacity and settlement, CRC Press,1999.
- Tomlinson M.J., Pile design and construction Practice, Chapman and Hall Publication, 1994.
- Poulos,H.G.andDavis,F.H.,"PileFoundationAnalysisandDesign",WileyandSons. 1980

Program Elective –I
MCG-105A Soil Structure Interaction

Teaching Scheme

Lectures: 3 hrs/week

Course Outcomes: At the end of the course, students will be able to

1. Understand soil structure interaction concept and complexities involved.
2. Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics.
3. Prepare comprehensive design oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.
4. Analyze different types of frame structure founded on stratified natural deposits with linear and non-linear stress-strain characteristics.
5. Evaluate action of group of piles considering stress-strain characteristics of real soils.

Unit I

Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction.

Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method.

Unit II

Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics.

Unit III

Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc.

Unit IV

Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.

Determination of Pile Capacities and Negative Skin Friction, Action ofGroup of PilesConsidering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance.

Reference Books:

- Analytical and Computer Methods in Foundation, Bowels J.E.,McGraw Hill Book Co., New York, 1974.
- Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw Hill Book Co., New York.
- Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers.
- Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17, Elsevier Scientific Publishing Company.
- Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific Publishing Company.
- Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.
- Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing

MCG-107 A	Ground improvement technique						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.

Syllabus Contents:

Unit I

Introduction: situations where ground improvement becomes necessary

Unit II

Mechanical modification: dynamic compaction, impact loading, compaction by blasting, vibro-compaction; pre-compression, stone columns; Hydraulic modification: dewatering systems, preloading and vertical drains, electro-kinetic dewatering

Unit III

Chemical modification; modification by admixtures, stabilization using industrial wastes, grouting
Thermal modification: ground freezing and thawing.

Unit VI

Soil reinforcement: Reinforced earth, basic mechanism, type of reinforcements, selection of stabilization/improvement of ground using Geotextiles, Goegrid, geomembranes, geocells, geonets, and soil nails.

Application of soil reinforcement: shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, analysis and design of shallow foundations on reinforced earth, road designs with geosynthetics

References:

- Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-Hill International Editions,1990.
- Yonekura, R., Terashi, M. and Shibazaki, M. (Eds.), Grouting and Deep Mixing, A.A. Balkema,1966.
- Moseley, M.P., Ground Improvement, Blackie Academic & Professional,1993.
- Xanthakos, P.P., Abramson, L.W. and Bruce, D.A., Ground Control and Improvement, John

Wiley & Sons, 1994.
- Koerner, R. M., Designing with Geosynthetics, Prentice Hall Inc.1998.
- Shukla, S.K., Yin, Jian-Hua, “Fundamentals of Geosynthetic Engineering”, Taylor &Francis.

Program Elective -I

MCG-109 A	PAVEMENT ANALYSIS AND DESIGN						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.

Syllabus Contents:

Unit I

Philosophy of design of flexible and rigid pavements, **Analysis** of pavements using different analytical methods,

Unit II

Selection of pavement design input parameters – traffic loading and volume

Unit III

Material characterization, drainage, failure criteria, reliability

Unit IV

Design of flexible and rigid pavements using different methods,
Comparison of different pavement design approaches, design of overlays and drainage system.

References:

- Yang and H. Huang, Pavement Analysis and Design, Pearson Prentice Hall,2004.
- Yoder and Witzech, Pavement Design, McGraw-Hill,1982.
- Sharma and Sharma, Principles and Practice of Highway Engg., Asia Publishing House, 1980.
- Teng, Functional Designing of Pavements, McGraw- Hill, 1980.

Program Elective -II

MCG- 111A FEM IN GEOTECHNICAL ENGINEERING TEACHING

Teaching Scheme

Lectures: 3 hrs/week

COURSE OUTCOME

Students can understand basic stress-strain relationship for soil and develop Stress deformation analysis.

Unit I

Stress-deformation analysis: One dimensional, Two dimensional and Three-dimensional formulations.

Unit II

Discretization of a Continuum, Elements, Strains, Stresses, Constitutive, Relations, Hooke's Law, Formulation of Stiffness Matrix, Boundary Conditions, Solution Algorithms.

Principles of discretization, element stiffness and mass formulation based on direct, variational and weighted residual techniques and displacements approach, Shape functions and numerical integrations, convergence.

Unit III

Displacement formulation for rectangular, triangular and isoparametric elements for two dimensional and axisymmetric stress analysis.

Unit IV

Settlement Analysis, 2-D elastic solutions for homogeneous, isotropic medium, Steady Seepage Analysis: Finite element solutions of Laplace's equation, Consolidation Analysis:
Terzaghi consolidation problem, Choice of Soil Properties for Finite Element Analysis

References:

- O.C. Zienkiewicz and R.L. Taylor, Finite element methods Vol I & Vol II, McGraw Hill,1989,1992.
- K.J. Bathe, Finite element procedures, PHI Ltd., 1996.
- David M Potts and LidijaZdravkovic, "Finite Element Analysis in Geotechnical Engineering Theory and Apllication", Thomas Telford. 1999

MCG-113 A	ENVIRONMENTAL GEOTECHNOLOGY						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.

Syllabus Contents:

Unit I

Soil as a multiphase system; Soil-environment interaction; Properties of water in relation to the porous media; Water cycle with special reference to soil medium.

Soil mineralogy; significance of mineralogy in determining soil behavior; Mineralogical characterization.

Unit II

Mechanisms of soil-water interaction: Diffuse double layer models; Force of attraction and repulsion; Soil-water-contaminant interaction; Theories of ion exchange; Influence of organic and inorganic chemical interaction.

Unit III

Concepts of waste containment; Sources, production and classification of wastes, Environmental laws and regulations, physico-chemical properties of soil, ground water flow and contaminant transport,desirable properties of soil; contaminant transport and retention; contaminated site remediation.

Unit IV

Soil characterization techniques; volumetric water content; gas permeation in soil; electrical and thermal properties; pore-size distribution; contaminant analysis. contaminated site characterization, estimation of landfill quantities, landfill site location, design of various landfill components such as liners, covers, leachate collection and removal, gas generation and management, ground water monitoring, end uses of landfill sites, slurry walls and barrier systems, design and construction, stability, compatibility and performance, remediation technologies, stabilization of contaminated soils and risk assessment approaches.

References:

- Mitchell,J.KandSoga, K.,FundamentalsofSoilBehavior, JohnWileyandSonsInc.,2005.
- Fang, H-Y., Introduction to Environmental Geotechnology, CRCPress,1997.
- Daniel, D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall,1993.
- Rowe, R.K., Quigley, R.M. and Booker, J.R., Clay Barrier Systems for Waste Disposal Facilities, E & FN Spon,1995.
- Rowe, R.K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers,2001.
- Reddi, L.N. and Inyang, H.F, Geoenvironmental Engineering - Principles and Applications, Marcel Dekker Inc,2000.
- Sharma, H.D. and Lewis, S.P, Waste Containment Systems, Waste Stabilization and Landfills:

Program Elective -II

MCG-115 A	CRITICAL SOIL MECHANICS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.

Syllabus Contents:

Unit I

Soil Behavior: State of stress and strain in soils, Stress and strain paths and invariants, behavior of soils under different laboratory experiments

The Critical state line and the Roscoe surface: Families of undrained tests, Families of drained tests, the critical state line, drained and undrained surfaces, The Roscoe surface

Unit II

Behavior of Overconsolidated samples:
The Hvorslev surface: Behaviour of overconsolidated samples, drained and undrained tests, The Hvorslev surface, complete State Boundary Surface, Volume changes and pore water pressure changes

Unit III

Behaviour of Sands: The critical state line for sands, Normalized plots, the effect of dilation, Consequences of Taylor's model

Unit IV

Behaviour of Soils before Failure: Elastic and plastic deformations, Plasticity theory, Development of elastic-plastic model based on critical state soil mechanics, The Cam-clay model, The modified Cam-clay model

References:

- J. H. Atkinson and P. L. Bransby, “The mechanics of soils: An introduction to critical state soil mechanics”, McGraw Hill, 1978
- D. M. Wood, “Soil behaviour and critical state soil mechanics”, Cambridge University Press, 1990
- B. M. Das, “Fundamental of geotechnical engineering”, Cengage Learning, 2013

MCG-117 A	Lab-I SOIL Mechanics-1						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
0	**0**	**2**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							

Syllabus Content:

List of Experiments:

1. Determination of Moisture Content and Specific gravity of soil
2. Grain Size Distribution Analysis and Hydrometer Analysis
3. Atterberg Limits (Liquid Limit, Plastic limit, Shrinkage limit)
4. Visual Classification Tests
5. Vibration test for relative density of sand
6. Standard and modified proctor compaction test
7. Falling head permeability test and Constant head permeability test

Consolidation test

MCG-119A	Lab- II Soil Mechanics-II						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
0	**0**	**2**	**2**	**60**	**40**	**100**	**3 Hrs.**

List of Experiments:

1. Unconfined compression test
2. Direct shear test
3. Tri-axial compression test – UU, CU, CD tests
4. Laboratory vane shear test
5. Field Vane shear test

MTRM-111 A Research Methodology and IPR

Teaching Scheme
Lectures: 2 hrs/ week

Course Outcomes

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about,
economic growth and social benefits.

Syllabus Contents:

Unit I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit II

Effective literature studies approaches, analysis Plagiarism, Research ethics,
Effective technical writing, how to write report, Paper

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committeePatent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

- Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
- Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
- Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”
- Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
- Mayall , “Industrial Design”, McGraw Hill, 1992.
- Niebel , “Product Design”, McGraw Hill, 1974.
- Asimov , “Introduction to Design”, Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.

T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Audit-I

MTAD-101 A	English For Research Paper Writing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Student will able to understand the basic rules of research paper writing.*						
Course Outcomes (CO)							
CO1	*Understand that how to improve your writing skills and level of readability*						
CO2	*Learn about what to write in each section*						
CO3	*Understand the skills needed when writing a Title*						
CO4	*Ensure the good quality of paper at very first-time submission*						

UnitI

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit III

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit IV

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

References:

1) Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

2) Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

3) Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.

4) Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Audit -I

MTAD-103 A	Disaster Management						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	0	0	-	100	100	3 Hrs.
Program Objective (PO)	*Develop an understanding of disaster risk reduction and management*						
Course Outcomes (CO)							
CO1	*Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.*						
CO2	*Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.*						
CO3	*Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.*						
CO4	*critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in*						

Unit I

Introduction: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit II

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit III

Disasters Prone Areas in India: Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit IV

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

References:

1) R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2) Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

3) Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

Audit -I

MTAD-105 A	Sanskrit for Technical Knowledge						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Students will be able to Understanding basic Sanskrit language and Ancient Sanskrit literature about science & technology can be understood and Being a logical language will help to develop logic in students*						
Course Outcomes (CO)							
CO1	*To get a working knowledge in illustrious Sanskrit, the scientific language in the world*						
CO2	*Learning of Sanskrit to improve brain functioning*						
CO3	*Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power*						
CO4	*The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature*						

Unit I

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit II

Order, Introduction of roots, Technical information about Sanskrit Literature

Unit III

Technical concepts of Engineering: Electrical, Mechanical

Unit IV

Technical concepts of Engineering: Architecture, Mathematics

References

1) "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi

2) "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

3) "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Audit I

MTAD-107 A	Value Education						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	0	0	-	100	100	3 Hrs.
Program Objective (PO)	*Understand value of education and self- development, Imbibe good values in students and Let the should know about the importance of character*						
Course Outcomes (CO)							
CO1	*Knowledge of self-development*						
CO2	*Learn the importance of Human values*						
CO3	*Developing the overall personality*						
CO4	*Know about the importance of character*						

Unit I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.

Unit II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature,Discipline

Unit III

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

Unit IV

Character and Competence –Holy books Vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

References

1) Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

M Tech Semester - II

MCG-102A DYNAMICS OF SOILS AND FOUNDATIONS

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- Students understand theory of vibration and resonance phenomen on, dynamic amplification.
- Students understand propagation of body waves and surface waves throughsoil.
- Student exposed to different methods for estimation of dynamic soil properties required for design purpose.
- Students can predict dynamic bearing capacity and assess liquefaction potential of anysite.
- Students apply theory of vibrations to design machine foundation based on dynamic soil properties and bearing capacity.

Syllabus Contents:

Unit I

Fundamentals of vibrations: single, two and multiple degree of freedom systems, vibration isolation, vibration absorbers, vibration measuring instruments

Wave propagation: elastic continuum medium, semi-infinite elastic continuum medium ,soil behaviour under dynamic loading.

Unit II

Liquefaction of soils: liquefaction mechanism, factors affecting liquefaction, studies by dynamic tri-axial testing, oscillatory shear box, shake table and blast tests, assessment of liquefaction potential.

Unit III

Dynamic elastic constants of soil: determination of dynamic elastic constants, various methods including block resonance tests, cyclic plate load tests, wave propagation tests,oscillatory shear box test.

Machine foundations: Design criteria for machine foundations; Elastic homogeneous half space and lumped parameter solutions, analysis and design of foundations for reciprocating and impact type machines, turbines, effect of machine foundation on adjoiningstructures.

Unit IV

Bearing capacity of foundations: Introduction to bearing capacity of dynamically loaded foundations, such as those of water towers, chimneys and high rise buildings, response of pile foundations.

References:

- Das, B.M., “Fundamentals of Soil Dynamics”,Elsevier,1983.
- Steven Kramer, “Geotechnical Earthquake Engineering”,Pearson,2008.
- Prakash, S., Soil Dynamics, McGraw Hill,1981.
- Kameswara Rao, N.S.V., Vibration analysis and foundation dynamics,

- Richart, F.E. Hall J.R and Woods R.D., Vibrations of Soils and Foundations, Prentice Hall Inc.,1970.
- Prakash, S. and Puri, V.K., Foundation for machines: Analysis and Design, John Wiley & Sons,1998

MCG 104 A SUBSURFACE INVESTIGATIONS AND INSTRUMENTATION

Teaching Scheme
Lectures: 3 hrs/ week

COURSE OUTCOME

- Students can plan subsurface investigation based on the requirement of civil engineering project and site condition. Can finalize depth and number of boreholes
- Students can execute different subsurface exploration tests, collect disturbed/undisturbed samples for laboratory tests and can suggest design parameters.
- Student exposed to different methods for estimation of dynamic soil properties required for design purpose.
- Students can develop instrumentation scheme for monitoring of critical sites

UNIT I

PLANNING OF EXPLORATION AND GEOPHYSICAL METHODS Scope and objectives, planning an exploration program, methods of exploration, exploration for preliminary and detailed design, spacing and depth of bores, data presentation. Geophysical exploration and interpretation, seismic and electrical methods, cross bore hole, single bore hole – up hole -down hole methods.

UNIT II

EXPLORATION TECHNIQUES Methods of boring and drilling, non-displacement and displacement methods, drilling in difficult subsoil conditions, limitations of various drilling techniques, stabilization of boreholes, bore logs.

UNIT III

SOIL SAMPLING Sampling Techniques – quality of samples – factors influencing sample quality - disturbed and undisturbed soil sampling advanced sampling techniques, offshore sampling, shallow penetration samplers, preservation and handling of samples.

FIELD TESTING IN SOIL EXPLORATION

Field tests, penetration tests, Field vane shear, Insitu shear and bore hole shear test, pressuremeter test, dilatometer test - plate load test–monotonic and cyclic; field permeability tests – block vibration test. Procedure, limitations, correction and data interpretation of all methods.

UNIT IV

INSTRUMENTA Instrumentation in soil engineering, strain gauges, resistance and inductance type, load cells, earth pressure cells, settlement and heave gauges, pore pressure measurements - slope indicators, sensing units, case studies.

Program Elective -III

MCG-106 A	MARINE GEOTECHNIQUES						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.

COURSE OUTCOME

Students can execute investigation program for marine soil deposits and select necessary design parameters. Design suitable marine foundation as per project requirement. Can develop numerical model for response of marine foundation for off shore conditions.

Syllabus Contents:

Unit I

Marine soil deposits: Offshore environment, Offshore structures and foundations, Specific problems related to marine soil deposits, Physical and engineering properties of marine soils

Unit II

Behavior of soils subjected to repeated loading: Effect of wave loading on offshore foundations, Behavior of sands and clays under cyclic loading, Laboratory experiments including repeated loading, Cyclic behavior of soils based on fundamental theory of mechanics, Approximate engineering methods which can be used for practical cases

Unit III

Site Investigation in the case of marine soil deposits: Challenges of site investigation in marine environment, Different site investigation techniques, sampling techniques, Geophysical methods, Recent advancements in site investigation and sampling used for marine soil deposits

Unit IV

Foundations in marine soil deposits: Different offshore and near shore foundations, Gravity platforms, Jack-up rigs, pile foundations. cassions, spudcans

Numerical modeling of marine foundations subjected to wave loading: Numerical modeling of cyclic behavior of soils, empirical models, elastic-plastic models, FEM analysis of marine foundations subjected to wave loading

References:

- H. G. Poulos. “Marine Geotechnics”, Unwin Hyman Ltd, London, UK,1988
- D. V. Reddy and M. Arockiasamy, “Offshore Structures”, *Volume: 1*, R.E. Kreiger Pub and Co.,1991
- D. Thomson and D. J. Beasley, “Handbook of Marine Geotechnical Engineering”, US Navy,2012

Program Elective III
MCG -108A COMPUTATIONAL GEOMECHANICS

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- Students can understand different numerical and statistical tools for analyzing various geotechnical engineering problems.
- Students can apply probabilistic approach for selection of design parameters and compute their impact on risk assessment

Unit I

Solution of Non-linear Equations: Bisection, False Position, Newton-Raphson, Successive approximation method, Iterative methods

Solution of Linear Equations: Jacobi's method, Gauss Seidal method, Successive over relaxation method.

Unit II

Finite Difference Method: Two point Boundary value problems – Disichlet conditions, Neumann conditions; ordinary and partial differential equations.

Finite Element Method: Fundamentals, Constitutive finite element models for soils.

Unit III

Correlation and Regression Analysis: Correlation - Scatter diagram, Karl Pearson coefficient of correlation, Limits of correlation coefficient; Regression –Lines of regression, Regression curves, Regression coefficient, Differences between correlation and regression analysis.

Unit IV

One-dimensional Consolidation - Theory of consolidation, Analytical procedures, Finite difference solution procedure for multilayered systems, Finite element formulation

Flow Through Porous Media - Geotechnical aspects, Numerical methods, Applications and Design analysis, Flow in jointed media.

References:

- S. Chandrakant., Desai and John T. Christian, "Numerical Methods in Geotechnical Engineering", Mc. Graw Hill Book Company, 1977.
- M.K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering computations", Third edition, New Age International (P) Ltd. Publishers, New Delhi.

Program Elective -III

MCG-110 A	ENGINEERING ROCK MECHANICS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.

COURSE OUTCOME

The students will be able to perform various laboratory tests on rock and classify rock mass. Be able to predict strength of rock mass with respect to various Civil Engineering applications

Syllabus Contents:

Unit I

Rock: Formation of rocks, Physical properties, Classification of rocks and rock masses, Elastic constants of rock; Insitu stresses in rock

Rock Testing: Laboratory and Field tests

Unit II

Discontinuities in Rock Masses: Discontinuity orientation, Effect of discontinuities on strength of rock ;

Unit III

Strength Behaviour: Compression, Tension and Shear, Stress-Strain relationships, Rheological behavior ;

Strength/ Failure Criterion: Mohr-Coulomb, Griffith theory, Hoek and Brown, strength and other strength criteria. Stresses in rock near underground openings.

Unit IV

Application of rock mechanics in Civil Engineering: Rock tunneling, rock slope stability, bolting, blasting, grouting and rock foundation design. Modern modelling techniques & analyses in rocks.

References:

- Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction tothe Principles, 1997. Elsevier, Oxford
- Goodman, R.E. Introduction to Rock Mechanics, John Wiley &Sons.
- Ramamurthy, T., “Engineering in Rocks”, PHI Learning Pvt.Ltd.
- Jaeger, J.C. and Cook, N.G.W, Fundamentals of Rock Mechanics, Chapman and Hall, 1976.
- Wyllie, D.C., Foundations on Rock, E & FN Spon. 2nd Edition,199

Program Elective -IV

MCG-112 A	EARTH RETAINING STRUCTURES						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.

COURSE OUTCOME

- The students will be able to do analysis and design of different types of retaining strcuctures

Syllabus Contents:

Unit I

Earth Pressure: Rankine and Coulomb theories, active, passive and pressure at rest; concentrated surcharge above the back fill, earth pressure due to uniform surcharge, earth pressure of stratified backfills, saturated and partially saturated backfill.

Unit II

Retaining walls: Proportioning of retaining walls, stability of retaining walls, mechanically stabilized retaining walls/reinforced earth retaining walls
Sheet Pile wall: free earth system, fixed earth system

Unit III

Bulkheads: bulkheads with free and fixed earth supports, equivalent beam method, Anchorage of bulkheads and resistance of anchor walls, spacing between bulkheads and anchor walls, resistance of anchor plates

Unit IV

Tunnel and Conduit: Stress distribution around tunnels, Types of conduits, Load on projecting conduits; Arching and Open Cuts: Arching in soils,

Braced excavations: Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clays

References:

- Das, Braja M., "Principles of Foundation Engineering", PWS Publishing.1998
- Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997

Program Elective -IV

MCG-114 A	DESIGN OF UNDERGROUND EXCAVATIONS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.

COURSE OUTCOME

- Students can understand the use of elastic and plastic analysis in the design of underground support system.
- Students will have idea about the field tests generally conducted during and after construction of under structures.

Syllabus Contents:

Unit I

Introduction, planning of and exploration for various underground construction projects, stereographic projection method, principle and its application in underground excavation design.
Elastic stress distribution around tunnels, stress distribution for different shapes and under different in-situ stress conditions, Greenspan method, design principles, multiple openings, openings in laminated rocks, elasto-plastic analysis of tunnels, Daemen's theory

Unit II

Application of rock mass classification systems, ground conditions in tunneling, analysis of underground openings in squeezing and swelling ground, empirical methods, estimation of elastic modulus and modulus of deformation of rocks; uniaxial jacking / plate jacking tests, radial jacking and Goodman jacking tests, long term behaviour of tunnels and caverns,NewAustrianTunnelingMethod(NATM),NorwegianTunnelingMethod(NTM), construction dewatering.

Unit III

Rock mass-tunnel support interaction analysis, ground response and support reaction curves, Ladanyi'selasto-plastic analysis of tunnels, design of various support systems including concrete and shotcrete linings, steel sets, rock bolting and rock anchoring, combined support systems, estimation of load carrying capacity of rock bolts

Unit IV

In-situ stress, flat jack, hydraulic fracturing and over coring techniques and USBM type drill hole deformation gauge, single and multi-point bore hole extensometers, load cells, pressure cells, etc. Instrumentation and monitoring of underground excavations, during and after construction, various case studies

References:

Hoek, E and and Brown, E. T.," Underground Excavations in Rocks",
Institute of Mining Engineering.
Obert, L. and Duvall, W.I., "Rock Mechanics and Design of Structures in Rocks", John Wiley. Singh, B. and Goel, R.K.,"Rock Mass Classification- A Practical Engineering Approach", Elsevier.

Singh, B. and Goel, R.K., "Tunnelling in Weak Rocks", Elsevie

MCG-116 PHYSICAL AND CONSTITUTIVE MODELLING ON GEOMECHANICS

Teaching Scheme

Lectures:3 hrs/ week

COURSE OUTCOME

- Students can understand theory of plasticity and various yield criteria and flow rule.
- Students can apply critical state concept to consolidation and triaxial soil behavior.

Unit I

Role of constitutive modeling; importance of laboratory testing with relation to constitutive modeling; Elasticity: linear, quasi linear, anisotropic;

Unit II

Plasticity basics: yield criteria, flow rule, plastic potential, hardening/softening; rate Independent Plasticity: mohr-coulomb, nonlinear failure criteria, Drucker Prager, and cap models;

Unit III

Critical state soil mechanics: critical state concept, cam clay models, simulation of single element test using cam clay.

Unit IV

Consolidation, drained and undrained triaxial test; Stress dilatancy theory; Work hardening plasticity theory: formulation and implementation; Application of elasto-plastic models; Special Topics : hypoelasticity-plasticity, disturbed state concept.

References:

Hicher and Shao, "Constitutive Modeling of Soils and Rocks", John Wiley, 2008

C.S. Desai and H.J. Siriwardane, "Constitutive Laws for Engineering Materials with Emphasis on Geologic Materials", Prentice-Hall, Inc., New Jersey, 1984.

David M Potts and Lidija Zdravkovic, " finite Element Analysis in Geotechnical Engineering Theory and Application", Thomas Telford. 1999.

C.S. Desai, " Mechanics of Materials and Interfaces: The Disturbed State Concept, CRC Press LLC. 2000.

A.P.S. Selvadurai, M.J. Boulon, "Mechanics of Geomaterial Interfaces, Elsevier.

MCG-118 A	Sub-soil exploration lab						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
0	0	2	2	60	40	100	3 Hrs.

Syllabus Content

List of Practical

1 Exploratory borings by different methods including auger boring, wash boring, percussion drilling rotary drilling.
2 Standard penetration test
3 Dynamic cone penetration test
4 Static cone penetration test
5 Plate load test
6 Pressure meter test
7 Geophysical exploration tests

MCG-120A	Soil Dynamic Lab						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
0	0	2	2	60	40	100	3 Hrs.

List of Practical

1. Spectral analysis of surface waves (SASW) Test / Multi-channel analysis of surface waves (MASW)test
2. Seismic cross-hole test
3. Seismic down-hole / up-hole test
4. Seismic dilatometer test
5. Resonant column test
6. Piezoelectric bender element test
7. Cyclic triaxialtest
8. Cyclic direct shear test

MCG-122 A	Mini Project						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**

Syllabus Content:

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Semester and End Semester will be monitored by the departmental committee.

Audit II

MTAD-102 A	Constitution of India						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.*						
Course Outcomes (CO)							
CO1	*Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*						
CO2	*Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*						
CO3	*Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.*						
CO4	*Discuss the passage of the Hindu Code Bill of 1956.*						

Unit I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features

Unit 2

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality , Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor , Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit 3

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit 4

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References

1) The Constitution of India, 1950 (Bare Act), Government Publication.
2) Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3) M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4) D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Audit-II

MTAD-104 A	Pedagogy Studies						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers and Identify critical evidence gaps to guide the development.*						
Course Outcomes (CO)							
CO1	*What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?*						
CO2	*What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?*						
CO3	*How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?*						
CO4	*What is the importance of identifying research gaps?*						

Unit I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology , Theories of learning, Curriculum, Teacher education., Conceptual framework, Research questions. Overview of methodology and Searching. Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. , Curriculum, Teacher education.

Unit II

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit III

Professional development: alignment with classroom practices and follow-up support, Peer support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes,

Unit IV

Research gaps and future directions: Research design, Contexts , Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

References

1) Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

2) Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

3) Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4) Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

5) Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

Audit II

MTAD-106 A	Stress Management by Yoga						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To achieve overall health of body and mind and to overcome stress						
Course Outcomes (CO)							
CO1	*Develop healthy mind in a healthy body thus improving social health.*						
CO2	*Improve efficiency*						
CO3	*Learn the Yog asan*						
CO4	*Learn the pranayama*						

Unit I

Definitions of Eight parts of yog (Ashtanga).

Unit II

Yam and Niyam, Do`s and Don't's in life; Ahinsa, satya, astheya, bramhacharya and aparigraha; Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit III

Asan and Pranayam, Various yog poses and their benefits for mind & body,

Unit IV

Regularization of breathing techniques and its effects-Types of pranayam.

References

1) 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2) "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Audit II

MTAD-108 A	Personality Development through Life Enlightenment Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To learn to achieve the highest goal happily To become a person with stable mind, pleasing personality and determination To awaken wisdom in students						
Course Outcomes (CO)							
CO1	*Students become aware about leadership.*						
CO2	*Students will learn how to perform his/her duties in day to day work.*						
CO3	*Understand the team building and conflict*						
CO4	*Student will learn how to become role model for the society.*						

Unit I

Neetisatakam-Holistic development of personality: Verses: 19, 20, 21, 22 (wisdom); Verses: 29, 31, 32 (pride & heroism); Verses: 26, 28, 63, 65 (virtue); Verses: 52, 53, 59 (don's); Verses: 71, 73, 75, 78 (do's).

Unit II

Approach to day to day work and duties; Shrimad Bhagwad Geeta: Chapter-2: Verses: 41, 47, 48; Chapter-3: Verses: 13, 21, 27, 35; Chapter-6: Verses: 5, 13, 17, 23, 35; Chapter-18: Verses: 45, 46, 48.

Unit III

Statements of basic knowledge; Shrimad Bhagwad Geeta: Chapter-2: Verses: 56, 62, 68; Chapter-12: Verses: 13, 14, 15, 16, 17, 18.

Unit IV

Personality of Role model; Shrimad Bhagwad Geeta: Chapter-2: Verses: 17; Chapter-3: Verses: 36, 37, 42: Chapter-4: Verses: 18, 38, 39; Chapter-18: Verses: 37, 38, 63.

References:

1) Srimad Bhagavad Gita, Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2) Bhartrihari's Three Satakam (Niti-sringar-vairagya), P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

M Tech Semester –III

Program Elective -V

MCG-201 A	STABILITY ANALYSIS OF SLOPES						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.

COURSE OUTCOME

- Student will be able to check the stability of earthen dams, and the safety measures to be undertaken to prevent the instability of slopes, earthen dams andembankments

Syllabus Contents:

Unit I

Slopes: Types and causes of slope failures, mechanics of slope failure, failure modes.

Unit II

Stability analysis: infinite and finite slopes with or without water pressures; concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods, friction circle method ; Method of slices, Bishop's method, Janbu's method, Morgenstern and Price, Spencer's method

Unit III

Stability analysis in the presence of seepage: two dimensional flow – Laplace equation and it's solution, graphical method, determination of phreatic line, flow nets in homogeneous and zoned earth dams under steady seepage and draw-down conditions, seepage control in earth dams, influence of seepage on slope stability stability analysis of dam body during steady seepage

Unit IV

Strengthening measures: stabilization of slopes by drainage methods, surface and subsurface drainage, use of synthetic filters, retaining walls, stabilization and strengthening of slopes, shotcreting, rock bolting and rock anchoring, instrumentation and monitoring of slopes, slope movements, warning devices, maintenance of slopes

References:

- Chowdhary R and ChowdharyI , "Geotechnical Slope Analysis", CRCPress.
- Harr M.E.," Ground Water and Seepage", McGraw Hill.1962

Program Elective –V

MCG-203 A	FOUNDATIONS AND WEAK ROCKS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**

COURSE OUTCOME

The students will be able to classify different types of rock mass and design different types of foundations placed over rock mass.

Unit I

Engineering properties of weak rocks, different rock mass classification systems, relative merits and demerits

Failure criteria for weak rocks, bi-linear Mohr-Coulomb failure criterion, Hoek and Brown criterion and modified Hoek and Brown failure criterion etc.

Unit II

Effect of structural planes on rock foundations, possible modes of failure of foundations on rocks/ rock masses, determination of in-situ shear strength of rocks and rock masses

Unit III

Requirements for satisfactory performance of foundations, bearing capacity of foundations on rocks and rock masses, allowable bearing pressure of rock foundations using a nonlinear failure criterion, monotonic and cyclic plate load tests

Unit IV

Pressure-settlement characteristics, effect of layering, anisotropy, heterogeneity andinelasticity.

Shallow foundations, shallow foundations on sloping ground, raft foundations, stilt foundations, foundations for suspension bridges, transmission line towers, framed buildings etc, treatment of foundations - open joints, solution cavities, weak seams.

References:

- Wyllie Duncan C.," Foundations on Rock: Engineering Practice", E&FN Spon, Taylor and Francis.
- Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to the Principles, 1997. Elsevier, Oxford
- Singh, B. and Goel, R.K.,"Rock Mass Classification- A Practical Engineering Approach", Elsevier .
- Ramamurthy, T., "Engineering in Rocks", PHI Learning Pvt. Ltd.

MCG-205A	GEOTECHNICAL EARTHQUAKE ENGINEERING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 Hrs.

COURSE OUTCOME

- Students will know the causes and quantification of earthquake.
- Student will be exposed to the effect of earthquake and the design criterions to be followed for the design different geotechnical structures

Syllabus Contents:

Unit I

Earthquake seismology – Causes of earthquake, Plate tectonics, Earthquake fault sources,Seismic waves, Elastic rebound theory, Quantification of earthquake, Intensity and magnitudes, Earthquake source models.

Unit II

Earthquake ground motion – Seismograph, Characteristics of ground motion, Effect of localsite conditions on ground motions, Design earthquake, Design spectra, Development of sitespecification and code-based design.

Unit III

Ground response analysis – One-dimensional ground response analysis: Linear approaches,Equivalent linear approximation of non-linear approaches, Computer code "SHAKE".
Liquefaction and lateral spreadingLiquefactionrelated phenomena, Liquefactionsusceptibility: Historical, Geological, Compositional and State criteria. Evaluation ofliquefaction by cyclic stress and cyclic strain approaches, Lateral deformation and spreading, Criteria for mapping liquefaction hazard zones.

Unit IV

Seismic design of foundations, Seismic slope stability analysis: Internal stability and weakening instability and Seismic design of retaining walls.

References:

- Steven Kramer, "Geotechnical Earthquake Engineering", Pearson,2008.
- Seco e Pinto, P., Seismic behaviour of ground and Geotechnical structure, A. A.
- Naeim, F., The Seismic Design Handbook, Kluwer Academic Publication, 2nd Edition, 2001.

Ferrito, J.M, Seismic design criteria for soil liquefaction, Tech. Report of NavalFacilities service centre, Port Hueneme, 1997.

Open Elective

MTOE-201 A	Business Analytics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes (CO)							
CO1	*Able to have knowledge of various business analysis techniques.*						
CO2	*Learn the requirement specification and transforming the requirement into different models.*						
CO3	*Learn the requirement representation and managing requirement assests.*						
CO4	*Learn the Recent Trends in Embedded and collaborative business*						

Unit 1

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.
Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit 2

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.
Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit 3

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements.
Managing Requirements Assets: Change Control, Requirements Tools

Unit 4

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

References:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

MTOE-203 A	Industrial Safety						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the industrial safety.*						
Course Outcomes (CO)							
CO1	*Understand the industrial safety.*						
CO2	*Analyze fundamental of maintenance engineering.*						
CO3	*Understand the wear and corrosion and fault tracing.*						
CO4	*Understanding that when to do periodic inceptions and apply the preventing maintenance.*						

Unit-1

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-2

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-3

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-4

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

MTOE-205 A	Operations Research						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enable students to aware about the dynamic programming to solve problems of discreet and continuous variables and model the real world problem and simulate it.						
Course Outcomes (CO)							
CO1	*Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.*						
CO2	*Students should able to apply the concept of non-linear programming*						
CO3	*Students should able to carry out sensitivity analysis*						
CO4	*Student should able to model the real world problem and simulate it.*						

Unit -1

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit -2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit- 3

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit -4

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

MTOE-207 A	Cost Management of Engineering Projects						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to make aware about the cost management for the engineering project and apply cost models the real world projects.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the strategic cost management process.*						
CO2	*Students should able to types of project and project team types*						
CO3	*Students should able to carry out Cost Behavior and Profit Planning analysis.*						
CO4	*Student should able to learn the quantitative techniques for cost management.*						

Unit-1

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-2

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit-3

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-4

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

MTOE-209 A	Composite Materials						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the composite materials and their properties.*						

Course Outcomes (CO)	
CO1	*Students should able to learn the Classification and characteristics of Composite materials.*
CO2	*Students should able reinforcements Composite materials.*
CO3	*Students should able to carry out the preparation of compounds.*
CO4	*Student should able to do the analysis of the composite materials.*

UNIT–1:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Iso-strain and Iso-stress conditions.

UNIT – 2

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–3

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – 4

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

MTOE-211 A	Waste to Energy						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the generation of energy from the waste.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification of waste as a fuel.*						
CO2	*Students should able to learn the Manufacture of charcoal.*						
CO3	*Students should able to carry out the designing of gasifiers and biomass stoves.*						
CO4	*Student should able to learn the Biogas plant technology.*						

Unit-1

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-2

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-3

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-4

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1) Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2) Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3) Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4) Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
5)

MCG-207 A Dissertation Phase – I

Teaching Scheme

Lab work : 20 hrs/week

Course Outcomes:
At the end of this course, students will be able to

1. Identify Geotechnical engineering problems reviewing available literature.
2. Identify appropriate techniques to analyze complex structural systems.
3. Apply engineering and management principles through efficient handling of project

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

1. Relevance to social needs of society

    - Relevance to value addition to existing facilities in the
    - Relevance to industry need

2. Problems of national importance

3. Research and development in various domain

4. The student should complete the following:

    - Literature survey Problem
    - Definition Motivation for study and Objectives

    - Preliminary design / feasibility / modular approaches
    - Implementation and Verification

5. Report and presentation

Guidelines for Dissertation Phase – I

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated.
Phase – I: July to December

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The refer redliterature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

M Tech Semester-IV

MCG202-ADissertation Phase - II

Teaching Scheme

Lab work : 32 hrs/week

Course Outcomes:
At the end of this course, students will be able to

4. Identify Geotechnical engineering problems reviewing available literature.
5. Identify appropriate techniques to analyze complex structural systems.
6. Apply engineering and management principles through efficient handling of project

Syllabus Contents:
The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

5. Relevance to social needs of society
    - Relevance to value addition to existing facilities in the
    - Relevance to industry need
6. Problems of national importance
7. Research and development in various domain
8. The student should complete the following:
    - Literature survey Problem
    - Definition Motivation for study and Objectives
    - Preliminary design / feasibility / modular approaches
    - Implementation and Verification

5. Report and presentation

The dissertation phase- II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

Experimental verification / Proof of concept.

Design, fabrication, testing of Communication System.

The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase-II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The refer red literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

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Dissertation Phase – I and Dissertation Phase - II

Teaching Scheme

Lab work : 20 hrs/week for Dissertation Phase- I

Course Outcomes:

At the end of this course, students will be able to

7. Identify structural engineering problems reviewing available literature.
8. Identify appropriate techniques to analyze complex structural systems.
9. Apply engineering and management principles through efficient handling of project

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

9. Relevance to social needs of society

    - Relevance to value addition to existing facilities in the
    - Relevance to industry need

10. Problems of national importance

11. Research and development in various domain

12. The student should complete the following:

    - Literature survey Problem
    - Definition Motivation for study and Objectives

    - Preliminary design / feasibility / modular approaches
    - Implementation and Verification

5. Report and presentation

The dissertation phase- II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

Experimental verification / Proof of concept.

Design, fabrication, testing of Communication System.

The viva-voce examination will be based on the above report and work.

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Guidelines for Dissertation Phase – I and Phase-II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referredliterature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

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KURUKSHETRA UNIVERSITY, KURUKSHETRA

("A^{+}" Grade, NAAC Accredited)

SCHEME OF EXAMINATIONS FOR

Master of Technology (Civil Engineering) Specialization: Transportation Engineering

(w.e.f. SESSION: 2018-19)

SEMESTER- I

S. No.	Course Code	SUBJECT	L	T	P	Total	Evaluation		Cr.	Duration of Exam (Hrs.)
							Mid Sem	End Sem		
1	MTTE-101 A	Traffic Engineering	3	-	-	3	40	60	3	3
2	MTTE-103 A	Geometric Design of Highways	3	-	-	3	40	60	3	3
3	MTTE-105 A	Public Transportation	2	-	-	2	40	60	2	3
4	*	Program Elective –I	3	-	-	3	40	60	3	3
5	**	Program Elective-II	3	-	-	3	40	60	3	3
6	MTTE-115 A	Traffic Lab	-	-	2	2	40	60	2	3
7	MTRM-111 A	Research Methodology and IPR	2	-	-	2	40	60	2	3
8	***	Audit Course-I	2	-	-	2	100	-	0	0
	TOTAL		**16**	**2**	**2**	**20**	**280**	**420**	**18**	
							700			

***Program Elective - I**		****Program Elective- II**	
MTTE-107 A	Concrete Technology	MTTE-111 A	Intelligent Transport Systems
MTTE-109 A	Pavement Materials	MTTE-113 A	Environmental Impact Assessment

***** Audit Course-I**	
MTAD-101 A	English for Research Paper Writing
MTAD-103 A	Disaster Management
MTAD-105 A	Sanskrit for Technical Knowledge
MTAD-107 A	Value Education

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2. *** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

SEMESTER-II

S. No.	Course code	Subject	L	T	P	Total	Evaluation		Cr.	Duration of Exam (Hrs.)
							Mid Sem	End Sem		
1	MTTE-102 A	Pavement Analysis & Design	3	-	-	3	40	60	3	3
2	MTTE-104 A	Bridge Engineering	3	-	-	3	40	60	3	3
3	MTTE-106 A	Pavement Construction, Maintenance & Management	2	-	-	2	40	60	2	3
4	*	Program Elective-III	3	-	-	3	40	60	3	3
5	**	Program Elective-IV	3	-	-	3	40	60	3	3
6	MTTE-116 A	Computational Lab		-	2	2	40	60	2	3
7	MTTE- 118 A	Mini Project	-	-	4	2	40	60	2	3
8	***	Audit Course-II	2			0	100		0	3
	TOTAL		**16**		**4**	**18**	**280**	**420**	**18**	
							700			

***Program Elective - III**		****Program Elective – IV**	
MTTE-108 A	Advanced Railway Engineering	MTTE-112 A	Transportation Safety & Environment
MTTE-110 A	Transportation Planning	MTTE-114 A	Transportation Economics & Finance

***** Audit Course - II**	
MTAD-102 A	Constitution of India
MTAD-104 A	Pedagogy Studies
MTAD-106 A	Stress Management by Yoga
MTAD-108 A	Personality Development through Life Enlightenment Skills.

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2. ***Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

SEMESTER-Ⅲ

S. No.	Course Code	Subject	L	T	P	Total	Evaluation		Cr.	Duration of Exam (Hrs.)
							Mid Sem	End Sem		
1	*	Program Elective-V	3	-	-	3	40	60	3	3
2	**	Open Elective	3	-	-	3	40	60	3	3
3	MTTE-205 A	Dissertation Phase-I	-	-	20	20	100	-	10	3
		TOTAL	**6**		**20**	**26**	**180**	**120**	**16**	
							300			

***Program Elective –V**	
MTTE-201 A	Planning & Design of Airport
MTTE-203 A	Docks & Harbour Engineering

****Open Elective**		
1.	MTOE-201 A	Business Analytics
2.	MTOE-203 A	Industrial Safety
3.	MTOE-205 A	Operations Research
4.	MTOE-207 A	Cost Management of Engineering Projects
5.	MTOE-209 A	Composite Materials
6.	MTOE-211 A	Waste to Energy

SEMESTER-IV

S. No.	Course Code		L	T	P	Total	Evaluation		Cr.	Duration of Exam (Hrs.)
							Mid Sem	End Sem		
1	MTTE-202 A	Dissertation Phase-II	-	-	32	32	100	200	16	3
	TOTAL						**300**		**16**	

Total Credits of all four semesters: 68

Note: 1.The course of program elective/ open elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

MTTE-101 A	Traffic Engineering						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Study Different type of Traffic Characteristics, Regulations & Parking.*						
CO2	*Use of IRC method to design Signals & its recommendations for the design of various aspects of Roads.*						

UNIT – I

Traffic Characteristics: Importance of traffic characteristics, road user characteristics, vehicular characteristics. Max dimensions and weights of vehicles allowed in India. Effects of traffic characteristics on various design elements of the road.

Traffic Studies: Traffic volume study, speed study and origin and destination study. Speed and delay study. Use of photographic techniques in traffic surveys.

UNIT – II

Traffic Accidents: Accident surveys. Causes of road accidents and preventive measures. Capacity and level of Service, fundamental diagram of traffic flow. Relationship between speed, volume and density. PCU. Design service volume. Capacity of non-urban roads. IRC recommendations. Brief review of capacity of urban roads.

UNIT – III

Traffic Regulation and Control Devices: Traffic control devices: signs, signals, markings and islands. Types of signs. Types of signals. Design of signal by IRC method. Intersections at grade and grade separated intersections. Design of a rotary. Types of grade separated intersections.

Design of Parking Lighting and Terminal Facilities: Parking surveys. On street parking. Off street parking.

UNIT – IV

Traffic Regulation: Need and scope of traffic regulations. Regulation of speed, vehicles and drivers. General traffic regulations. Motor vehicle act. Scope of traffic management.

References:

1) Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.
2) Highway Engg by S.K.Khanna & C.E.G. Justo, New Chand Bros., Roorkee.
3) Principles and Practice of Highway Engg. By L.R.Kadiyali, Khanna Publishers, Delhi.
4) Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd. N. Delhi.
5) MORTH Specifications for Road and Bridge Works, IRC Publication.

MTTE-103 A	Geometric Design of Highways						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Study Highway Alignment, cross-section Elements & their inter-related terms.*						
CO2	*Analyse Sight Distances & design of super-elevation.*						

UNIT -I

Highway Alignment: Requirements. Factors controlling alignment. Obligatory points. Engineering surveys for highway location. Route selection. Steps in new project. Highway classifications.

UNIT –II

Cross Sectional Element: Pavement surface characteristics. Factors affecting skid resistance. Pavement unevenness. Camber. Providing camber in the field. Width of carriageway. Design Vehicle, medians, kerbs, road margins, right of way and typical cross sections of roads.

UNIT -III

Sight Distances: Introduction. Stopping sight distance. Reaction time. Analysis of stopping distance. Overtaking sight distance. Analysis of overtaking sight distance. Effect of grade on sight distances. Overtaking zone. Intermediate sight distance. Sight distance at intersections.
Superelevation: Requirement of superelevation. Limits and attainment of superelevation in the field.

UNIT –IV

Horizontal Alignment: General. Design speed. Horizontal curves. Superelevation. Analysis of superelevation. Superelevation design. Attainment of superelevation. Widening of pavement on horizontal curves. Methods of introducing extra widening. Horizontal Transition curves. Different types of transition curves. Length of transition curve. Setting out of transition curve. Set-back distance on horizontal curves. Curve resistance.
Vertical Alignment: General. Gradients. Compensation in gradient on horizontal curves. Vertical curves. Summit curve. Length of summit curve. Valley Curve. Length of valley curve and profile. Relevant IRC standards for urban and rural roads.

References:

1) Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.
2) Highway Engg.by S.K.Khanna & C.E.G. Justo, New Chand Bros., Roorkee.
3) Principles and Practice of Highway Engg.by. L.R.Kadiyali, Khanna Publishers, Delhi.
4) Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd. N. Delhi.
5) MORTH Specifications for Road and Bridge Works, IRC Publication.
6) Principles of Highway Engineering and Traffic Analysis, by Mannering, F., W. Kilareski, and S. Washburn 3rd Edition, John Wiley and Sons, 2005.

MTTE-105 A	Public Transportation						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Understand Transit System & its Capacity.*						
CO2	*Understand Public Transportation & Intermediate Public Transport.*						

UNIT – I

Public Transportation: Modes of public transportation and application of each to urban travel needs.

UNIT – II

Transit System: Transit system operations, para-transit systems, street transit systems, rapid transit systems, estimation of transit demand. Route development, properties of a good route set, determination of a good route set, stop location and stopping policy, schedule development, properties of a good schedule, determination of a good schedule.

UNIT – III

Capacity of Transit System: Capacity of rapid transit systems, line capacity of RTS, capacity of street transit systems. Transit corridor, identification and planning, mass transport management measures, integration of public transportation modes. Public transport infrastructure, case studies, multi mode transportation system.

UNIT – IV

Intermediate Public Transport: Planning for public transport, fares and subsidies. Intermediate public transport in Indian cities, types of IPT vehicles. Characteristics of IPT modes.

References:

1) Traffic Engg. And Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.
2) Introduction to Transport Planning by Bruton, M.J., Hutchinson Technical Education, London.
3) Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.

MTTE-107 A	Concrete Technology						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Study Ingredients, different properties & Production process of Concrete.*						
CO2	*Design Mix to achieve the specified grade of concrete.*						
CO3	*Understand Non-destructive testing & Concrete deteriorations.*						
CO4	*Introduction to advancement in Concrete.*						

UNIT – I

Concrete as Pavement Material: Introduction. Preparation and grade of concrete.

Concrete Ingredients: Types of cement. Aggregates. Classification of aggregate. Properties of aggregate. Quality of mixing water. Admixtures.

UNIT – II

Properties of Concrete: Introduction, workability, stress strain characteristics of concrete, young's modulus of concrete, creep and shrinkage of concrete, permeability, durability of concrete, joints.

UNIT – III

Production of Concrete: Batching, mixing, transportation, compaction, vibration, curing, formwork removing. Ready mixed concrete.

Non-Destructive Testing of Concrete: Significance. Rebound hammer. Ultrasonic pulse velocity technique. Penetration technique. Pullout test. Cover meter. Core tests.

UNIT – IV

Deteriorations: Causes, deteriorations by water, surface weir, frost action, chemical Reaction, corrosion of reinforcement etc, preventive measures.

Advances in Concrete: Introduction to light weight concrete. High strength concrete. Prestressed concrete. Fibre reinforced concrete. Polymer concrete composites.

References:

1) M.L.Gambhir, "Concrete Technology" TMH Pub. N Delhi.
2) Shetty M.S. "Concrete Technology" S. Chand & Co. N Delhi.

MTTE-109 A	Pavement Materials						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Study the different types of materials; it's Properties for the construction of Roads.*						
CO2	*Use of IS & IRC codes for the construction of Bituminous & concrete pavement.*						

UNIT – I

Subgrade: Significance of subgrade soil. Characteristics of soil. Desirable properties. Index properties of Soil. Soil classification based on grain size. Soil classification system. Evaluation of soil strength. **Aggregates:** Introduction. Desirable properties of road aggregates. Tests for road aggregates.

UNIT – II

Bituminous Materials: Introduction. Types of bituminous materials. Tests on bitumen. Cutback and emulsions.
Bituminous Paving Mixes: Design of bituminous mix. Marshal method of bituminous mix design.

UNIT – III

Polymer and Rubber Modified Binders: Physical and chemical properties. Fly ash and its characterization. Performance based mix design Approaches. Visco elastic properties of bitumen and bituminous mixture.

UNIT – IV

Construction Methods: Bituminous and concrete pavements. Relevant IS and IRC codes.

Reference:

1) Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.
2) Highway Engg by S.K.Khanna & C.E.G. Justo, New Chand Bros., Roorkee.
3) Principles and Practice of Highway Engg. By L.R.Kadiyali, Khanna Publishers, Delhi.
4) Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd. N.Delhi.
5) MORTH Specifications for Road and Bridge Works, IRC Publication.

MTTE-111 A	Intelligent Transport System						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Ability to collect data and analyse for ITS.*						
CO2	*Ability to develop ITS Model*						
CO3	*Ability to apply ITS for sustainable mobility.*						

UNIT – I

Fundamental of ITS: Definition of ITS, the historical context of ITS from both public policy and market economic perspective, Types of ITS, Historical background, Benefits of ITS.

UNIT – II

Sensor Technologies and data requirements of ITS: Importance of telecommunications in the ITS information management, Traffic management centers (TMC), Application of sensors to traffic management, Traffic flow sensors technologies, Transponders and communication systems, Data fusion at TMC, Sensor Plan and specification requirements, Elements of Vehicle location and Route navigation and guidance concepts.

ITS data collection techniques: Detectors, Automatic vehicle locations (AVL), Automatic vehicle identification (AVI), GIS, Video data collection.

UNIT – III

ITS User needs, services and functional areas: Introduction, Advanced traffic management systems (ATMS), Advanced traveller information systems (ATIS), Commercial vehicle operations (CVO), Advanced vehicle control systems (AVCS), Advanced public transportation systems (APTS), Advanced rural transportation systems (ARTS).

ITS Architecture: Regional and project ITS architecture, Concept of operations, ITS model and evaluation methods, Planning and human factors issues for ITS, Case studies on deployment planning and systems design and operation, ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business model, ITS planning.

UNIT – IV

ITS Applications: Traffic and incident management systems, ITS and sustainable mobility, Travel demand management, Electronic Toll Collection (ETC), ITS and road-prizing, Transportation network operation, Commercial vehicle operation and intermodal freight, Public transportation applications, ITS and regional strategic transportation planning including regional architectures.

ITS and changing transportation institutions: Automated highway systems- Vehicles in platoons, Integration of Automated highway systems, ITS program in the world- Overview of ITS implementations in developed countries, ITS in developing countries.

References:

1) Fundamental of Intelligent transportation systems planning by Mashrur A. Chaudhary, Adel Wadid Sadek.
2) Sensor technologies and Data requirements of ITS, Lawrence A. Klein.
3) ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
4) Perspective on ITS, Artech House Publishers, Sussman, J.M.

MTTE-113 A	Environmental Impact Assessment						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Assessment of Environmental impacts due to human activities.*						
CO2	*Management of Air Quality, Aquatic Environment & waste to reduce the impact on environment.*						

UNIT-I

Environment and Human Activity: Resources, pollution, reuse and environmental management. **Management of Aquatic Environment:** Water quality controls. Drainage basin activities and water pollution. The impact of human activity on aquatic resources. The control measures, regional planning.

UNIT-II

Air Quality Management: Atmosphere, effect of human activity on air quality, waste disposal alternative. Optimization, planning of waste disposal.

UNIT-III

Waste Management: Impact of waste disposal of human activity land use management, impact of land use on human life. Control of hazards in land use, management of land use.

UNIT-IV

Environmental Assessment: National environmental policy, implication of environment assessment in design process. Preparation of assessment, quantification. General requirements of environmental standards. Techniques of setting standards. Case studies of EIA of river valley projects and thermal power projects.

References:

1) Environmental Impact Analysis by R.K.Jail and L.V.Urban
2) Environmental Impact Assessment by Canter
3) Environmental Impact Assessment by J.Glasson

MTTE-115 A	Traffic Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
0	**0**	**2**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Study Traffic Volume & speed using Videography technique.*						
CO2	*Speed study by different methods*						
CO3	*Determine reaction time & Bitumen content*						
CO4	*Study parking, accident investigation & accident prone location.*						

1) Traffic volume study using videography technique.

2) Traffic speed study using videography technique.

3) Speed study by radar gun

4) Speed study by endoscope

5) Determination of reaction time of driver

6) Parking study

7) Accident investigation study

8) Study for improvement of an accident prone location

9) Bitumen content determination through centrifuge extrude

10) Proportioning of aggregate

MTRM -111 A	Research Methodology and IPR						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Understand Research problem formulation*						
CO2	*Analyze research related information*						
CO3	*Follow research ethics*						
CO4	*Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.*						
CO5	*Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.*						
CO6	*Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits*.						

Unit I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit II

Effective literature studies approaches, analysis Plagiarism, Research ethics.
Effective technical writing, how to write report paper,
Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.

6. Niebel , “Product Design”, McGraw Hill, 1974
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

MTTE-102 A	Pavement Analysis & Design						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Study the stresses in Flexible & Rigid Pavement for its design.*						
CO2	*Design flexible & Rigid Pavement by different methods.*						
CO3	*Evaluate Pavement & its maintenance.*						

UNIT - I

Pavement Types: Definition, highway and airport pavement comparison, wheel loads, tyre pressure, contact pressure, design factors. Type of distresses structural and functional, serviceability.

UNIT – II

Stresses in Flexible: Layered system concept, multilayered solutions. Burmister's method, fundamental design concepts.

Stresses in Rigid Pavements: Relative stiffness of slabs. Modulus of subgrade reaction. Stresses due to warping, stresses due to friction, effect of warping, contraction and expansion. Plain versus reinforced pavements, stresses in dowel bar, tie bar, combined stresses.

UNIT – III

Design of Flexible Pavements: Design factors. Design wheel load. Equivalent single wheel load. Difference between airport and highway design concept. Different design methods. Examples of comprehensive design process. AASHTO method. McLeod method. New IRC Code method.

Design of Rigid Pavement: General design considerations. Design of joints in cement concrete pavements, spacing of expansion joint, spacing of contraction joints. Design of dowel bar. Design of tie bar. IRC recommendations for design of concrete pavements.

UNIT – IV

Pavement Evaluation: Pavement distresses in flexible and rigid pavements, condition and evaluation survey. Present serviceability index. Methods of measuring condition, skid resistance. Principles of maintenance. Methods of structural evaluation.

References:

1) Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.
2) Highway Engg by S. K. Khanna & C.E.G. Justo, New Chand Bros., Roorkee.
3) Principles of Pavement Design, by Yoder E.J. and Witczak M.W. 2nd, John Wiley & Sons, INC.
4) Principles and Practice of Highway Engg. By L.R.Kadiyali, Khanna Publishers, Delhi.
5) Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd. N. Delhi.
6) MORTH Specifications for Road and Bridge Works, IRC Publication.

MTTE-104 A	Bridge Engineering						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Study different types of Bridge & loading as per IRC & IRS specifications*						
CO2	*Design RC & steel bridges by specifications & standards*						
CO3	*Study different types of bearing used in Bridges with their functions.*						

UNIT - I

Types of Bridges: Consideration of loads and stresses in bridges, bridge loading as per IRC and IRS specifications, traffic lanes, footway, kerbs, railing and parapet loading, impact, wind load, longitudinal forces, temp effects, secondary stresses, erection stresses, earth pressure, effect of live load on back fill and on the abutment.

UNIT – II

Design of RC Bridges: Slab culvert, box culvert, pipe culvert, T-beam bridge, super structure, design examples, brief introduction to rigid frame, arch and bow string girder bridges. Design of pre-stressed concrete bridges, pre-tensioned and post tensioned concrete bridges, analysis and design of multi-lane prestressed concrete T-beam bridge super structure.

UNIT – III

Steel Bridges: Types, economical span, loads, permissible stresses, fluctuation of stresses, secondary stresses, plate girder bridges, general arrangement, bridge floors, plate girder railway bridges, deck type plate girder bridges, design example. Truss bridges, types, wind force on lattice girder bridge, bracings, truss bridge for railway – through type truss bridge. Pier, abutment and wing walls, types of piers, forces on piers, stability, abutments, bridge code provisions for abutments, wing walls, design examples.

UNIT – IV

Bearings: Functions, bearings for steel and concrete bridges, bearings for continuous span bridges, IRC provisions for bearings, fixed bearings, expansion bearings, materials and specifications, permissible stresses, design considerations for rocker and roller cum rocker bearings, sliding bearings. Foundations, types, general design criterion, design of well and pile foundations for piers and abutments.

References:

1) Victor DJ, Essentials of Bridge Engineering, Oxford & IBH Pubb Co.
2) Rowe RE, Concrete ridge Design

MTTE-106 A	Pavement Construction, Maintenance & Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Study the construction procedure of different types of Bituminous, Non-Bituminous & cement concrete Pavements*						
CO2	*Study the Maintenance techniques for different types of Pavements.*						

UNIT – I

Introduction: History of road construction, stages of construction, seasonal limitations of pavement construction.

Stabilization of Soil: Mechanical stabilization, cementing additives and chemicals, thermal stabilization.

UNIT – II

Construction of Non-bituminous Pavements: Brief introduction to earthwork machinery: shovel, hoe, clamshell, dragline, bulldozers, cleaning and grubbing, excavation for road and drain, principles of field compaction of embankment / subgrade. Compacting equipments. Granular roads. Construction steps of GSB, WBM and WMM.

Construction of Bituminous Pavements: Various types of bituminous constructions. Prime coat, tack coat, seal coat and surface dressing. Construction of busg, premix carpet, BM, DBM and AC. Brief coverage of machinery for construction of bituminous roads: bitumen boiler, sprayer, pressure distributer, hot-mix plant, cold-mix plant, tipper trucks, mechanical paver or finisher, rollers. Mastic asphalt. Introduction to various IRC and MORTH specifications.

UNIT – III

Construction of Cement Concrete Roads: Construction of cement concrete pavements, machinery involved in construction, slip-form pavers, joints in cement concrete pavements, IRC and MORTH specifications. Construction of other types of pavements: basic concepts of the following: soil stabilized roads, use of geo-synthetics, reinforced cement concrete pavements, prestress concrete pavements, roller compacted concrete pavements and fibre reinforced concrete pavements. Use of fly ash in cement concrete road construction.

UNIT – IV

Highway Maintenance: Pavement distresses, Maintenance operations, Maintenance of WBM, bituminous surfaces and cement concrete pavements. Functional and structural evaluation of pavements, pavement maintenance, maintenance management

Related Topics: Emulsified bituminous mix, precoating of aggregates, recycling of bituminous pavements, shoulder construction.

References:

1) Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.
2) Highway Engg. By S.K.Khanna & C.E.G. Justo, New Chand Bros., Roorkee.

MTTE-108 A	Advanced Railway Engineering						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Study Railway Track Components*						
CO2	*Understand important terms related to Railway Curves, Control System & Rehabilitation.*						

UNIT - I

Railway Track: Track and track stresses. Train resistances and hauling power of locomotives. Railway track components.

UNIT - II

Point & Crossings: Important features. Railway curves. Superelevation, gradients and grade compensation. Points and crossing and their design approaches.

UNIT-III

Maintenance, Control System: Construction and maintenance of railway track. Control of train movements. Signals and interlocking,

UNIT-IV

Railway Rehabilitation: Modernization of railways and future trends. Track standards and track rehabilitation. Essential Reading.

References:

1) J.S. Mundrey, Railway Track Engineering, Tata McGraw Hill Co. Ltd., 3rd Edition, 2000.
2) M.M. Agarwal, Railway Track Engineering, Standard Publishers, 1st Ed 2005.
Supplementary Reading.
3) S. Chandra and Agarwal, Railway Engineering, Oxford University Press, 1st Ed. Feb 2008.
4) A.D. Kerr, Fundamentals of Railway Track Engineering, Simmons Boardman Pub Co (December 30, 2003)

MTTE-110 A	Transportation Planning						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Study the Transportation Planning Process & Survey.*						
CO2	*Study Trip Generation & Distribution for Transportation Planning.*						
CO3	*Study Modal split, Mass Rapid Transit Systems & It's Type.*						

UNIT – I

Transport Planning Process : Status of transportation in India. Objectives and scope of transport planning. Urban, regional and national transport planning. Transport planning process, various stages. Land use and traffic.

UNIT – II

Transportation Survey: Definition of study area. Zoning. Types of surveys. O-D surveys. Inventories of existing transport facilities, land use and economic activities. TRIP.

Generation: Trip purpose. Factors affecting trip generation. Trip generation estimation by multiple linear regression analysis, brief review of category analysis, advantages and limitations of these methods.

UNIT – III

Trip Distribution: Methods of trip distribution. Basic concepts of uniform factor method, average factor method and opportunity model. Trip distribution by gravity model.

Traffic Assignment: Principles of assignment. Assignment techniques. All or nothing assignment. Brief review of multipath assignment, capacity restraint assignment and diversion curves.

UNIT – IV

Modal Split: General considerations for modal split. Factors affecting modal split. Brief introduction to various methods of modal split.

Evaluation: Need for evaluation. Several plans to be formulated. Testing. Considerations in evaluation. Economic evaluation, basic principles, brief introduction to various methods of economic evaluation, comparison.

Mass Rapid Transit Systems: Problems of Urban Transport. Introduction to MRTS. Requirements of MRTS. Types of MRTS. MRTS in India

References:

1) Traffic Engg. And Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.
2) Highway Engg by S.K. Khanna & C.E.G. Justo, New Chand Bros., Roorkee.
3) Introduction to Transport Planning by Bruton, M.J., Hutchinson Technical Education, London.
4) Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall

MTTE-112 A	Transportation Safety & Environment						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Analyze the Road Accidents & the safety measures to reduce accidents*						
CO2	*Role of different organisation for Road safety.*						

UNIT – I

Road Accidents & safety measures: Trends in roads and highways development. Problem of road accidents in India. Characteristics of road accidents. Causes of accidents. Global and Indian road safety scenario. Factors responsible for success stories in road safety. Role of highway professionals in highway safety.

UNIT – II

Various Aspects for traffic safety: Planning of roads for safety. Land use planning and zoning. Development control and encroachment. Network hierarchy. Route planning through communities. Access control. Traffic segregation. Traffic calming designing for safety: road link design, alignment design. Cross-sectional elements. Traffic control devices. Road side safety. Road side facilities. Some critical elements. Junction design Basic principles. Selection of junction type. Factors affecting safety at various junction types. Elements to improve road safety. Provisions for vulnerable road users.

UNIT – III

Road safety audit: Concepts of road safety audit, Road safety auditors & key personnel in RSA. Organizing and conducting a road safety audit. Example and commonly identified. Issues during RSA, Road safety audit report. Development of cost-effective of road safety audit accident investigation and prevention. Basic strategies for accident reduction. Significance of accident data. Accident investigation and identification of potential sites for treatment. Problem diagnosis. Selection of countermeasures. Example of selection of counter measures. Detailed design and implementation of countermeasures.

UNIT – IV

Road safety Evaluation: Monitoring and evaluation non-engineering measures for road safety, behavioral counter measures, education. Training and publicity. The goal of police traffic control activities. Strategy for road safety management by police. Role of NGOs in road safety. Legal framework for road safety transport related pollution, noise pollution, air pollution, effects of weather conditions, vehicular emission parameters, pollution standards. EIA requirements of highway projects, world bank guidelines, EIA practices in India. Fuel crisis and transportation, factors affecting fuel consumption, fuel economy in various modes of transportation, various types of alternative fuels.

References:

1) Traffic Engg. And Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.
2) Highway Engg. By S.K.Khanna& C.E.G. Justo, New Chand Bros., Roorkee.

MTTE-114 A	Transportation Economics & Finance						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Evaluate economy in highway Projects by different methods.*						
CO2	*Find out different Cost in vehicle Operations, Maintenance & accidents.*						
CO3	*Study Traffic Congestion, Traffic Restraints, Road Pricing and Highway Finance.*						

UNIT – I

Economic Evaluation of Transport Plans: Need for economic evaluation. Cost and benefits of transport projects. Time horizon in economic assessment. Basic principles of economic evaluation, interest rate, method of economic evaluation, benefit cost ratio method, first year rate of return, net present value method, internal rate of return method. Comparison of various methods of economic evaluation.

UNIT – II

Vehicle Operating Costs: Introduction. Road used cost study in India. Components of VOC, factors affecting VOC. Fuel consumption relationship. Spare parts consumption. Maintenance and repairs labour cost, tyre life, lubricants, utilisation and fixed costs.

UNIT – III

Value of Travel Time Savings: Introduction. Classes of transport users enjoying travel time savings. Methodology for monetary evaluation of passengers, travel time. Review of work in India on passengers travel time.

Accidents Costs: Introduction. Relevance of accident costing for a developing country. Review of alternative methodologies for accident costing, Indian studies.

UNIT – IV

Traffic Congestion, Traffic Restraints and Road Pricing: Congestion as a factor in road traffic, Traffic restraint. Road pricing.

Highway Finance: Basic principles. Distribution of highway cost. Sources of revenue, Highway financing in India.

References:

1) Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.
2) Highway Engg by S.K.Khanna & C.E.G. Justo, New Chand Bros., Roorkee.
3) Principles and Practice of Highway Engg. By L.R.Kadiyali, Khanna Publishers, Delhi.
4) Principles of Transportation and Highway Engineering *by* G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd. N.Delhi.
5) MORTH Specifications for Road and Bridge Works, IRC Publication.

MTTE-116 A	Computational Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
0	**0**	**2**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Use of MORTH software for Rate Analysis of Highway Projects.*						
CO2	*Use of IRC Software for Pavement design & decision modeling.*						
CO3	*Conduct Experiments on geometric design of Highway by different software.*						

Exposure to various transportation related software's like:

1) Rate analysis by MORTH software.
2) IRC software's for pavement design.
3) IRC software's for decesion modeling.
4) Software for geometric design.

MTTE-118 A	Mini Project						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Identify Transportation engineering problems reviewing available literature*						
CO2	*Study different techniques used to analyze complex Transportation systems.*						
CO3	*Work on the solutions given and present solution by using his/her technique applying engineering principles.*						

Syllabus Content:

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals‟ contribution.

Continuous assessment of Mini Project at Mid Semester and End Semester will be monitored by the departmental committee.

MTTE-201 A	Planning & Design of Airport						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Study the layout of Airport by ICAO standards.*						
CO2	*Study the Runway Orientation & geometric Design.*						
CO3	*Plan & design Apron & Airport landscaping.*						

UNIT-I

Classification of Airports: ICAO standards. Planning for airport, airport components, zoning laws.

UNIT-II

Runways Orientation and Geometric Design: Runway patterns. Taxiways alignment geometry and turning radius exit taxiways.

UNIT-III

Aprons Planning And Design: Design principles of critical, semi-critical, non-critical airport pavements, FAA and PCA methods. Airport hangars, their planning and design criteria.

UNIT-IV

Airport landscaping: Grading and drainage general aspects. Airport terminal and amenities. Airport lighting and marking.

Recommended Books

1) N.J. Ashford, P.H. Wright, Airport Engineering, 3rd Edition, 1992, John Wiley
2) R.M. Horonjeff, F.X. McKelvey, W.J Sproule, Seth Young, Planning and Design of Airports, TMH International Publishers, Fifth Edition, 2009
3) Khanna, Arora and Jain, Planning and Design of Airports, New Chand Bros., 2001
4) Wells, Alexander; Young, Seth, Airport Planning & Management, McGraw Hill, 5th Edition, July, 2009
5) De N. Richard, & Odoni, Airport Systems: Planning, Design, and Management, McGraw Hill Amedeo, 1st Edition, 2004

MTTE-203 A	Docks and Harbour Engineering						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Enhance the knowledge of Docks and Harbour Engineering for the water transportation in the context of regional and intercontinental transportation.*						
CO2	*Study the techniques of planning and designing of infrastructures required for Harbour and Port area.*						
CO3	*Study cargo and passenger demand forecasting, cargo handling capacity of ports and economic evaluation of port project.*						

UNIT - I

Water Transportation: Scope, Merits, Developments of Water Transportation in India, Inland waterways, River, Canal, Inland water transportation, Development of ports & Harbours, Harbour classification, Site selection, Harbour dimensioning.

Natural Phenomena: Wind, Tides, Water waves, Wave decay & port, wave diffraction, breaking, reflection, Littoral drift, sediment transport, Effects on Harbour and structure design.

UNIT - II

Harbour Infrastructures: Types of breakwaters, jetty, dock fenders, piers, wharves, dolphin, mooring accessories, Repair facilities, wet docks, lift docks, dry docks, gates for graving docks, floating docks, slipways, locks and gates.

UNIT - III

Port facility: Transit shed, warehouses, cargo handling, container handling, Inland port facility, Navigational aids, types, requirements of signals, lighthouses, beacon light, buoys. Dredging & coastal protection: Types of dredgers, choices, usage of dredged material, sea wall protection-sea wall revetment, bulkhead.

UNIT - IV

Planning of ports: for regional and intercontinental transportation development, forecasting cargo & passenger demand, regional connectivity, cargo handling capacity of port, economic evaluation of port project, impacts of port activities.

References:

1) Bindra S.P., Docks & Harbour Engineering, Dhanpat Rai Publications,
2) Srinivasan R., Harbours, Docks & Tunnel Engineering, Charotar Publishing House, Anand, 1999.
3) Alonzo Def. Quinn, Design and Construction of Ports and Marine Structure, McGraw - Hill Book Company, New York

Open Elective

MTOE-201 A	Business Analytics						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**

Program Objective (PO)	
PO1	*Understand the role of business analytics within an organization*
PO2	*Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization*
PO3	*To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making*
PO4	*To become familiar with processes needed to develop, report, and analyze business data*
PO5	*Use decision-making tools/Operations research techniques*
PO6	*Mange business process using analytical and management tools*
PO7	*Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc*
Course outcomes (CO)	
CO1	*Students will demonstrate knowledge of data analytics*
CO2	*Students will demonstrate the ability of think critically in making decisions based on data and deep analytics*
CO3	*Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making*
CO4	*Students will demonstrate the ability to translate data into clear, actionable insights*

Unit I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

Unit II

Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit III

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization

Unit IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression orecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model

Unit V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without 8 Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit VI

Recent Trends in Embedded and collaborative business intelligence, Visual data 4 recovery, Data Storytelling and Data journalism.

References

1) Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2) Business Analytics by James Evans, persons Education

Open Elective

MTOE-203 A	Industrial Safety						
Lecture	Tutorial	Practical	Credit	End Sem. Evaluation	Mid Sem. Evaluation	Total	Time
3	0	0	3	60	40	100	3 Hrs.

Unit I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

Unit II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment

Unit III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment‟s like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

References

1) Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2) Maintenance Engineering, H. P. Garg, S. Chand and Company.
3) Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication
4) Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

Open Elective

MTOE-205 A	Operations Research						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Students should able to apply the dynamic programming to solve problems of discreet and continuous variables*						
CO2	*Students should able to apply the concept of non-linear programming*						
CO3	*Students should able to carry out sensitivity analysis*						
CO4	*Student should able to model the real world problem and simulate it*						

Unit I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References

1) H.A. Taha, Operations Research, An Introduction, PHI, 2008
2) H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982
3) J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4) Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5) Pannerselvam, Operations Research: Prentice Hall of India 2010
6) Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Open Elective

MTOE-207 A	Cost Management of Engineering Projects						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Students should able to learn the cost concepts in decision making*						
CO2	*Student should be able to do cost planning and Marginal Costing*						
CO3	*Students should be able to create a database for operational control and decision making.*						

Unit I

Introduction and Overview of the Strategic Cost Management Process

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit II

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Unit III

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit IV

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References

1) Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2) Charles T. Horngren and George Foster, Advanced Management Accounting
3) Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

Open Elective

MTOE-209 A	Composite Materials						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the composite materials and their properties.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification and characteristics of Composite materials.*						
CO2	*Students should able reinforcements Composite materials.*						
CO3	*Students should able to carry out the preparation of compounds.*						
CO4	*Student should able to do the analysis of the composite materials.*						

UNIT I

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Iso-strain and Iso-stress conditions.

UNIT II

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT III

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT IV

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Open Elective

MTOE-211 A	Waste to Energy						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the generation of energy from the waste.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification of waste as a fuel.*						
CO2	*Students should able to learn the Manufacture of charcoal.*						
CO3	*Students should able to carry out the designing of gasifiers and biomass stoves.*						
CO4	*Student should able to learn the Biogas plant technology.*						

Unit I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit II

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit III

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit IV

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1) Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2) Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

3) Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

4) Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Audit-I

MTAD-101 A	English For Research Paper Writing						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Student will able to understand the basic rules of research paper writing.*						
Course Outcomes (CO)							
CO1	*Understand that how to improve your writing skills and level of readability*						
CO2	*Learn about what to write in each section*						
CO3	*Understand the skills needed when writing a Title*						
CO4	*Ensure the good quality of paper at very first-time submission*						

Unit I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit III

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit IV

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

References:

1) Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2) Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3) Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman‟sbook.
4) Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Audit -I

MTAD-103 A	Disaster Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Develop an understanding of disaster risk reduction and management*						
Course Outcomes (CO)							
CO1	*Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.*						
CO2	*Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.*						
CO3	*Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.*						
CO4	*critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in*						

Unit I

Introduction: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit II

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit IV

Disasters Prone Areas in India: Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit 4

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People‟s Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

References:

1) R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “„New Royal book Company.

2) Sahni, PardeepEt.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.

3) Goel S. L., Disaster Administration And Management Text And Case Studies”,Deep &Deep Publication Pvt. Ltd., New Delhi.

Audit -I

MTAD-105 A	Sanskrit for Technical Knowledge						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Students will be able to Understanding basic Sanskrit language and Ancient Sanskrit literature about science & technology can be understood and Being a logical language will help to develop logic in students*						
Course Outcomes (CO)							
CO1	*To get a working knowledge in illustrious Sanskrit, the scientific language in the world*						
CO2	*Learning of Sanskrit to improve brain functioning*						
CO3	*Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power*						
CO4	*The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature*						

Unit I

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit II

Order, Introduction of roots,Technical information about Sanskrit Literature

Unit III

Technical concepts of Engineering: Electrical, Mechanical

Unit IV

Technical concepts of Engineering: Architecture, Mathematics

References

1) "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2) "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3) "India‟s Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Audit I

MTAD-107 A	Value Education						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand value of education and self- development, Imbibe good values in students and Let the should know about the importance of character*						
Course Outcomes (CO)							
CO1	*Knowledge of self-development*						
CO2	*Learn the importance of Human values*						
CO3	*Developing the overall personality*						
CO4	*Know about the importance of character*						

Unit I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.

Unit II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

Unit III

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

Unit IV

Character and Competence –Holy books Vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

References

1) Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Audit II

MTAD-102 A	Constitution of India						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective andto address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.*						
Course Outcomes (CO)							
CO1	*Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*						
CO2	*Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*						
CO3	*Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.*						
CO4	*Discuss the passage of the Hindu Code Bill of 1956.*						

Unit I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features

Unit 2

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality , Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor , Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit 3

Local Administration: District‟s Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit 4

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References

1) The Constitution of India, 1950 (Bare Act), Government Publication.
2) Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3) M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4) D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Audit-II

MTAD-104 A	Pedagogy Studies						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers and Identify critical evidence gaps to guide the development.*						
Course Outcomes (CO)							
CO1	*What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?*						
CO2	*What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?*						
CO3	*How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?*						
CO4	*What is the importance of identifying research gaps?*						

Unit I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology , Theories of learning, Curriculum, Teacher education., Conceptual framework, Research questions. Overview of methodology and Searching. Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. , Curriculum, Teacher education.

Unit II

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers‟ attitudes and beliefs and Pedagogic strategies.

Unit III

Professional development: alignment with classroom practices and follow-up support, Peer support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes,

Unit IV

Research gaps and future directions: Research design, Contexts , Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

References

1) Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

2) Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

3) Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4) Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

5) Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

6) Chavan M (2003) Read India: A mass scale, rapid, „learning to read‟ campaign.

Audit II

MTAD-106 A	Stress Management by Yoga						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To achieve overall health of body and mind and to overcome stress						
Course Outcomes (CO)							
CO1	*Develop healthy mind in a healthy body thus improving social health.*						
CO2	*Improve efficiency*						
CO3	*Learn the Yog asan*						
CO4	*Learn the pranayama*						

Unit I

Definitions of Eight parts of yog (Ashtanga).

Unit II

Yam and Niyam, Do`s and Don‟t‟s in life; Ahinsa, satya, astheya, bramhacharya and aparigraha; Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit III

Asan and Pranayam, Various yog poses and their benefits for mind & body,

Unit IV

Regularization of breathing techniques and its effects-Types of pranayam.

References

1) „Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2) "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Audit II

MTAD-108 A	Personality Development through Life Enlightenment Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To learn to achieve the highest goal happily To become a person with stable mind, pleasing personality and determination To awaken wisdom in students						
Course Outcomes (CO)							
CO1	*Students become aware about leadership.*						
CO2	*Students will learn how to perform his/her duties in day to day work.*						
CO3	*Understand the team building and conflict*						
CO4	*Student will learn how to become role model for the society.*						

Unit I

Neetisatakam-Holistic development of personality: Verses: 19, 20, 21, 22 (wisdom); Verses: 29, 31, 32 (pride & heroism); Verses: 26, 28, 63, 65 (virtue); Verses: 52, 53, 59 (don‟s); Verses: 71, 73, 75, 78 (do‟s).

Unit II

Approach to day to day work and duties; Shrimad Bhagwad Geeta: Chapter-2: Verses: 41, 47, 48; Chapter-3: Verses: 13, 21, 27, 35; Chapter-6: Verses: 5, 13, 17, 23, 35; Chapter-18: Verses: 45, 46, 48.

Unit III

Statements of basic knowledge; Shrimad Bhagwad Geeta: Chapter-2: Verses: 56, 62, 68; Chapter-12: Verses: 13, 14, 15, 16, 17, 18.

Unit IV

Personality of Role model; Shrimad Bhagwad Geeta: Chapter-2: Verses: 17; Chapter-3: Verses: 36, 37, 42: Chapter-4: Verses: 18, 38, 39; Chapter-18: Verses: 37, 38, 63.

References:

1) Srimad Bhagavad Gita, Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2) Bhartrihari‟s Three Satakam (Niti-sringar-vairagya), P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

MTTE-209 A Dissertation Phase – I

(Credits 0 : 0 : 20 =10)

Semester III

Teaching Scheme

Lab work : 20 hrs/week for Dissertation Phase- I
Mid Semester Evaluation weightage- 30% and End Semester Evaluation weightage- 70%

Course Outcomes:

At the end of this course, students will be able to

1. Identify structural engineering problems reviewing available literature.
2. Identify appropriate techniques to analyze complex structural systems.
3. Apply engineering and management principles through efficient handling of project

Syllabus Contents:

The dissertation-I will have mid semester presentation and end semester presentation. The mid semester presentation will include identification of problem based on literature review on the topic referring to latest literature available.
End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individual contribution.
Continuous assessment of Dissertation-I and Dissertation-II at mid semester and end semester will be monitored by the departmental committee.

MTTE-202 A Dissertation Phase – II
(Credits 0 : 0 : 32 = 16)

Semester IV

Teaching Scheme

Contact Hours : 3 hrs/week for Dissertation Phase- II

Course Outcomes:
At the end of this course, students will be able to:

1. Solve complex structural problems by applying appropriate techniques and tools.
2. Exhibit good communication skill to engineering community and society.
3. Demonstrate professional ethics and work culture.

Syllabus Contents:

Dissertation-II will be extension of the work on the topic identified in Dissertation-I
Continuous assessment should be done of the work done adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre-submission seminar at the end of academic term. After the approval the student has to submit the detailed report and external examiner is called for the viva-voce to assess along with guide.

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Guidelines for Dissertation Phase – I and Phase-II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department‟s laboratories and centers OR in industry allotted through department‟s T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Civil Engineering, Structural Engineering and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

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KURUKSHETRA UNIVERSITY, KURUKSHETRA
('A$^+$' Grade, NAAC Accredited)

SCHEME OF EXAMINATIONS FOR
Master of Technology (Civil Engineering) Specialization: Structural Engineering
(w.e.f. SESSION: 2018-19)

SEMESTER- I

S. No.	Course Code	SUBJECT	L	T	P	Total	Evaluation		Cr.	Duration of Exam (Hrs.)
							Mid Sem	End Sem		
1	MTSE-101 A	Advanced Structural analysis	3	-	-	3	40	60	3	3
2	MTSE-103 A	Advanced solid mechanics	3	-	-	3	40	60	3	3
3	*	Program Elective –I	3	-	-	3	40	60	3	3
4	**	Program Elective-II	3	-	-	3	40	60	3	3
5	MTSE-117 A	Structural Design Lab	-	-	2	2	40	60	2	3
6	MTSE-119 A	Advanced Concrete Lab	-	-	2	2	40	60	2	3
7	MTRM-111 A	Research Methodology and IPR	2	-	-	2	40	60	2	3
8	***	Audit Course-I	2	-	-	0	100	-	0	0
	TOTAL		**16**	**0**	**4**	**18**	**280**	**420**	**18**	
							700			

***Program Elective - I**		****Program Elective- II**	
MTSE-105 A	Theory of Thin Plates and Shells	MTSE-111A	Analytical and Numerical Methods for Structural Engineering.
MTSE-107 A	Theory and Applications of Cement Composites	MTSE-113 A	Structural Health Monitoring
MTSE-109 A	Theory of Structural Stability	MTSE-115 A	Structural Optimization

***** Audit Course-I**	
MTAD-101 A	English for Research Paper Writing
MTAD-103 A	Disaster Management
MTAD-105 A	Sanskrit for Technical Knowledge
MTAD-107 A	Value Education

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.
2. *** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

SEMESTER-II

S. No.	Course code	Subject	L	T	P	Total	Evaluation		Cr.	Duration of Exam (Hrs.)
							Mid Sem	End Sem		
1	MTSE- 102 A	FEM in Structural Engineering	3	-	-	3	40	60	3	3
2	MTSE-104 A	Structural Dynamics	3	-	-	3	40	60	3	3
3	*	Program Elective-III	3	-	-	3	40	60	3	3
4	**	Program Elective-IV	3	-	-	3	40	60	3	3
5	MTSE-122 A	Model Testing Lab		-	2	2	40	60	2	3
6	MTSE- 124 A	Numerical Analysis Lab	-	-	2	2	40	60	2	3
7	MTSE- 126 A	Mini Project	-	-	4	2	40	60	2	3
8	***	Audit Course-II	2			0	100		0	3
	TOTAL		**14**		**8**	**18**	**280**	**420**	**18**	
							700			

***Program Elective - III**		****Program Elective – IV**	
MTSE-106 A	Advanced Steel Design	MTSE-114 A	Design of Advanced Concrete Structures
MTSE-108 A	Design of Formwork	MTSE-116 A	Advanced Design of Foundations
MTSE-110 A	Design of High Rise Structures	MTSE-118 A	Soil Structure Interaction
MTSE-112 A	Design of Masonry Structures	MTSE-120 A	Design of Industrial Structure

***** Audit Course - II**	
MTAD-102 A	Constitution of India
MTAD-104 A	Pedagogy Studies
MTAD-106 A	Stress Management by Yoga
MTAD-108 A	Personality Development through Life Enlightenment Skills.

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2.***Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

SEMESTER-Ⅲ

S. No.	Course Code	Subject	L	T	P	Total	Evaluation		Cr.	Duration of Exam (Hrs.)
							Mid Sem	End Sem		
1	*	Program Elective-V	3	-	-	3	40	60	3	3
2	**	Open Elective	3	-	-	3	40	60	3	3
3	MTSE-209 A	Dissertation Phase-I	-	-	20	20	100	-	10	3
		TOTAL	**6**		**20**	**26**	**180**	**120**	**16**	
							300			

***Program Elective –V**	
MTSE-201 A	Design of Pre-stressed Concrete Structures
MTSE-203 A	Analysis of Laminated Composite Plates
MTSE-205 A	Fracture Mechanics of Concrete Structures
MTSE-207 A	Design of Plates and Shells

****Open Elective**		
1.	MTOE-201 A	Business Analytics
2.	MTOE-203 A	Industrial Safety
3.	MTOE-205 A	Operations Research
4.	MTOE-207 A	Cost Management of Engineering Projects
5.	MTOE-209 A	Composite Materials
6.	MTOE-211 A	Waste to Energy

SEMESTER-IV

S. No.	Course Code		L	T	P	Total	Evaluation		Cr.	Duration of Exam (Hrs.)
							Mid Sem	End Sem		
1	MTSE-202 A	Dissertation Phase-II	-	-	32	32	100	200	16	3
	TOTAL						**300**		**16**	

Total Credits of all four semesters: 68

Note: 1.The course of program elective/ open elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

Evaluation of Mid Sem.(40 Marks) for all the semesters:

(a)Mid semester examination(s): Two Nos each of 10 marks=20 Marks

(b)Attendance/ Regularity : 10 Marks

(c) Teacher's Assessment / Quizzes/ Assignments etc : 10 Marks

MTSE-101 A	Advanced Structural Analysis						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Analyze the skeleton structures using stiffness analysis code.*						
CO2	*Use direct stiffness method understanding its limitations*						

Unit I

Influence Coefficients: Physical Significance, Effects of Settlements, Temperature Change andLack of Fit, Member Approach and Structure Approach

Unit II

Stiffness Method applied to Large Frames: Local Coordinates and Global Coordinates.

Stiffness Matrix Assembly of Structures: Stiffness Matrix in GlobalCoordinates, BoundaryConditions,Solution of Stiffness Matrix Equations, Calculation of Reactions and Member Forces

Unit III

Applications to Simple Problems: Beams, Plane Trusses, Plane Rigid Jointed Frames andGrids by Structure Approach and Member Approach.

Unit IV

Boundary Value Problems (BVP): Approximate Solution of Boundary Value Problems,Modified GalerkinMethod for One-Dimensional BVP, Matrix Formulation ofthe Modified GalerkinMethod.

Linear Element: Shape Functions, Solution for Poisson's Equation, General OneDimensionalEquilibrium Problem.

References:

1) Matrix Analysis of Framed Structures, Weaver and Gere.
2) The Finite Element Method, Lewis P. E. and WardJ. P., Addison-Wesley Publication Co.
3) Computer Methods in Structural Analysis, MeekJ. L., E and FN, Span Publication.
4) The Finite Element Method, Desai and Able, CBS Publication.
5) Matrix Analysis of Structures, Pandit& Gupta, Tata McGraw Hill Publications

MTSE-103 A	Advanced Solid Mechanics						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Solve simple problems of elasticity and plasticity understanding the basic concepts*						
CO2	*Apply numerical methods to solve continuum problems*						

Unit I

Introduction to Elasticity: Displacement, Strain and Stress Fields, Constitutive Relations,Cartesian Tensors and Equations of Elasticity.

Strain and Stress Field: Elementary Concept of Strain, Stain at a Point, Principal Strains andPrincipal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic andDeviatoric Components.

Unit II

Equations of Elasticity: Equations of Equilibrium, Stress- Strain relations, Strain Displacementand Compatibility Relations, Boundary Value Problems, Co-axialityof the Principal Directions.

Unit III

Two-Dimensional Problems of Elasticity: Plane Stress and Plane Strain Problems, Airy'sstress Function, Two-Dimensional Problems in Polar Coordinates.

Torsion of Prismatic Bars: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion ofRectangular Bar, Torsion of Thin Tubes

Unit IV

Plastic Deformation: Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, vonMises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.

References:

1) Theory of Elasticity, Timoshenko S. and Goodier J. N., McGraw Hill, 1961.
2) Elasticity, Sadd M.H.,Elsevier,2005.
3) Engineering Solid Mechanics, Ragab A.R., Bayoumi S.E., CRC Press,1999.
4) Computational Elasticity, Ameen M., Narosa,2005.
5) Solid Mechanics, Kazimi S. M. A., Tata McGraw Hill,1994.
6) Advanced Mechanics of Solids, Srinath L.S., Tata McGraw Hill, 2000.

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MTSE-117 A	Structural Design Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
0	**0**	**2**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Design and Detail all the Structural Components of Frame Buildings.*						
CO2	*Design and Detail complete Multi-Storey Frame Buildings*						

Syllabus Content:

Design and detailed drawing of complete G+ 3 structures by individual student using latest relevant IS codes.

MTSE-119 A	Advanced Concrete Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
0	**0**	**2**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Design high grade concrete and study the parameters affecting its performance*						
CO2	*Conduct Non Destructive Tests on existing concrete structures*						
CO3	*Apply engineering principles to understand behavior of structural/ elements*						

List of Experiments:

1. Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
2. Effect of cyclic loading on steel.
3. Non-Destructive testing of existing concrete members.
4. Behavior of Beams under flexure, Shear and Torsion.

References:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
2. Concrete Technology, Shetty M. S., S. Chand and Co., 2006.

MTRM -111 A	Research Methodology and IPR						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Understand Research problem formulation*						
CO2	*Analyze research related information*						
CO3	*Follow research ethics*						
CO4	*Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.*						
CO5	*Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.*						
CO6	*Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.*						

Unit I

Meaning of research problem, Sources of research problem, Criteria Characteristicsof a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit II

Effective literature studies approaches, analysisPlagiarism,Research ethics.

Effective technical writing, how to write report paper,

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patentinformation and databases. Geographical Indications

New Developments in IPR: Administration of Patent System. New developments inIPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

MTSE-102 A	Finite Element Method in Structural Engineering						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Use Finite Element Method for structural analysis.*						
CO2	*Execute the Finite Element Program/ Software*						
CO3	*Solve continuum problems using finite element analysis*						

Unit I

Introduction: History and Applications. Spring and Bar Elements, Minimum Potential EnergyPrinciple, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress

Unit II

Beam Elements: Flexure Element, Element Stiffness Matrix, Element Load Vector.

Method of Weighted Residuals: Galerkin Finite Element Method, Application to StructuralElements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications

Unit III

Types: Triangular Elements, Rectangular Elements, Three-Dimensional Elements, IsoparametricFormulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature

Unit IV

Application to Solid Mechanics: Plane Stress, CST Element, Plane Strain Rectangular Element,Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations.

Computer Implementation of FEM procedure, Pre-Processing, Solution, Post-Processing, Useof Commercial FEA Software.

References:

1) Finite Element Analysis, Seshu P., Prentice-Hall of India,2005.
2) Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995.
3) Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004
4) Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995
5) Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000
6) Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., Prentice Hall India, 1991

MTSE-104 A	Structural Dynamics						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Analyze and study dynamics response of single degree freedom system using fundamental theory and equation of motion.*						
CO2	*Analyze and study dynamics response of Multi degree freedom system using fundamental theory and equation of motion*						
CO3	*Use the available software for dynamic analysis*						

Unit I

Introduction: Objectives, Importance of Vibration Analysis, Nature of ExcitingForces, Mathematical Modeling of Dynamic Systems.

Unit II

Single Degree of Freedom System: Free and Forced Vibration with and without Damping,Response to Harmonic Loading, Response to General Dynamic Loading using Duhamel's Integral, Fourier Analysis for Periodic Loading, State Space Solution for Response.

Numerical Solution to Response using Newmark Method and Wilson Method, NumericalSolution for State Space Response using Direct Integration.

Unit III

Multiple Degree of Freedom System (Lumped parameter): Two Degree of Freedom System,Multiple Degree of Freedom System, Inverse Iteration Method for Determination ofNatural Frequencies andMode Shapes, Dynamic Response by Modal Superposition Method, Direct Integration ofEquation ofMotion.

Unit IV

Multiple Degree of Freedom System (Distributed Mass and Load): Single Span Beams, FreeandForced Vibration, Generalized Single Degree of Freedom System

Special Topics in Structural Dynamics(Concepts only): Dynamic Effects ofWind Loading,Moving Loads, Vibrations caused by Traffic, Blasting andPile Driving, Foundations for Industrial Machinery, Base Isolation.

References:

1) Dynamics of Structures, Clough R. W. and Penzien J., McGraw Hill.
2) Structural Dynamics and Introduction to Earthquake Engineering, Chopra A. K.
3) Vibration of Structures - Application in Civil Engineering Design, Smith J. W., Chapman and Hall
4) Dynamics of Structures, Humar J. L., Prentice Hall.
5) Structural Dynamics - Theory and Computation, Paz Mario, CBS Publishers
6) Dynamics of Structures, Hart and Wong

MTSE-122 A	Model Testing Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
0	**0**	**2**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Understand the response of structures.*						
CO2	*Prepare the models*						
CO3	*Conduct model testing for static loading.*						
CO4	*Conduct model testing for free and forced vibrations*						

Syllabus Content:

1. Response of structures and its elements against extreme loading events.
2. **Model Testing**: Static - testing of plates, shells, and frames models.
3. **Model Testing**: Free and forced vibrations, Evaluation of dynamic modulus.
4. Beam vibrations, Vibration isolation, Shear wall building model, Time and frequency-domain study, Vibration Characteristics of RC Beams using Piezoelectric Sensors etc.

MTSE-124 A	Numerical Analysis Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
0	**0**	**2**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Find Roots of non-linear equations by Bisection method and Newton's method.*						
CO2	*Do curve fitting by least square approximations.*						
CO3	*Solve the system of Linear Equations using Gauss - Elimination/ Gauss - Seidal Iteration/ Gauss - Jorden Method*						
CO4	*To Integrate Numerically Using Trapezoidal and Simpson's Rules*						
CO5	*To Find Numerical Solution of Ordinary Differential Equations by Euler's Method, Runge- Kutta Method*						

List of Experiments:

1. Find the Roots of Non-Linear Equation Using Bisection Method.
2. Find the Roots of Non-Linear Equation Using Newton's Method.
3. Curve Fitting by Least Square Approximations.
4. Solve the System of Linear Equations Using Gauss - Elimination Method.
5. Solve the System of Linear Equations Using Gauss - Seidal Iteration Method.
6. Solve the System of Linear Equations Using Gauss - Jorden Method.
7. Integrate numerically using Trapezoidal Rule.
8. Integrate numerically using Simpson's Rules.
9. Numerical Solution of Ordinary Differential Equations By Euler's Method.
10. Numerical Solution of Ordinary Differential Equations ByRunge- Kutta Method.

MTSE-126 A	Mini Project						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Identify structural engineering problems reviewing available literature*						
CO2	*Study different techniques used to analyze complex structural systems.*						
CO3	*Work on the solutions given and present solution by using his/her technique applying engineering principles.*						

Syllabus Content:

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Semester and End Semester will be monitored by the departmental committee.

Program Elective -I

MTSE-105 A	Theory of Thin Plates and Shells						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Use analytical methods for the solution of thin plates and shells*						
CO2	*Use analytical methods for the solution of shells.*						
CO3	*Apply the numerical techniques and tools for the complex problems in thin plates*						
CO4	*Apply the numerical techniques and tools for the complex problems in shells.*						

Unit 1

Introduction: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations,Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation ofEquilibrium using Principle ofVirtual Work, Boundary Conditions.

Unit 2

Static Analysis of Plates: Governing Equation for a Rectangular Plate, NavierSolution forSimply-Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions

Unit 3

Circular Plates: Analysis under Axi- Symmetric Loading, Governing Differential Equation inPolar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.

Unit 4

Static Analysis of Shells: Membrane Theory ofShells - Cylindrical, Conical andSphericalShells,

Unit 5

Shells ofRevolution: with Bending Resistance - Cylindrical andConical Shells, Application toPipes and Pressure Vessels.

Unit 6

Thermal Stresses in Plate/ Shell

References:

1. Theory of Plates and Shells, Timoshenko S. and Krieger W., McGraw Hill.
2. Stresses in Plates and Shells, UguralAnsel C., McGraw Hill.
3. Thin Elastic Shells, Kraus H" John Wiley and Sons
4. Theory of Plates, Chandra shekhara K., Universities Press
5. Design and Construction of Concrete Shells, RamaswamyG.S

Program Elective -I

MTSE-107 A	Theory and Applications of Cement Composites						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Formulate constitutive behaviour of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete - by understanding their strain- stress behaviour.*						
CO2	*Classify the materials as per orthotropic and anisotropic behaviour.*						
CO3	*Estimate strain constants using theories applicable to composite materials.*						
CO4	*Analyse and design structural elements made of cement composites.*						

Unit 1

Introduction: Classification and Characteristics of Composite Materials- Basic Terminology,Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.

Unit 2

Mechanical Behaviour: Mechanics of Materials Approach to Stiffness- Determination ofRelations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness

Unit 3

Cement Composites: Types of Cement Composites, Terminology, Constituent Materialsand their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferrocement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing

Unit 4

Mechanical Properties of Cement Composites :Behavior of Ferrocement, Fiber ReinforcedConcrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion

Unit 5

Application of Cement Composites: FRC and Ferrocement- Housing, Water Storage, Boats andMiscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants

Unit 6

Analysis and Design of Cement Composite Structural Elements - Ferrocement, SIFCONand Fibre Reinforced Concrete.

References:

1) Mechanics of Composite Materials, Jones R. M,, 2nd Ed., Taylor and Francis ,BSP Books, 1998. Ferrocement – Theory and Applications, Pama R. P., IFIC, 1980
2) New Concrete Materials, Swamy R.N., 1stEd., Blackie, Academic and Professional, Chapman & Hall, 1983

Program Elective -I

MTSE-109 A	Theory of Structural Stability						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Determine stability of columns and frames*						
CO2	*Determine stability of beams and plates*						
CO3	*Use stability criteria and concepts for analyzing discrete and continuous systems*						

Unit-1

Criteria for Design of Structures: Stability, Strength, and Stiffness, Classical Concept ofStability of Discrete and Continuous Systems, Linear and nonlinear behavior.

Unit-2

Stability of Columns: Axial and Flexural Buckling, Lateral Bracing of Columns, CombinedAxial, Flexural and Torsion Buckling.

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Unit-3

Stability of Frames: Member Buckling versus Global Buckling, Slenderness Ratio of FrameMembers.

Unit-4

Stability of Beams: lateral torsion buckling

Unit-5

Stability of Plates: axial flexural buckling, shear flexural buckling, buckling under combinedloads

Unit-6

Stability of Plates: axial flexural buckling, shear flexural buckling, buckling under combinedloads

Reference Books:

1) Theory of elastic stability, Timoshenko and Gere, Tata McGraw Hill,1981
2) Principles of Structural Stability Theory, Alexander Chajes, Prentice Hall, New Jersey
3) Structural Stability of columns and plates, Iyengar, N. G. R., Eastern west press Pvt. Ltd.
4) Strength of Metal Structures,Bleich F. Bucking, Tata McGraw Hill, New York.

Program Elective -II

MTSE-111 A	Analytical and Numerical Methods for Structural Engineering						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Solve ordinary and partial differential equations in structural mechanics using numerical methods*						
CO2	*Write a program to solve a mathematical problem.*						

Unit 1

Fundamentals of Numerical Methods: Error Analysis, Polynomial Approximations andInterpolations

Unit 2

Curve Fitting; Interpolation and extrapolation

Unit 3

Solution of Nonlinear Algebraic and Transcendental Equations

Unit 4

Elements of Matrix Algebra: Solution of Systems of Linear Equations, Eigen Value Problems

Unit 5

Numerical Differentiation & Integration: Solution of Ordinary and Partial DifferentialEquations.

Unit 6

Finite Difference scheme: Implicit & Explicit scheme

Unit 7

Computer Algorithms: Numerical Solutions for Different Structural Problems, Fuzzy Logic andNeural Network

References:

1) An Introduction to Numerical Analysis, AtkinsonK.E., J. Wiley and Sons, 1989.
2) Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.
3) Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998

Program Elective -II

MTSE-113 A	Structural Health Monitoring						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Diagnosis the distress in the structure understanding the causes and factors.*						
CO2	*Assess the health of structure using static field methods.*						
CO3	*Assess the health of structure using dynamic field tests*						
CO4	*Suggest repairs and rehabilitation measures of the structure*						

Unit 1

Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.

Unit 2

Structural Health Monitoring: Concepts, Various Measures, Structural Safety in Alteration.

Unit 3

Structural Audit: Assessment of Health of Structure, Collapse and Investigation, InvestigationManagement, SHM Procedures.

Unit 4

Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems andhardware requirements, Static Response Measurement.

Unit 5

Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic ResponseMethods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

Unit 6

Introduction to Repairs and Rehabilitations of Structures: Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

References:

1) Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006
2) Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007
3) Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006
4) Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007

Program Elective -II

MTSE-115 A	Structural Optimization						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Use Variational principle for optimization*						
CO2	*Apply optimization techniques to structural steel and concrete members*						
CO3	*Design using frequency constraint*						

Unit 1

Introduction: Simultaneous Failure Mode andDesign, ClassicalExternalProblems.

Unit 2

Calculus of Variation: Variational Principles with Constraints.

Unit 3

Linear Programming Integer Programming, Nonlinear Programming, Dynamic Programming, Geometric Programming and Stochastic Programming.

Unit 4

Applications: Structural Steel and Concrete Members, Trusses and Frames

Unit 5

Design: Frequency Constraint, Design of Layouts

References:

1) Elements of Structural Optimization, Haftka, Raphael T., Gürdal, Zafer, Springer.
2) Variational methods for Structural optimization, Cherkaev Andrej, Springer

Program Elective -III

MTSE-106 A	Advanced Steel Design						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Design steel structures/ components by different design processes*						
CO2	*Analyze and design beams and columns for stability and strength, and drift*						
CO3	*Design welded and bolted connections*						

Unit 1

Properties of Steel: Mechanical Properties, Hysteresis, Ductility.

Unit 2

Hot Rolled Sections: compactness and non-compactness, slenderness, residual stresses.

Unit 3

Design of Steel Structures: Inelastic Bending Curvature, Plastic Moments, Design CriteriaStability, Strength, Drift.

Unit 4

Stability of Beams: Local Buckling of Compression Flange &Web, Lateral Torsional Buckling.

Unit 5

Stability of Columns: Slenderness Ratio, Local Buckling of Flanges and Web, Bracing of Columnabout Weak Axis.

Unit 6

Method of Designs: Allowable Stress Design, Plastic Design, Load and Resistance Factor Design;

Unit 7

Strength Criteria: Beams - Flexure, Shear, Torsion, Columns - Moment Magnification Factor,Effective Length PM Interaction, Biaxial Bending, Joint Panel Zones.

Unit 8

Drift Criteria: P Effect, Deformation Based Design

Unit 9

Connections: Welded, Bolted, Location Beam Column, Column Foundation, Splices.

References:

1) Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi
2) Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee
3) The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R., Heyman J., ELBS
4) Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London
5) IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007
6) SP – 6 - Handbook of Structural Steel Detailing, BIS,1987

Program Elective -III

MTSE-108 A	Design of Formwork						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Select proper formwork, accessories and material*						
CO2	*Design the form work for Beams, Slabs, columns, Walls and Foundations*						
CO3	*Design the form work for Special Structures*						
CO4	*Understand the working of flying formwork*						
CO5	*Judge the formwork failures through case studies*						

Unit 1

Introduction: Requirements and Selection of Formwork

Unit 2

Formwork Materials- Timber, Plywood, Steel, Aluminum, Plastic, and Accessories. Horizontaland Vertical Formwork Supports

Unit 3

Formwork Design: Concepts, Formwork Systems and Design for Foundations, Walls, Columns,Slab and Beams

Unit 4

Formwork Design for Special Structures: Shells, Domes, Folded Plates, OverheadWater Tanks, Natural Draft Cooling Tower, Bridges

Unit 5

Flying Formwork: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete,Formwork Management Issues –Pre- and Post-Award.

Unit 6

Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story Building Construction

References:

1) Formwork for Concrete Structures, Peurify, McGraw Hill India, 2015
2) Formwork for Concrete Structures, Kumar NeerajJha, Tata McGraw Hill Education, 2012
3) IS 14687: 1999, False workfor Concrete Structures - Guidelines, BIS

Program Elective -III

MTSE-110 A	Design of High Rise Structures						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Analyze, design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions*						
CO2	*Analyze, design and detail the RC and Steel Chimney*						
CO3	*Analyze. design and detail the tall buildings subjected to different loading conditions using relevant codes*						

Unit 1

Design of transmission/ TV tower, Mast and trestles: Configuration, bracing system, analysisand design for vertical transverse and longitudinal loads.

Unit 2

Analysis and Design of RC and Steel Chimney, Foundation design for varied soil strata.

Unit 3

Tall Buildings: Structural Concept, Configurations, various systems, Wind and Seismic loads,Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions

Unit 4

Application of software in analysis and design.

References:

1) Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., SouthAsian Publishers, New Delhi, 2002
2) Structural Analysis and Design of Tall Buildings, Taranath B. S., McGraw Hill, 1988
3) Illustrated Design of Reinforced Concrete Buildings (GF+3storeyed), Shah V. L. &Karve S. R., Structures Publications, Pune, 2013
4) Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976
5) Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991
6) High Rise Building Structures, Wolfgang Schueller, Wiley., 1971
7) Tall Chimneys, Manohar S. N., Tata McGraw Hill Publishing Company, New Delhi

Program Elective -III

MTSE-112 A	Design of Masonry Structures						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Understand the masonry design approaches.*						
CO2	*Analyze Reinforced Masonry Members*						
CO3	*Determine interactions between members*						
CO4	*Determine shear strength and ductility of Reinforced Masonry members*						
CO5	*Check the stability of walls*						
CO6	*Perform elastic and Inelastic analysis of masonry walls*						

Unit-I

Introduction: Historical Perspective, Masonry Materials, Masonry Design Approaches, Overviewof Load Conditions, Compression Behavior of Masonry, Masonry Wall Configurations, Distribution of Lateral Forces

Unit-II

Flexural Strength of Reinforced Masonry Members: In plane and Out-of-plane Loading

Unit-III

Interactions: Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation

Unit-IV

Shear Strength and Ductility of Reinforced Masonry Members

Unit-V

Prestressed Masonry - Stability of Walls, Coupling of Masonry Walls, Openings, Columns,Beams

Unit-VI

Elastic and Inelastic Analysis, Modeling Techniques, Static Push-Over Analysis and use ofCapacity Design Spectra

References Books:

1) Design of Reinforced Masonry Structures, NarendraTaly, ICC, 2nd Edn
2) Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G., 1994
3) Mechanics of Masonry Structures, Editor: Maurizio Angelillo, 2014
4) Earthquake-resistant Design of Masonry Buildings,TomaeviMiha, Imperial College Press, 1999

Program Elective -IV

MTSE-114 A	Design of Advanced Concrete Structures						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Analyze the special structures by understanding their behaviour*						
CO2	*Design and prepare detail structural drawings for execution citing relevant IS codes*						

Unit-I

Design philosophy, Modeling of Loads, Material Characteristics

Unit-II

Reinforced Concrete - P-M, M-phi Relationships, Strut-and- Tie Method, Design of Deep Beamand Corbel, Design of Shear Walls, Compression Field Theory for Shear Design, Design against Torsion; IS, ACI and Eurocode

Unit-III

Steel Structures -- Stability Design, Torsional Buckling - Pure, Flexural and Lateral, Designof Beam-Columns, Fatigue Resistant Design, IS code, AISC Standards and Eurocode

References Books:

1) Reinforced Concrete Design, Pillai S. U. and MenonD., Tata McGraw-Hill, 3rd Ed, 1999
2) Design of Steel Structures, Subramaniam N., Oxford University Press, 2008
3) Reinforced Concrete Structures, Park R.andPaulayT. , John Wiley & Sons, 1995
4) Advanced Reinforced Concrete Design, Varghese P. C., Prentice Hall of India, New Delhi
5) Unified Theory of Concrete Structures, Hsu T. T. C. and Mo Y. L., John Wiley & Sons, 2010
6) Steel Structures Design and Behavior Emphasizing Load and Resistance Factor Design, Salmon C. G., Johnson J. E. and Malhas F. A., Pearson Education, 5th Ed, 2009
7) Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi
8) Plastic Methods of Structural Analysis, Neal B.G., Chapman and Hall London

Program Elective -IV

MTSE-116 A	Advanced Design of Foundation						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	Decide the suitability of soil strata for different projects						
CO2	Design shallow foundations deciding the bearing capacity of soil						
CO3	Analyze and design the pile foundation						
CO4	Understand analysis methods for well foundation						

Unit-I

Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods ofBorings along with Various Penetration Tests

Unit-II

Shallow Foundations, Requirements for Satisfactory Performance of Foundations, Methods ofEstimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws

Unit-III

Pile Foundations, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations,Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behavior of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles

Unit-IV

Well Foundation, IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods

Unit-V

Tunnels and Arching in Soils, Pressure Computations around Tunnels

Unit-VI

Open Cuts, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types

Unit-VII

Coffer Dams, Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structureinteraction

Reference Books

1) Design of foundation system, N.P. Kurian, Narosa Publishing House
2) Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York
3) Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi

Program Elective -IV

MTSE-118 A	Soil Structure Interaction						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Understand soil structure interaction concept and complexities involved*						
CO2	*Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics*						
CO3	*Prepare comprehensive design oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc*						
CO4	*Analyze different types of frame structure founded on stratified natural deposits with linear and non-linear stress-strain characteristics*						
CO5	*Evaluate action of group of piles considering stress-strain characteristics of real soils*						

Unit- I

Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction

Unit-II

Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method.

Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics

Unit -III

Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc.

Unit-IV

Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.

Unit- V

Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance

References:

1) Analytical and Computer Methods in Foundation, Bowels J.E.,McGraw Hill Book Co., New York, 1974
2) Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw Hill Book Co., New York
3) Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers
4) Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17, Elsevier Scientific Publishing Company
5) Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific Publishing Company
6) Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.
7) Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing

Program Elective -IV

MTSE-120 A	Design of Industrial Structure						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Design Steel Gantry Girders*						
CO2	*Design Steel Portal, Gable Frames*						
CO3	*Design Steel Bunkers and Silos*						
CO4	*Design Chimneys and Water Tanks*						

Unit I

Steel Gantry Girders – Introduction, loads acting on gantry girder, permissible stress, types ofgantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure

Unit II

Portal Frames – Design of portal frame with hinge base, design of portal frame with fixed base - Gable Structures – Lightweight Structures

Unit III

Steel Bunkers and Silos – Design of square bunker – Jansen's and Airy's theories – IS Codeprovisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners

Unit IV

Chimneys – Introduction, dimensions of steel stacks, chimney lining, breech openings andaccess ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation

Unit V

Water Tanks – Design of rectangular riveted steel water tank – Tee covers – Plates – Stays – Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts

Unit VI

Design of pressed steel water tank – Design of stays – Joints – Design of hemispherical bottomwater tank – side plates – Bottom plates – joints – Ring girder –Design of staging and foundation

References:

1) Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 1998
2) Design of Steel Structures, Ram Chandra, 12th Ed., Standard Publishers, 2009.
3) Design of Steel Structures, Subramaniyam

Program Elective -V

MTSE-201 A	Design of Pre-stresssed Concrete Structures						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Find out losses in the prestressed concrete. Understand the basic aspects of prestressed concrete fundamentals, including pre and post-tensioning processes*						
CO2	*Analyze prestressed concrete deck slab and beam/ girders*						
CO3	*Design prestressed concrete deck slab and beam/ girders*						
CO4	*Design of end blocks for prestressed members*						

Unit I

Introduction to prestressed concrete: types of prestressing, systems and devices, materials,losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions

Unit II

Statically determinate PSC beams: design for ultimate and serviceability limit states forflexure, analysis and design for shear and torsion, code provisions

Unit III

Transmission of prestressin pretensioned members; Anchorage zone stresses for posttensionedmembers

Unit IV

Statically indeterminate structures - Analysis and design - continuous beams and frames,choice of cable profile, linear transformation and concordancy

Unit V

Composite construction with precast PSC beams and cast in-situ RC slab - Analysis and design,creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack-width calculations

Unit VI

Analysis and design of prestressed concrete pipes, columns with moments

References Books:

1) Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955
2) Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981
3) Limited State Design of PrestressedCONcrete,GuyanY., Applied Science Publishers, 1972
4) IS: 1343- Code of Practice for Prestressed Concrete

Program Elective -V

MTSE-203 A	Analysis of Laminated Composite Plates						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Analyze the rectangular composite plates using the analytical methods*						
CO2	*Analyze the composite plates using advanced finite element method*						
CO3	*Develop the computer programs for the analysis of composite plates*						

Unit I

Introduction: Displacement Field Approximations for Classical Laminated Plate Theory (CLPT) and First Order Shear Deformation Theory (FSDT), Analytical Solutions for Bending of Rectangular Laminated Plates using CLPT

Unit II

Governing Equations.Navier Solutions of Cross-Ply and Angle-Ply Laminated Simply-Supported Plates, Determination of Stresses. Levy Solutions for Plates with Other Boundary Conditions, Analytical Solutions for Bending of Rectangular Laminated Plates Using FSDT

Unit III

Finite Element Solutions for Bending of Rectangular Laminated Plates using CLPT

Unit IV

Introduction to Finite Element Method, Rectangular Elements, Formation of Stiffness Matrix, Formation of Load Vector, Numerical Integration, Post Computation of Stresses

Unit V

Finite Element Solutions for Bending of Rectangular Laminated Plates using FSDT

Unit VI

Finite Element Model, C^0Element Formulation, Post Computation of Stresses. Analysis of Rectangular Composite Plates using Analytical Methods

Reference:

1) Mechanics of Laminated Composites Plates and Shells, Reddy J. N., CRC Press

Program Elective -V

MTSE-205 A	Fracture Mechanics of Concrete Structures						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Identify and classify cracking of concrete structures based on fracture mechanics*						
CO2	*Implement stress intensity factor for notched members*						
CO3	*Apply fracture mechanics models to high strength concrete and FRC structures*						
CO4	*Compute J-integral for various sections understanding the concepts of EFM*						

Unit I

Introduction: Basic Fracture Mechanics, Crack in a Structure, Mechanisms of Fracture and CrackGrowth, Cleavage Fracture, Ductile Fracture, Fatigue Cracking, Environment assisted Cracking, Service Failure Analysis

Unit II

Stress at Crack Tip: Stress at Crack Tip, Linear Elastic Fracture Mechanics, Griffith's Criteria,Stress Intensity Factors, Crack Tip Plastic Zone, Erwin's Plastic Zone Correction, R curves, Compliance, J Integral, Concept of CTOD and CMD

Unit III

Material Models: General Concepts, Crack Models, Band Models, Models based on ContinuumDamage Mechanics, Applications to High Strength Concrete, Fibre Reinforced Concrete, Crack Concepts and Numerical Modeling.

References:

1) Fracture Mechanics, Suri C. T. and Jin Z.H., 1st Edition, Elsevier Academic Press, 2012
2) Elementary Engineering Fracture Mechanics, BroekDavid, 3rd Rev. Ed. Springer, 1982.
3) Fracture Mechanics of Concrete Structures – Theory and Applications, Elfgreen L., RILEM Report, Chapman and Hall, 1989
4) Fracture Mechanics – Applications to Concrete, Victor, Li C., Bazant Z. P., ACI SP 118, ACI Detroit, 1989

Program Elective -V

MTSE-207 A	Design of Plates and Shells						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Analyze and design prismatic folded plate systems*						
CO2	*Analyze and design shells using approximate solutions*						
CO3	*Analyze and Design Cylindrical Shells*						
CO4	*Design Doubly Curved Shells using Approximate Solutions*						

Unit I

Prismatic folded Plate Systems

Unit II

Shell Equations

Unit III

Approximate Solutions

UnitIV

Analysis and Design of Cylindrical Shells

Unit V

Approximate Design methods for Doubly Curved Shells

References:

1) Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata McGraw Hill Edition, 2010
2) Design and Construction of Concrete Shell Roofs, Ramaswamy G. S., 1st Edition, 2005
3) Design of Reinforced Concrete Shells & Folded Plate, Varghese P. C., 1st Edition, PHI
4) Design of Plate and Shell Structures, JawadMaan H., Springer Science

Open Elective

MTOE-201 A	Business Analytics						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)							
PO1	*Understand the role of business analytics within an organization*						
PO2	*Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization*						
PO3	*To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making*						
PO4	*To become familiar with processes needed to develop, report, and analyze business data*						
PO5	*Use decision-making tools/Operations research techniques*						
PO6	*Mange business process using analytical and management tools*						
PO7	*Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc*						
Course outcomes (CO)							
CO1	*Students will demonstrate knowledge of data analytics*						
CO2	*Students will demonstrate the ability of think critically in making decisions based on data and deep analytics*						
CO3	*Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making*						
CO4	*Students will demonstrate the ability to translate data into clear, actionable insights*						

Unit I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

Unit II

Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit III

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization

Unit IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression orecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model

Unit V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without 8 Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit VI

Recent Trends in Embedded and collaborative business intelligence, Visual data 4 recovery, Data Storytelling and Data journalism.

References

1) Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press

2) Business Analytics by James Evans, persons Education

Open Elective

MTOE-203 A	Industrial Safety						
Lecture	Tutorial	Practical	Credit	End Sem. Evaluation	Mid Sem. Evaluation	Total	Time
3	0	0	3	60	40	100	3 Hrs.

Unit I

Industrial safety: Accident, causes, types, results and control, mechanical and electricalhazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering,Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment

Unit III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reductionmethods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need andapplications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing,cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

References

1) Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2) Maintenance Engineering, H. P. Garg, S. Chand and Company.
3) Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication
4) Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

Open Elective

MTOE-205 A	Operations Research						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Students should able to apply the dynamic programming to solve problems of discreet and continuous variables*						
CO2	*Students should able to apply the concept of non-linear programming*						
CO3	*Students should able to carry out sensitivity analysis*						
CO4	*Student should able to model the real world problem and simulate it*						

Unit I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References

1) H.A. Taha, Operations Research, An Introduction, PHI, 2008
2) H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982
3) J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4) Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5) Pannerselvam, Operations Research: Prentice Hall of India 2010
6) Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Open Elective

MTOE-207 A	Cost Management of Engineering Projects						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO)							
CO1	*Students should able to learn the cost concepts in decision making*						
CO2	*Student should be able to do cost planning and Marginal Costing*						
CO3	*Students should be able to create a database for operational control and decision making.*						

Unit I

Introduction and Overview of the Strategic Cost Management Process

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit II

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Unit III

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.Standard Costing and Variance Analysis.

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit IV

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References

1) Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2) Charles T. Horngren and George Foster, Advanced Management Accounting
3) Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

Open Elective

MTOE-209 A	Composite Materials						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the composite materials and their properties.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification and characteristics of Composite materials.*						
CO2	*Students should able reinforcements Composite materials.*						
CO3	*Students should able to carry out the preparation of compounds.*						
CO4	*Student should able to do the analysis of the composite materials.*						

UNIT I

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites.Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Iso-strain and Iso-stress conditions.

UNIT II

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostaticpressing.Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT III

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT IV

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Open Elective

MTOE-211 A	Waste to Energy						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the generation of energy from the waste.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification of waste as a fuel.*						
CO2	*Students should able to learn the Manufacture of charcoal.*						
CO3	*Students should able to carry out the designing of gasifiers and biomass stoves.*						
CO4	*Student should able to learn the Biogas plant technology.*						

Unit I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit II

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit III

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit IV

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1) Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2) Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3) Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4) Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Audit-I

MTAD-101 A	English For Research Paper Writing						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Student will able to understand the basic rules of research paper writing.*						
Course Outcomes (CO)							
CO1	*Understand that how to improve your writing skills and level of readability*						
CO2	*Learn about what to write in each section*						
CO3	*Understand the skills needed when writing a Title*						
CO4	*Ensure the good quality of paper at very first-time submission*						

UnitI

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit III

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

UnitIV

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

References:

1) Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2) Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3) Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4) Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Audit -I

MTAD-103 A	Disaster Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Develop an understanding of disaster risk reduction and management*						
Course Outcomes (CO)							
CO1	*Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.*						
CO2	*Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.*						
CO3	*Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.*						
CO4	*critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in*						

UnitI

Introduction: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UnitII

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit IV

Disasters Prone Areas in India: Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit 4

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment.Strategies for Survival.Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation.Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

References:

1) R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2) Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

3) Goel S. L., Disaster Administration And Management Text And Case Studies",Deep&Deep Publication Pvt. Ltd., New Delhi.

Audit -I

MTAD-105 A	Sanskrit for Technical Knowledge						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Students will be able to Understanding basic Sanskrit language and Ancient Sanskrit literature about science & technology can be understood and Being a logical language will help to develop logic in students*						
Course Outcomes (CO)							
CO1	*To get a working knowledge in illustrious Sanskrit, the scientific language in the world*						
CO2	*Learning of Sanskrit to improve brain functioning*						
CO3	*Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power*						
CO4	*The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature*						

Unit I

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit II

Order, Introduction of roots,Technical information about Sanskrit Literature

Unit III

Technical concepts of Engineering: Electrical, Mechanical

Unit IV

Technical concepts of Engineering: Architecture, Mathematics

References

1) "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2) "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3) "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Audit I

MTAD-107 A	Value Education						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand value of education and self- development, Imbibe good values in students and Let the should know about the importance of character*						
Course Outcomes (CO)							
CO1	*Knowledge of self-development*						
CO2	*Learn the importance of Human values*						
CO3	*Developing the overall personality*						
CO4	*Know about the importance of character*						

Unit I

Values and self-development –Social values and individual attitudes.Work ethics, Indian vision of humanism.Moral and non- moral valuation.Standards and principles.Value judgments.

Unit II

Importance of cultivation of values.Sense of duty.Devotion, Self-reliance.Confidence, Concentration.Truthfulness, Cleanliness.Honesty, Humanity.Power of faith, National Unity.Patriotism.Love for nature,Discipline

Unit III

Personality and Behavior Development - Soul and Scientific attitude.Positive Thinking.Integrity and discipline.Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance.True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits.Association and Cooperation. Doing best for saving nature

Unit IV

Character and Competence –Holy books Vs Blind faith.Self-management and Good health.Science of reincarnation.Equality, Nonviolence,Humility, Role of Women.All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

References

1) Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Audit II

MTAD-102 A	Constitution of India						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.*						
Course Outcomes (CO)							
CO1	*Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*						
CO2	*Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*						
CO3	*Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.*						
CO4	*Discuss the passage of the Hindu Code Bill of 1956.*						

Unit I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features

Unit 2

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality , Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor , Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit 3

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit 4

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References

1) The Constitution of India, 1950 (Bare Act), Government Publication.
2) Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3) M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4) D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Audit-II

MTAD-104 A	Pedagogy Studies						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers and Identify critical evidence gaps to guide the development.*						
Course Outcomes (CO)							
CO1	*What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?*						
CO2	*What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?*						
CO3	*How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?*						
CO4	*What is the importance of identifying research gaps?*						

Unit I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology , Theories of learning, Curriculum, Teacher education., Conceptual framework, Research questions. Overview of methodology and Searching. Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. , Curriculum, Teacher education.

UnitII

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change.Strength and nature of the body of evidence for effective pedagogical practices.Pedagogic theory and pedagogical approaches.Teachers' attitudes and beliefs and Pedagogic strategies.

UnitIII

Professional development: alignment with classroom practices and follow-up support, Peer support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes,

Unit IV

Research gaps and future directions: Research design, Contexts , Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

References

1) Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

2) Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

3) Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4) Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

5) Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

6) Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

Audit II

MTAD-106 A	Stress Management by Yoga						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To achieve overall health of body and mind and to overcome stress						
Course Outcomes (CO)							
CO1	*Develop healthy mind in a healthy body thus improving social health.*						
CO2	*Improve efficiency*						
CO3	*Learn the Yogasan*						
CO4	*Learn the pranayama*						

Unit I

Definitions of Eight parts of yog (Ashtanga).

Unit II

Yam and Niyam, Do`s and Don't's in life; Ahinsa, satya, astheya, bramhacharya and aparigraha; Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit III

Asan and Pranayam, Various yog poses and their benefits for mind & body,

Unit IV

Regularization of breathing techniques and its effects-Types of pranayam.

References

1) 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami YogabhyasiMandal, Nagpur
2) "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Audit II

MTAD-108 A	Personality Development through Life Enlightenment Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem. Evaluation**	**Mid Sem. Evaluation**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To learn to achieve the highest goal happily To become a person with stable mind, pleasing personality and determination To awaken wisdom in students						
Course Outcomes (CO)							
CO1	*Students become aware about leadership.*						
CO2	*Students will learn how to perform his/her duties in day to day work.*						
CO3	*Understand the team building and conflict*						
CO4	*Student will learn how to become role model for the society.*						

Unit I

Neetisatakam-Holistic development of personality: Verses: 19, 20, 21, 22 (wisdom); Verses: 29, 31, 32 (pride & heroism); Verses: 26, 28, 63, 65 (virtue); Verses: 52, 53, 59 (don's); Verses: 71, 73, 75, 78 (do's).

Unit II

Approach to day to day work and duties; ShrimadBhagwadGeeta: Chapter-2: Verses: 41, 47, 48; Chapter-3: Verses: 13, 21, 27, 35; Chapter-6: Verses: 5, 13, 17, 23, 35; Chapter-18: Verses: 45, 46, 48.

Unit III

Statements of basic knowledge; ShrimadBhagwadGeeta: Chapter-2: Verses: 56, 62, 68; Chapter-12: Verses: 13, 14, 15, 16, 17, 18.

Unit IV

Personality of Role model; ShrimadBhagwadGeeta: Chapter-2: Verses: 17; Chapter-3: Verses: 36, 37, 42: Chapter-4: Verses: 18, 38, 39; Chapter-18: Verses: 37, 38, 63.

References:

1) Srimad Bhagavad Gita, Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata.
2) Bhartrihari's Three Satakam (Niti-sringar-vairagya), P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

MTSE-209 A Dissertation Phase – I

(Credits 0 : 0 : 20 =10)

Teaching Scheme

Lab work : 20 hrs/week for DissertationPhase- I
Mid Semester Evaluation weightage- 30% and End Semester Evaluation weightage- 70%

Course Outcomes:

At the end of this course, students will be able to

1. Identify structural engineering problems reviewing available literature.
2. Identify appropriate techniques to analyze complex structural systems.
3. Apply engineering and management principles through efficient handling of project

Syllabus Contents:

The dissertation-I will have mid semester presentation and end semester presentation. The mid semester presentation will include identification of problem based on literature review on the topic referring to latest literature available.
End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individual contribution.
Continuous assessment of Dissertation-I and Dissertation-II at mid semester and end semester will be monitored by the departmental committee.

MTSE-202 A Dissertation Phase – II
(Credits 0 : 0 : 32 =16)

Teaching Scheme

Contact Hours : 3hrs/week for Dissertation Phase- II

Course Outcomes:
At the end of this course, students will be able to:

1. Solve complex structural problems by applying appropriate techniques and tools.
2. Exhibit good communication skill to engineering community and society.
3. Demonstrate professional ethics and work culture.

Syllabus Contents:

Dissertation-II will be extension of the work on the topic identified in Dissertation-I
Continuous assessment should be done of the work done adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre-submission seminar at the end of academic term. After the approval the student has to submit the detailed report and external examiner is called for the viva-voce to assess along with guide.

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Guidelines for Dissertation Phase – I and Phase-II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referredliterature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Civil Engineering, Structural Engineering and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

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KURUKSHETRA UNIVERSITY, KURUKSHETRA

('A+' Grade, NAAC Accredited)

SCHEME OF EXAMINATIONS FOR MASTER OF TECHNOLOGY IN Civil HIGHWAY ENGINEERING

(W. E. F. SESSION: 2018-19)

SEMESTER- I

S. No.	Course Code	SUBJECT	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MCH-101A	Traffic Engineering	3	-	-	3	40	60	3	3
2	MCH-103A	Geometric Design of Highways	3	-	-	3	40	60	3	3
3	MCH-105A	Pavement Materials	3	-	-	3	40	60	3	3
4	*	Program Elective-I	3	-	-	3	40	60	3	3
5	**	Program Elective-II	2	-	-	2	40	60	2	3
6	MCH-119A	Traffic Lab	-	-	4	4	40	60	2	3
7	MTRM-111A	Research Methodology and IPR	2	-	-	2	40	60	2	3
8	***	Audit Course-I	2	-	-	2	100	-	0	3
	TOTAL		**18**	**0**	**4**	**22**	**280**	**420**	**18**	
							700			

*Program Elective – I		**Program Elective- II	
MCH-107A	Concrete Technology	MCH-113A	Transport Safety and Environment
MCH-109A	Mass Transportation System	MCH-115A	Low Volume Roads
MCH-111A	Transportation Data Analysis	MCH-117A	Highway Subgrade and Foundation Analysis

***Audit Course-I	
MTAD-101A	English for Research Paper Writing
MTAD-103A	Disaster Management
MTAD-105A	Sanskrit for Technical Knowledge
MTAD-107A	Value Education

Note1: The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

*** **Note2:** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

M.Tech. in Civil (Highway Engg.) : SEMESTER-II

S. No.	Course code	Subject	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MCH-102A	Pavement Analysis and Design	3	-	-	3	40	60	3	3
2	MCH-104A	Pavement Construction, Maintenance and Management	3	-	-	3	40	60	3	3
3	MCH-106A	Public Transportation	3	-	-	3	40	60	3	3
4	*	Program Elective-III	3	-	-	3	40	60	3	3
5	MCH-114A	Accidental Analysis	3	-	0	3	40	60	3	3
6	MCH-116A	Road Safety and Audit Lab	-	-	2	2	40	60	2	3
8	**	Audit Course	2			2	100	-	0	3
	TOTAL		**17**		**2**	**19**	**240**	**360**	**17**	
							600			

***Program Elective – III**	
MCH-108A	Highway Drainage System
MCH-110A	Advanced Methods in Road and Airfield Infrastructure Design
MCH-112A	Traffic Management and Intelligent Transport System

****Audit Course – II**	
MTAD-102A	Constitution of India
MTAD-104A	Pedagogy Studies
MTAD-106A	Stress Management by Yoga
MTAD-108A	Personality Development through Life Enlightenment Skills.

Note1: The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

****Note2:** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

M.Tech. in Civil (Highway Engg.) : SEMESTER-III

S. No.	Course Code	Subject	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	*	Program Elective-IV	3	-	-	3	40	60	3	3
2	**	Open Elective	3	-	-	3	40	60	3	3
3	MCH-207A	Dissertation Phase-I	-	-	18	18	100	-	11	3
		TOTAL	**6**		**18**	**24**	**180**	**120**	**17**	
							300			

*Program Elective – IV	
MCH-201A	Highway Planning
MCH-203A	Road Transport Regulation and Administration
MCH-205A	Design and construction of Bridges and Flyovers

**Open Elective		
1.	MTOE-201A	Business Analytics
2.	MTOE-203A	Industrial Safety
3.	MTOE-205A	Operations Research
4.	MTOE-207A	Cost Management of Engineering Projects
5.	MTOE-209A	Composite Materials
6.	MTOE-211A	Waste to Energy

M.Tech. in Civil (Highway Engg.): SEMESTER-IV

S. No.	Course Code		L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MCH-202A	Dissertation Phase-II	-	-	32	32	100	200	16	3
	TOTAL						**300**		**16**	

Total credits of all four semesters – 68

Note 1: At the end of the second semester each student is required to do his/her Dissertation work in the identified area in consent of the Guide/Supervisor. Synopsis for the Dissertation Part-I is to be submitted within three weeks of the beginning of the Third Semester.

Note 2: Each admitted student is required to submit the report of his/her Dissertation Part-I as per the schedule mentioned in Academic calendar for the corresponding academic session otherwise the Dissertation Part-II cannot be continued at any level.

Note 3: Each admitted student is required to submit his/her final Dissertation Part-II as per the schedule mentioned in Academic calendar for the corresponding academic session only after the publication of two papers in a journal/International/National conference of repute like IEEE, Springer, Elsevier, ACM etc.

Note 4: The course of program/open elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

MCH-101A :Traffic Engineering

L	T	P/D	Credits	Max. Marks: 100	
3			3	Major Test	: 60 Marks
				Minor Test	: 40 Marks
				Duration	: 3Hours

UNIT-I

Traffic Characteristics: Importance of traffic characteristics , road user characteristics , vehicular characteristics. Max dimensions and weights of vehicles allowed in India. Effects of traffic characteristics on various design elements of the road.

Traffic Studies: Traffic volume study, speed study and origin and destination study. Speed and delay study. Use of photographic techniques in traffic surveys.

UNIT-II

Traffic Accidents: Accident surveys. Causes of road accidents and preventive measures . Capacity and level of Service, fundamental diagram of traffic flow. Relationship between speed, volume and ciensity. PCU. Design service volume. Capacity of non-urban roads. IRC recommendations. Brief review of capacity of urban roads.

UNIT- III

Traffic Regulation and Control Devices: Traffic control devices: signs , signals, markings and islands. Types of signs. Types of signals. Design of signal by IRC method. Intersections at grade and grade separated intersections. Design of a rotary. Types of grade separated intersections.

Design of Parking Lighting and Terminal Facilities: Parking surveys. On street parking. Off street parking.

UNIT-IV

Traffic Regulation: Need and scope of traffic regulations. Regulation of speed, vehicles and drivers. · General traffic regulations. Motor vehicle act. Scope of traffic management.

Recommended Books

(i) Principles of Transportation Engineering by Chakraborty & Das, Prentice Hall, India.
(ii) Highway Engg by S.K.Khanna & C.E.G. Justo, New Chand Bros., Roorkee.

(iii) Principles and Practice of Highway Engg. By L.R.Kadiyali , Khanna Publishers , Delhi.

(iv) Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd. N. Delhi.
(v) MORTH Specifications for Road and Bridge Works, IRC Publication.

MCH-103A : Geometric Design of Highways

L	T	P/D	Credits		
3			3	Max. Marks	: 100
				Major Test	: 60 Marks
				Minor Test	: 40 Marks
				Duration	:3Hours

UNIT -I

Highway Alignment: Requirements. Factors controlling alignment. Obligatory points. Engineering surveys for highway location. Route selection. Steps in new project. Highway classifications.

Cross Sectional Element: Pavement surface characteristics. Factors affecting skid resistance. Pavement unevenness. Camber. Providing camber in the field. Width of carriageway. Design Vehicle , medians, kerbs, road margins, right of way and typical cross sections of roads.

UNIT -II

Sight Distances: Introduction. Stopping sight distance. Reaction time. Analysis of stopping distance .

Overtaking sight distance. Analysis of overtaking sight distance. Effect of grade on sight distances.

Overtaking zone. Intermediate sight distance. Sight distance at intersections.

Superelevation: Requirement of superelevation. Limits and attainment of superelevation in the field.

UNIT-III

Highway Alignment: General. Design speed. Horizontal curves. Superelevation. Analysis of superelevation. Superelevation design. Attainment of superelevation. Widening of pavement on horizontal curves. Methods of introducing extra widening. Horizontal Transition curves. Different types of transition curves. Length of transition curve. Setting out of transition curve. Set-back distance on horizontal curves. Curve resistance.

UNIT-IV

Vertical Alignment: General. Gradients. Compensation in gradient on horizontal curves. Vertical curves. Summit curve. Length of summit curve. Valley Curve. Length of valley curve and profile. Relevant IRC standards for urban and rural roads.

Recommended Books

(i) Principles of Transportation Engineering by Chakraborty & Das, Prentice Hall, India.

(ii) Highway Engg.by S.K.Khanna & C.E.G. Justo, New Chand Bros., Roorkee.

(iii) Principles and Practice of Highway Engg.by. L.R.Kadiyali, Khanna Publishers, Delhi.

(iv) Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd. N. Delhi.

(v) MORTH Specifications for Road and Bridge Works, IRC Publication.

(vi) Principles of Highway Engineering and Traffic Analysis, by Mannering, F., W. Kilareski, and S. Washburn 3rd Edition, John Wiley and Sons, 2005.

MCH-105A: Pavement Materials

L T P/D	Credits	Max. Marks	: 100
3	3	Major Test	: 60 Marks
		Minor Test	: 40 Marks
		Duration	:3Hours

UNIT-I

Subgrade: Significance of subgrade soil. Characteristics of soil. Desirable properties. Index properties of Soil. Soil classification based on grain size. Soil classification system. Evaluation of soil strength. Aggregates: Introduction . Desirable properties of road aggregates. Tests for road aggregates.

UNIT-II

Bituminous Materials: Introduction. Types of bituminous materials. Tests on bitumen . Cutback and

emulsions .Bituminous Paving Mixes: Design of bituminous mix. Marshal method of bituminous mix design.

UNIT-III

Polymer and Rubber Modified Binders: Physical and chemical properties. Fly ash and its mix design characterization. Performance Approaches. Visco elastic properties of bitumen and based bituminous mixture.

UNIT-IV

Construction Methods: Bituminous and concrete pavements . Relevant IS and IRC codes.

Recommended Books

(i) Principles of Transportation Engineering by Chakraborty & Das, Prentice Hall, India.
(ii) Highway Engg by S.K.Khanna & C.E.G. Justo, New Chand Bros., Roorkee.
(iii) Principles and Practice of Highway Engg. By L.R.Kadiyali, Khanna Publishers , Delhi .

(iv) Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd. N.Delhi .
(v) MORTH Specifications for Road and Bridge Works, IRC Publication.

MCH-107A: Concrete Technology

L	T	P/D	Credits
3			3

Max. Marks: 100
Major Test : 60 Marks
Minor Test : 40 Marks
Duration :3 Hours

UNIT-I

Concrete as Pavement Material: Introduction. Preparation and grade of concrete.

Concrete Ingredients: Types of cement. Aggregates. Classification of aggregate. Properties of aggregate. Quality of mixing water. Admixtures.

UNIT-II

Properties of Concrete: Introduction, workability, stress strain characteristics of concrete, yo ung's modulus of concrete, creep and shrinkage of concrete, permeability, durability of concrete, joints.

UNIT-III

Production of Concrete: Batching, mixing, transportation , compaction , vibration, curing, formwork removing. Ready mixed concrete.
Non-Destructive Testing of Concrete: Significance. Rebound hammer. Ultrasonic pulse velocity technique. Penetration technique. Pullout test. Cover meter. Core tests.

UNIT-IV

Deteriorations: Causes, deteriorations b y water, surface we1r, frost action, chemical Reaction, corrosion of reinforcement etc, preventive measures.

Advances in Concrete: Introduction to light weight concrete. High strength concrete. Prestressed concrete. Fibre reinforced concrete. Polymer concrete composites.

Recommended Books:

(i) M.L.Gambhir, "Concrete Technology" TMH Pub. N Delhi.
(ii) Shetty M.S. "Concrete Technology" S. Chand & Co. N Delhi.

MCH- 109A: MASS TRANSPORTATION SYSTEMS

L	T	P/D	Credits	Max.Marks	:100
3	0		3	Major Test	:60 Marks
				Minor Test	:40 Marks
				Duration	:3Hours

UNIT I

Role of Transportation: History of transit, Recent Trends in transit, Mass transportation characteristics, Demand Characteristics: Spatial, temporal and behavioral characteristics.
Mass Transportation Planning: Transportation demand surveys, Mass transportation demand estimation, Demand projection, Trip generation, Trip distribution, Model split and route assignment. Bus scheduling, Transit corridor identification.

UNIT II

Transport system Performance: Performance evaluation and analysis, Structure of decision making, Evaluation and selection methods, and selection procedure.
Generation of alternative schemes, Economic evaluation methods.

UNIT III

Terminals: Public transport infrastructures, Functions of terminals, Design, Typical Terminal characteristics.
Scheduling and Routes: Service analysis, Vehicle dispatch policy, Vehicle Requirements, Spacing of bus stops, Route spacing and performance.

UNIT IV

Management: Operational and management issues in transport planning, integration of public transport modes, Reserved bus lanes and signals, Vehicle monitoring and control system, Nodal coordination. BRT corridors.
Special Systems: Multimodal transport systems, People mover systems, Underground transportation, para transit, Rail transit system, case studies.

REFERENCE BOOKS:

1. Khisthy, Lal, Transporation Engineering, PHI, Delhi, 2008 Hay, W.W., An Introduction to Transportation Engineering, 2nd Ed., John Wiley & Sons, 2001

2. Kadiyali, L. R, “Traffic Engineering and Transport Planning”, Khanna Publishers New Delhi – 110006, 2006

3. Hutchinson, Urban Transport Planning, John Wiley, 2006

4. Dickey, J.W., et. al., Metropolitan Transportation Planning, TMH edition, 2002.

5. Paguette, R.J., et.al, Transportation Engineering - Planning and design, 2nd Ed., John Wiley & Sons.

6. Railis, V.R, Intercity Transport, Engineering and Planning, The Macmillan Press, 2003.

MCH-111A: Transportaion Data Analysis

L	T	P/D	Credits		
3	0		3	Max Marks	:100
				Major Test	:60 Marks
				Minor Test	:40 Marks
				Duration	:3Hours

UNIT I

Multivariate Data Analysis Techniques: Types of Data, Basic Vectors and Matrices, Sample Estimate of Centroid, Standard Deviation, Dispersion, Variance and Covariance, Correlation Matrices, Principle Component, Factor Analysis, ANOVA and Cross Classification Procedure in Multivariate Data Analysis and Application to Problems in Traffic and Transportation Planning.

UNIT II

Analysis and Modeling of Travel Choices: Fundamentals of Micro-Economic Demand Theory – Choice Function – Direct and Cross Elasticity of Demand – Properties of some Empirically Derived Demand Functions – Market Demand; Theory of Behavioral Models, Deterministic and Stochastic Models, Random Utility Model, Probit, Logit and Descriminant Model Formulations for Mode and Route Choices, Implications; Value of Travel Time Studies.

UNIT III

Concept of Entropy and its Application in Travel Demand Modeling: Definition of Entropy, its relations to Probability and Uncertainty, Entropy of Probability Distribution, Entropy and Bayesian Statistics, Application of Entropy Concepts in Transport Models: Theory of Trip Distribution, Mode Split and Route Split, Production, Attraction, Doubly Constrained Gravity Models and Derivation of Intervening Opportunity Model, Missing Information and Use of Entropy in Travel Demand Modeling: Entropy and Information Theory Approaches for Estimating the Travel Demand using Indirect Methods such as Use of Link Volume Counts, Turning Counts,

UNIT IV

Forecasting using Time Series Analysis: Basic Components of Time Series – Stationery and Non-Stationery Processes- - Smoothing and Decomposition Methods – Correlation and Line Spectral Diagrams – Auto Correlations and Moving Averages; Introduction to Box-Jenkins Forecasting

REFERENCE BOOKS:

1. Cooley, WW and Lohnes, RR, Multi-variate Data Analysis, John Wiley.
2. Richard A. Johnson, Dean W. Wichern, Applied Multivariate Statistical Analysis, Prentice Hall.
3. Simon P. Washington, Matthew G. Karlaftis & Fred L. Mannering, Statistical and Econometric Methods for Transportation Data Analysis, Chapman & Hall/CRC.
4. Kanafani, A., Transportation Demand Analysis, McGraw-Hill.
5. Michael Meyer, Eric J Miller, Urban Transportation Planning, McGraw-Hill
6. Spyros G. Makridakis, Steven C. Wheelwright, Rob J Hyndman, Forecasting : Methods and Applications, Wiley.

MCH-113A: Transportation Safety and Environment

L	T	P/D	Credits		
2			2	Max. Marks	:100
				Major Test	:60 Marks
				Minor Test	:40 Marks
				Duration	:3 Hours

UNIT-I

Trends in roads and highways development. Problem of road accidents in India. Characteristics of road accidents. Causes of accidents. Global and Indian road safety scenario. Factors responsible for success stories in road safety. Role of highway professionals in highway safety.

UNIT-II

Planning of roads for safety. Land use planning and zoning. Development control and encroachment. Network hierarchy. Route planning through communities. Access control. Traffic segregation. Traffic calming designing for safety: road link design, alignment design. Cross-sectional elements.
Traffic control devices. Road side safety. Road side facilities. Some critical elements. Junction design. Basic principles. Selection of junction type. Factors affecting safety at various junction types. Elements to improve road safety. Provisions for vulnerable road users.

UNIT-III

Road safety audit. Concepts of road safety audit, Road safety auditors & key personnel in RSA. Organizing and conducting a road safety audit. Example and commonly identified. Issues during RSA, Road safety audit report. Development of cost-effective of road safety audit accident investigation and prevention. Basic strategies for accident reduction. Significance of accident data. Accident investigation and identification of potential sites for treatment. Problem diagnosis. Selection of countermeasures. Example of selection of counter measures. Detailed design and implementation of countermeasures.

UNIT-IV

Monitoring and evaluation non-engineering measures for road safety, behavioral counter measures , education. Training and publicity. The goal of police traffic control activities. Strategy for road safety management by police. Role of NGOs in road safety. Legal framework for road safety transport related pollution, noise pollution, air pollution, effects of weather conditions, vehicular emission parameters, pollution standards. EIA requirements of highway projects, world bank guidelines, EIA practices in India. Fuel crisis and transportation, factors affecting fuel consumption, fuel economy in various modes of transportation, various types of alternative fuels.

Recommended Books:

(i) Traffic Engg. And Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.
(ii) Highway Engg. By S.K.Khanna& C.E.G. Justo, New Chand Bros., Roorkee.

MCH- 115A: Low Volume Roads

L	T	P/D	Credits	Max Marks	:100
2	0		2	Major Test	:60 Marks
				Minor Test	:40 Marks
				Duration	:3Hours

UNIT I

Planning of rural road net work – Concept of core and non-core roads, general principle, guidelines laid down in recent 20-year plans and in PMGSY
Guidelines for alignment and geometric design of rural/low volume roads and safety aspects.

UNIT II

Investigations and surveys, soil and material surveys, Promoting use of alternate margina/ low cost waste / stabilized local materials in rural road works, fly ash in fill and other layers, use of other waste materials. Soil stabilization methods – mechanical, soil cement, soil lime, soil-lime-pozzolana, soil-lime-cement stabilization

UNIT III

Design of different types of pavements for rural roads, choice of pavement type / pavement materials. Guidelines and specifications by IRC, NRRDA and MORD
Road drainage – study of requirements of surface and subsurface drainage, and cross drains, standard design of culverts and small bridges

UNIT IV

Specifications and steps for the construction of different components of rural / low volume roads including pavement layers, quality control during construction
Maintenance of rural roads – shoulders, side and cross drains. Pavement distress, different types of failures and maintenance measures. Preventive maintenance works.

REFERENCE BOOKS:

1. CRRI “Low Volume Roads’ Central Road Research Institute”-New Delhi
2. IRC “Rural Roads Manual”-Special Publication 20 – 2002, Indian Roads Congress.
3. IRC SP- 26 “Report Containing Recommendations of IRC Regional Workshops on Rural Road Development”-1984, Indian Roads Congress
4. IRC SP:42 –1994, “Guidelines on Road Drainage”- Indian Roads Congress
5. IRC SP: 58-2001, “Guidelines for Use of Fly Ash in Road Embankments”- Indian Roads Congress
6. MoRTH “Specifications for Road and Bridge Works”- 2001, fourth revision, Indian Roads Congress
7. MORD “Specification for Rural roads”

MCH- 117A: Highway Subgrade and Foundation Analysis

L	T	P/D	Credits		
2	0		2	Max Marks	:100
				Major Test	:60Marks
				Minor Test	:40Marks
				Duration	:3 Hrs

UNIT I

Introduction: Soil Mechanics applications to Highway Engg. Soil formations, Types, Regional Soil deposits of India, Index properties, their determination, importance, various soil classification systems, HRB classification, problems. Soil Compaction: Introduction, Lab Tests, Factors affecting, Structure & Engg behavior of compacted cohesive soil, Field compaction specifications Filed compaction control, Different types of Equipments used for compaction, their choice.

UNIT II

Shear strength of soil: Introduction, Importance, Measurements, shear strength of clay, Sand, Elastic properties of soil – Tangent, Secant modulus, Stress – Strain curves, Poisson's ratio, Shear Modulus. Stability of slopes: Introduction, Types, Different methods of analysis of slopes for Øu+0 & C-Ø soil, Location of most critical circle, Earth dam slopes stability, Taylor's stability number. Effect of Earthquake Force, problems on above.

UNIT III

Permeability of soil: Darcy's Law, Validity, Soil-water system, Types, Determination of permeability, problems. Site Investigation: Introduction, Planning exploration programmes, Methods, Samplers, SPT, Subsoil investigation Report, Geophysical methods.

UNIT IV

Highway Drainage: Introduction, Importance, Surface drainage, Sub-surface drainage, methods, Design of subsurface drainage system, Road construction in water logged areas, Land slides – definition, classifies, factors producing. Reinforced Earth structures: Introduction , Components, Advantages, Types of stability – external, Internal, (No problems), Geo textiles – types, Functions, their uses in road embankments and railway works, other uses.

REFERENCE BOOKS:

1. "Basic and Applied soil Mechanics", Gopal Ranjan, ASR Rao, New Age International Publishers 2. "Soil Mechanics & Foundation Engg", Dr.B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd, 16th edition. 3. "Highway Engg", S.K. Khanna, C.E.G. Justo, 5th edition. 4. "Soil Mechanics & Foundation Engg" – K.R. Arora Standard Publishers Distributors. 5. "Soil Mechanics for road Engineers" – HMSO, London.

MCH-119A: Traffic lab

L	T	P/D	Credits
		4	2

Max. Marks : 100
Major Test : 60 Marks
Minor Test : 40 Marks
Duration : 3 Hours

LIST OF PRACTICALS:

1. Traffic volume study using videography technique .
2. Traffic speed study using videography technique.
3. Speed study by radar gun
4. Speed study by endoscope
5. Determination of reaction time of driver
6. Parking study
7. Accident investigation study
8. Study for improvement of an accident prone location
9. Bitumen content determination through centrifuge extrude.
10. Proportioning of aggregate

MTRM-111A : Research Meathodology and IPR

L	T	P/R	Credits		
2			2	Max. marks	: 100
				Major Test	: 60 Marks
				Minor Test	: 40 Marks
				Duration	: 3 Hours

Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2

Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper.Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 3

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 4

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patent information and databases.Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge Case Studies, IPR and IITs.

Recommended Books :

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’.
2. C.R. Kothari, “Research Methodology: Methods & Techniques, 2nd edition or above, New Age Publishers.
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2 ndEdition , “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.

MCH-102A :Pavement Analysis & Design

L	T	P/D	Credits		
3			3		

Max. Marks	:100
Major Test	:60 Marks
Minor Test	:40 Marks
Duration	:3Hours

UNIT-I

Pavement Types: Definition, highway and airport pavement comparison, wheel loads, tyre pressure, contact pressure, design factors. Type of distresses structural and functional, serviceability.

UNIT-II

Stresses in Flexible: Layered system concept, multilayered solutions. Burmister 's method, fundamental design concepts. Stresses in Rigid Pavements: Relative stiffness of slabs. Modulus of subgrade reaction . Stresses due to warping, stresses due to friction, effect of warping, contraction and expansion. Plain versus reinforced pavements, stresses in dowel bar, tie bar, combined stresses.

UNIT-III

Design of Flexible Pavements: Design factors. Design wheel load. Equivalent single wheel load. Difference between airport and highway design concept. Different design methods . Examples of comprehensive design process . AASHTO method. McLeod method. New IRC Code method.

UNIT-IV

Design of Rigid Pavement: General design considerations. Design of join ts in cement concrete pavements , spacing of expansion joint, spacing of contraction joints. Design of dowel bar. Design of tie bar. IRC recommendations for design of concrete pavements.

Pavement Evaluation and Rehabilitation: Pavement distresses in flexible and rigid pavements , condition and evaluation survey. Present serviceability index. Methods of measuring condition, skid resistance. Principles of maintenance. Methods of structural evaluation.

Recommended Books:

(i) Principles of Transportation Engineering by Chakraborty & Das, Prentice Hall, India.

(ii) Principles ofPavement Design, by Yoder E.J. and Witczak M.W. 2nd, John Wiley & Sons, INC.
(iii) Principles and Practice of Highway Engg. By L.R.Kadiyali , Khanna Publishers, Delhi.
(iv) Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd. N. Delhi.
(v) MORTH Specifications for Road and Bridge Works, IRC Publication.

MCH-104A: Pavement Construction, Maintenance & Management

L	T P/D	Credits
3		3

Max. Marks : 100
Major Test : 60 Marks
Minor Test : 40 Marks
Duration :3Hours

UNIT-I

Introduction: History of road construction, stages of construction, seasonal limitations of pavement construction.
Stabilization of Soil: Mechanical stabilization, cementing additives and chemicals , thermal stabilization

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UNIT-II

Construction of Non-bituminous Pavements: Brief introduction to earthwork machinery: shovel, hoe, clamshell, dragline, bulldozers, cleaning and grubbing, excavation for road and drain, principles of field compaction of embankment I subgrade. Compacting equipments. Granular roads . Construction steps of GSB, WBM and WMM.

Construction of Bituminous Pavements: Various types of bituminous constructions. Prime coat, tack coat, seal coat and surface dressing. Construction of busg, premix carpet, BM, DBM and AC. Brief coverage of machinery for construction of bituminous roads: bitumen boiler, sprayer, pressure distributer, hot-mix plant, cold-mix plant, tipper trucks, mechanical paver or finisher, rollers. Mastic asphalt. Introduction to various IRC and MORTH specifications.

UNIT -III

Construction of Cement Concrete Roads: Construction of cement concrete pavements , machinery involved in construction, slip-form pavers, joints in cement concrete pavements, IRC and MORTH specifications. Construction of other types of pavements: basic concepts of the following: soil stabilized roads, use of gee-synthetics, reinforced cement concrete pavements, prestress concrete pavements, roller compacted concrete pavements and fibre reinforced concrete pavements. Use of fly ash in cement concrete road construction.

UNIT-IV

Highway Maintenance: Pavement distresses, Maintenance operations, Maintenance of WBM, bituminous surfaces and cement concrete pavements. Functional and structural . evaluation of pavements, pavement maintenance, maintenance management
Related Topics: Emulsified bituminous mix, precoating of aggregates, recycling of bituminous pavements, shoulder construction.

Recommended Books

(i) Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.

(ii) Highway Engg. By S.K.Khanna & C.E.G. Justo, New Chand Bros., Roorkee .

MCH-106A: Public Transportation

L	T	P/D	Credits		
3				Max. Marks	: 100
				Major Test	: 60 Marks
			3	Minor Test	: 40 Marks
				Duration	:3Hours

UNIT-I

Modes of public transportation and application of each to urban travel needs.

UNIT-II

Transit system operations, para-transit systems, street transit systems, rapid transit systems, estimation of transit demand. Route development, properties of a good route set, determination of a good route set, stop location and stopping policy, schedule development, properties of a good schedule, determination of a good schedule.

UNIT-III

Capacity of rapid transit systems, line capacity of RTS, capacity of street transit systems. Transit corridor, identification and planning, mass transport management measures, integration of public transportation modes. Public transport infrastructure, case studies, multi mode transportation system.

UNIT-IV

Planning for public transport, fares and subsidies. Intermediate public transport in Indian cities, types of IPT vehicles. Characteristics of IPT modes.

Recommended Books:

(i) Traffic Engg. And Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.
(ii) Introduction to Transport Planning by Bruton, M.J., Hutchinson Technical Education, London.

(iii) Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.

MCH-108A: Highway Drainage System

L	T	P/D	Credits
3			3

Max marks :100
Major Test : 60 Marks
Minor Test : 40Marks
Duration : 3 hours

UNIT-I

Introduction, Importance of drainage, Type of Road Drainage, General Criterion for Road Drainage.
Systems of Drainage: Surface and sub-surface drainage systems.

UNIT-II

Internal drainage of pavement structure, components of surface drainage system, surface drains, road side drains, catch water drains, geometric drainage with transverse drains, horizontal drains, sub surface drain in heavy clayey soil, sub surface drain at valley curve I change of grade, capillary cut-off.

UNIT-III

Design of surface drainage and subsurface drainage system: Hydrologic analysis, hydraulic analysis, data for drainage design, design steps.

UNIT-IV

Cross Drainage, Sub surface drainage, lowering of water table, control of seepage flow, control of capillary rise, design of filter material, drainage of slopes and erosion control, road construction in water logged areas. Drainage in hill road. Drainage systems for Airport and Railways.

Recommended Books:

(i) Highway Engg by S.K. Khanna & C.E.G Justo, Nem Chand Bros., Roorkee.

(ii) Principles and Practive of Highway Engg by L.R. Kadiyali , Khanna Publishers , Delhi.

(iii) Rural Road Mannual, IRC SP-20

MCH- 110A: Advanced Methods for Airport Infrastructure Design

L	T	P/D	Credits
3	0		3

Max Marks :100
Major Test :60Marks
Minor Test :40Marks
Duration :3 Hours

UNIT I

Introduction: Growth of air transport, airport organization and associations, Classifications of airports airfield components, airport traffic zones and approach areas. Aircraft Characteristics Related to Airport Design: Components, size turning radius, speed, airport characteristics

UNIT II

Capacity and Delay: Factors affecting capacity, Determination of runway capacity related to delay, gate capacity, taxiway capacity Airport planning and surveys: Runway length and width, sight distances, longitudinal and transverse grades, runway intersections, taxiways, clearances, aprons, numbering, holding apron.

UNIT III

Design of the Terminal area: Operational concepts, space relationships and area requirements, noise control, vehicular traffic and parking at airports. Airport Grading and Drainage: Grading of airport area, hydrology, design of drainage systems, construction methods, layout of surface drainage and subsurface drainage system.

UNIT IV

Air Traffic Control and Aids: Runways and taxiways markings, dayand night landing aids, airport lighting and other associated aids.

REFERENCE BOOKS:

1. “Planning and Design of Airports” - Robert Horenjeff, 2nd edition, McGraw Hill Book Co.
2. “Airport Engineering”- G. Glushkov, V.Babkov, Mir Publuishers, Moscow.
3. “Airport Planning and Design”- Khanna, Arora and Jain, Nem Chand and Bros., Roorkee
4. Harry.R.Cedergern. “Drainage of Airfield pavements”- John Wiley and Sons.
5. Virender Kumar and Satish Chandra, “Airport Planning and Design”- Galotia Publication press.

MCH- 112A: Traffic Management and Intelligent Transportation Systems

L	P/D	Credits	Max Marks	:100
3		3	Major Test	:60Marks
			Minor Test	:40Marks
			Duration	:3Hours

UNIT I

Introduction to Intelligent Transportation Systems (ITS) –Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

UNIT II

Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

UNIT III

ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency and incident Management, Advanced Vehicle safety systems, Information Management.

UNIT IV

Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems.
ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

REFERENCE BOOKS:

1 ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

2 Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.

3 National ITS Architecture Documentation, US Department of Transportation, 2007 (CD-ROM).

MCH-114A : Accidental Analysis

L T P/D	Credits	Max Marks :100
3	3	Major Test :60Marks
		Minor Test :40Marks
		Duration :3 Hours

UNIT I

Introduction to Road Safety Engineering and Accident Investigation, Factors Relating to Accidents, various forms of recording of accident data, study of IRC recommended recording proforma.

UNIT II

Accident Investigation & Crash Problem Diagnosing: investigation at site, various driver related tests, calculation of post crash speed from skid marks, collision and condition diagrams, and traffic and speed studies.

UNIT III

Accident Costing, Economic Appraisal: various methods of calculation of accident costs, their advantages and disadvantages, case studies.

UNIT VI

Crash Problems into Solutions: research and development in accident analysis, issues and challenges in modeling of road accidents, Smeed's model, Base line models, General ADT models, Models with covariates, AMFs, various measures to improve road safety, before and after studies.

REFERENCE BOOKS:

1. Highway Engineering by Khanna and Justo, Nem Chand & Brothers, Roorkee
2. Kadiyali, L.R., `Traffic Engineering and Transport Planning', Khanna Publications.
3. Pignataro, Louis, `Traffic Engineering - Theory and Practice', John Wiley.
4. RRL, DSIR, `Research on Road Safety', HMSO, London.
5. Papacoastas 'Introduction to Transportation Engineering' –Prentice

MCH-116A: ROAD SAFETY AND AUDIT LAB

L	P/D	Credits
2		2

Max. Marks :100
Major Test :60 Marks
Minor Test : 40 Marks
Duration of Exam :3 Hrs

List of experiments:

1. Design stage audit: Study of project Drawings to identify safety concerns
2. Site Visits for Construction stage audit
3. Site Visits for existing road audit
4. Site Visits and Preparation of the Audit Reports
5. Visit to accident site
6. Compilation of FIR data and study of its limitations
7. Identification of black spots from FIR data
8. Study of accident recording forms

MCH-201A: Highway Planning

L	T	P/D	Credits		
3			3	Max. Marks	: 100
				Major Test	: 60 Marks
				Minor Test	: 40 Marks
				Duration	:3 Hours

UNIT-I

Transport Planning Process : Status of transportation in India. Objectives and scope of transport planning. Urban, regional and national transport planning. Transport planning process, various stages. Land use and traffic.

UNIT-II

Transportation Survey: Definition of study area. Zoning. Types of surveys. 0-D surveys. Inventories of existing transport facilities, land use and economic activities. TRIP.

Generation: Trip purpose. Factors affecting trip generation. Trip generation estimation by multiple linear regression analysis, brief review of category analysis, advantages and limitations of these methods.

UNIT-III

Trip Distribution: Methods of trip distribution. Basic concepts of uniform factor method , average factor method and opportunity model. Trip distribution by gravity model.

Traffic Assignment: Principles of assignment. Assignment techniques. All or nothing assignment.
Brief review of multipath assignment, capacity restraint assignment and diversion curves.

UNIT-IV

Modal Split: General considerations for modal split. Factors affecting modal split. Brief introduction to various methods of modal split.
Evaluation: Need for evaluation. Several plans to be formulated. Testing. Considerations in evaluation. Economic evaluation, basic principles, brief introduction to various methods of economic evaluation, comparison.

Mass Rapid Transit Systems: Problems of Urban Transport. Introduction to MRTS. Requirements of MRTS. Types of MRTS. MRTS in India

Recommended Books:

(i) Traffic Engg. And Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.
(ii) Highway Engg by S.K. Khanna & C.E.G. Justo, New Chand Bros., Roorkee.
(iii) Introduction to Transport Planning by Bruton, M.J., Hutchinson Technical Education, London.
(iv) Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall

MCH- 203A: Road Transport Regulations & Administration

L	T	P/D	Credits		
3		0	3	Max Marks	:100
				Major Test	:60 Marks
				Minor Test	:40Marks
				Duration	:3Hours

UNIT I

Introduction to Traffic regulations and control - Regulation on vehicles, drivers and traffic flow, Traffic control devices – Types & objectives of markings, signs, signals and islands, delineators.

Role of M.V. Department in existing road transport scenario in India

UNIT II

Transportation systems – sustainable transport - mobility, accessibility – safety, environment - revenue generation.

M.V. Act and CMV Rules – Implementation issues thereof, Issues in road enforcement, control of traffic, signage.

UNIT III

Transportation planning process and demand forecasting, road safety issues, coordination with other agencies, claims & compensation under MV Act.

Issues in insurance of vehicles, licensing of drivers, taxation of vehicles and passengers, permits under MV Act.

UNIT IV

Inspection/ testing and certification of vehicles. Bus body code & Bus body accreditation system.
Developing customer orientation in M.V. Department functions, RFID based Driving Skill Evaluation system (IDTS)

REFERENCE BOOKS:

1. Principles of Transportation Engineering by Chakraborty & Das, Prentice Hall, India.
2. Highway Engg by S.K.Khanna & C.E.G. Justo, New Chand Bros., Roorkee.
3. Principles and Practice of Highway Engg. By L.R.Kadiyali , Khanna Publishers , Delhi.
4. MORTH Specifications for Road and Bridge Works, IRC Publication

MCH- 205A: Design and Construction of Bridges and Flyovers

L	T	P/D	Credits		
3	0		3	Max Marks	:100
				Major Test	:60 Marks
				Minor Test	:40Marks
				Duration	: 3Hours

UNIT I

Introduction–classification and components of bridges– layout and planning– Structural forms of bridge decks – grillage analysis of slab decks, beam and slab decks, and cellular decks. Standard specifications for bridges – IRC loadings for road bridges – standards for railway bridges.

Loads on Bridge: Dead loads, live loads, dynamic effects of vehicles, longitudinal forces, centrifugal forces, wind loads, earth quake forces, stream flow pressure, load combinations, design examples

UNIT II

Design of T beam bridges – balanced cantilever bridges – rigid frame bridges – Arch bridges – bow string girder bridges.

Design of Bridge Slabs: Longitudinally reinforced deck slabs, transversely reinforced bridge slabs

UNIT III

Design of plate girder bridges – steel trussed bridges – Introduction to long span bridges: cable stayed bridges and suspension bridges –instability.

Principles of Planning of Elevated Rail Transit System, grade separation structures, pedestrian crossing and sub- ways.

Forces on piers and abutments – Design of piers and abutments – types of wing walls – types of bearings – design of bearings.

UNIT IV

Design of Prestressed Concrete Bridges: Design code, design examples. Segmental Box bridges - precast sections, criteria, design examples

Sub-Structure Design: Foundation investigation, bearings, bridge pier design, and abutment design.

Examples.

REFERENCE BOOKS:

1. Raina, R.K, 'Principles of Design of RCC Bridges, Tata McGraw Hill,1999.
2. N. Krishna Raju, Design of bridges, Oxford & IBH publishing Co. Ltd., New Delhi.
3. D.Johnson Victor, Essentials of bridge engineering, Oxford & IBH publishing Co. Ltd., New Delhi.
4. Jaikrishna and O.P Jain, Plain and reinforced concrete-vol.II, Nem Chnand & Bros,Roorkee.
5. IRC: 5 -1970, Standard specifications and code of practice for road bridges, Sections I to V.
6. Indian railway standard code of practice for the design of steel or wrought iron bridge carrying Rail, road or pedestrian traffic, Govt. of India, Ministry of Railways, 1962.
7. Conrad P. Heins and Richard A. Lawrie, `Design of Modern Concrete Highway Bridges,

MTOE-201A	Business Analytics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes (CO)							
CO1	*Able to have knowledge of various business analysis techniques.*						
CO2	*Learn the requirement specification and transforming the requirement into different models.*						
CO3	*Learn the requirement representation and managing requirement assests.*						
CO4	*Learn the Recent Trends in Embedded and collaborative business*						

Unit 1

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.

Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit 2

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.

Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit 3

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements.

Managing Requirements Assets: Change Control, Requirements Tools

Unit 4

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

References:

1. Business Analysis by James Cadle et al.

2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

MTOE-203A	Industrial Safety						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the industrial safety.*						
Course Outcomes (CO)							
CO1	*Understand the industrial safety.*						
CO2	*Analyze fundamental of maintenance engineering.*						
CO3	*Understand the wear and corrosion and fault tracing.*						
CO4	*Understanding that when to do periodic inceptions and apply the preventing maintenance.*						

Unit-1

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-2

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-3

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-4

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.
5.

MTOE-205A	Operations Research						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enable students to aware about the dynamic programming to solve problems of discreet and continuous variables and model the real world problem and simulate it.						
Course Outcomes (CO)							
CO1	*Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.*						
CO2	*Students should able to apply the concept of non-linear programming*						
CO3	*Students should able to carry out sensitivity analysis*						
CO4	*Student should able to model the real world problem and simulate it.*						

Unit -1

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit -2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit- 3

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit -4

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

MTOE-207A	Cost Management of Engineering Projects						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to make aware about the cost management for the engineering project and apply cost models the real world projects.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the strategic cost management process.*						
CO2	*Students should able to types of project and project team types*						
CO3	*Students should able to carry out Cost Behavior and Profit Planning analysis.*						
CO4	*Student should able to learn the quantitative techniques for cost management.*						

Unit-1

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost.Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-2

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit-3

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-4

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

MTOE-209A	Composite Materials						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the composite materials and their properties.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification and characteristics of Composite materials.*						
CO2	*Students should able reinforcements Composite materials.*						
CO3	*Students should able to carry out the preparation of compounds.*						
CO4	*Student should able to do the analysis of the composite materials.*						

UNIT–1:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites.Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Iso-strain and Iso-stress conditions.

UNIT – 2

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostaticpressing.Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–3

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – 4

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

MTOE-211A	Waste to Energy						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the generation of energy from the waste.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification of waste as a fuel.*						
CO2	*Students should able to learn the Manufacture of charcoal.*						
CO3	*Students should able to carry out the designing of gasifiers and biomass stoves.*						
CO4	*Student should able to learn the Biogas plant technology.*						

Unit-1

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-2

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-3

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-4

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

MTAD-101A	English For Research Paper Writing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Student will able to understand the basic rules of research paper writing.*						
Course Outcomes (CO)							
CO1	*Understand that how to improve your writing skills and level of readability*						
CO2	*Learn about what to write in each section*						
CO3	*Understand the skills needed when writing a Title*						
CO4	*Ensure the good quality of paper at very first-time submission*						

Unit 1

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit 2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit 3

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit4

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

MTAD-103A	Disaster Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Develop an understanding of disaster risk reduction and management*						
Course Outcomes (CO)							
CO1	*Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.*						
CO2	*Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.*						
CO3	*Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.*						
CO4	*critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in*						

Unit 1

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit 2

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit 3

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit 4

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment.Strategies for Survival.Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation.Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

References:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep&Deep Publication Pvt. Ltd., New Delhi.

MTAD-105A	Sanskrit for Technical Knowledge						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Students will be able to Understanding basic Sanskrit language and Ancient Sanskrit literature about science & technology can be understood and Being a logical language will help to develop logic in students*						
Course Outcomes (CO)							
CO1	*To get a working knowledge in illustrious Sanskrit, the scientific language in the world*						
CO2	*Learning of Sanskrit to improve brain functioning*						
CO3	*Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power*						
CO4	*The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature*						

Unit –1

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit – 2

Order, Introduction of roots,Technical information about Sanskrit Literature

Unit –3

Technical concepts of Engineering: Electrical, Mechanical

Unit –4

Technical concepts of Engineering: Architecture, Mathematics

References

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

MTAD-107A	Value Education						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand value of education and self- development, Imbibe good values in students and Let the should know about the importance of character*						
Course Outcomes (CO)							
CO1	*Knowledge of self-development*						
CO2	*Learn the importance of Human values*						
CO3	*Developing the overall personality*						
CO4	*Know about the importance of character*						

Unit 1

Values and self-development –Social values and individual attitudes.Work ethics, Indian vision of humanism.Moral and non- moral valuation.Standards and principles.Value judgements.

Unit 2

Importance of cultivation of values.Sense of duty.Devotion, Self-reliance.Confidence, Concentration.Truthfulness, Cleanliness.Honesty, Humanity.Power of faith, National Unity.Patriotism.Love for nature,Discipline

Unit 3

Personality and Behavior Development - Soul and Scientific attitude.Positive Thinking.Integrity and discipline.Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance.True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits.Association and Cooperation. Doing best for saving nature

Unit 4

Character and Competence –Holy books vs Blind faith.Self-management and Good health.Science of reincarnation. Equality, Nonviolence,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

References

1.Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

MTAD-102A	Constitution of India						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.*						
Course Outcomes (CO)							
CO1	*Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*						
CO2	*Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*						
CO3	*Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.*						
CO4	*Discuss the passage of the Hindu Code Bill of 1956.*						

Unit I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features

Unit 2

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality , Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive , President, Governor , Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit 3

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit 4

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

MTAD-104A	Pedagogy Studies						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers and Identify critical evidence gaps to guide the development.*						
Course Outcomes (CO)							
CO1	*What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?*						
CO2	*What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?*						
CO3	*How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?*						
CO4	*What is the importance of identifying research gaps?*						

Unit 1

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology , Theories of learning, Curriculum, Teacher education., Conceptual framework, Research questions. Overview of methodology and Searching. Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. , Curriculum, Teacher education.

Unit 2

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change.Strength and nature of the body of evidence for effective pedagogical practices.Pedagogic theory and pedagogical approaches.Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 3

Professional development: alignment with classroom practices and follow-up support, Peer support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes,

Unit 4

Research gaps and future directions: Research design, Contexts , Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

References

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

MTAD-106A	Stress Management by Yoga						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To achieve overall health of body and mind and to overcome stress						
Course Outcomes (CO)							
CO1	*Develop healthy mind in a healthy body thus improving social health.*						
CO2	*Improve efficiency*						
CO3	*Learn the Yogasan*						
CO4	*Learn the pranayama*						

Unit – 1

Definitions of Eight parts of yog (Ashtanga).

Unit- 2

Yam and Niyam, Do`s and Don't's in life; Ahinsa, satya, astheya, bramhacharya and aparigraha; Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit- 3

Asan and Pranayam, Various yog poses and their benefits for mind & body,

Unit- 4

Regularization of breathing techniques and its effects-Types of pranayam.

References

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

MTAD-108A	Personality Development through Life Enlightenment Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To learn to achieve the highest goal happily To become a person with stable mind, pleasing personality and determination To awaken wisdom in students						
Course Outcomes (CO)							
CO1	*Students become aware about leadership.*						
CO2	*Students will learn how to perform his/her duties in day to day work.*						
CO3	*Understand the team building and conflict*						
CO4	*Student will learn how to become role model for the society.*						

Unit – 1

Neetisatakam-Holistic development of personality: Verses: 19, 20, 21, 22 (wisdom); Verses: 29, 31, 32 (pride & heroism); Verses: 26, 28, 63, 65 (virtue); Verses: 52, 53, 59 (don's); Verses: 71, 73, 75, 78 (do's).

Unit – 2

Approach to day to day work and duties; ShrimadBhagwadGeeta: Chapter-2: Verses: 41, 47, 48; Chapter-3: Verses: 13, 21, 27, 35; Chapter-6: Verses: 5, 13, 17, 23, 35; Chapter-18: Verses: 45, 46, 48.

Unit - 3

Statements of basic knowledge; ShrimadBhagwadGeeta: Chapter-2: Verses: 56, 62, 68; Chapter-12: Verses: 13, 14, 15, 16, 17, 18.

Unit – 4

Personality of Role model; ShrimadBhagwadGeeta: Chapter-2: Verses: 17; Chapter-3: Verses: 36, 37, 42: Chapter-4: Verses: 18, 38, 39; Chapter-18: Verses: 37, 38, 63.

References:

1. Srimad Bhagavad Gita, Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya), P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Dissertation Phase – I and Dissertation Phase - II

Teaching Scheme

Lab work : 18 and 32 hrs/week for Dissertation Phase- I (MCH-207A)and Phase- II (MCH-202A) respectively

Course Outcomes:
At the end of this course, students will be able to

a. Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
b. Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
c. Ability to present the findings of their technical solution in a written report. Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:
The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

1. Relevance to social needs of society

    - Relevance to value addition to existing facilities in the
    - Relevance to industry need

2. Problems of national importance

3. Research and development in various domain

4. The student should complete the following:

    - Literature survey Problem Definition Motivation for study and Objectives
    - Preliminary design / feasibility / modular approaches
    - Implementation and Verification

5. Report and presentation

The dissertation phase- II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

Experimental verification / Proof of concept.

Design, fabrication, testing of Communication System.

The viva-voce examination will be based on the above report and work.

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Guidelines for Dissertation Phase – I and Phase-II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, a record of continuous progress.

Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

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KURUKSHETRA UNIVERSITY, KURUKSHETRA

Established by the state Legislature Act XII of 1956

('A+' Grade, NAAC Accredited)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING

(CREDIT BASED)(w. e. f. 2018-19)

SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

SEMESTER-1

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTIP-101A	Advanced Metal Casting	3	0	0	3	3	60	40	-	100	3
2	MTSE-101	Intelligent Manufacturing Systems	3	0	0	3	3	60	40	-	100	3
3		*Programme Elective-I	3	0	0	3	3	60	40	-	100	3
4		**Programme Elective-II	3	0	0	3	3	60	40	-	100	3
5	MTRM-111A	Research Methodology and IPR	2	0	0	2	2	60	40	-	100	3
6	MTSE-103	Metal Cutting and Tool Design Lab	0	0	4	4	2	-	40	60	100	3
7	MTSE-105	Advanced Manufacturing Lab	0	0	4	4	2	-	40	60	100	3
8		***Audit Course-I	2	0	0	2	-	-	100	-	100	3
					Total	**24**	**18**	**300**	**280**	**120**	**700**	

***PROGRAMME ELECTIVE- I (MTSE) for 1st Semester**		
1.	MTIP-105A	Tool Engineering
2.	MTIP-107A	Advanced Engineering Materials
3.	MTIP-109A	Non-Conventional Machining

****PROGRAMME ELECTIVE- II (MTSE) for 1st Semester**		
1.	MTIP-111A	Product Design and Development
2.	MTIP-113A	Simulation of Industrial Systems
3.	MTIP-115A	Supply Chain Management

*****AUDIT COURSE – I for 1st Semester (MTSE)**		
1.	MTAD-101A	English for Research Paper Writing
2.	MTAD-103A	Disaster Management
3.	MTAD-105A	Sanskrit for Technical Knowledge
4.	MTAD-107A	Value Education

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2.*** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

3. The programme Elective I & II and Audit Course-I are common with M.TECH. (I&P).The course starts with MTIP code is common with M.TECH (I&P).

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SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

SEMESTER-II

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTSE-102	Mechanical Forming of Materials	3	0	0	3	3	60	40	-	100	3
2	MTSE-104	Computer Integrated Manufacturing and Automation	3	0	0	3	3	60	40	-	100	3
3		*Programme Elective-III	3	0	0	3	3	60	40	-	100	3
4		**Programme Elective-IV	3	0	0	3	3	60	40	-	100	3
5	MTSE-106	Computer Integrated Manufacturing Lab	0	0	4	4	2	-	40	60	100	3
6	MTSE-108	Advance Welding Lab	0	0	4	4	2	-	40	60	100	3
7	MTSE-110	Mini Project	0	0	4	4	2	-	-	100	100	3
8		***Audit Course-II	2	0	0	2	-	-	100	-	100	3
					Total	**26**	**18**	**240**	**240**	**220**	**700**	

***PROGRAMME ELECTIVE-III (MTSE) for 2nd Semester**		
1.	MTIP-106A	Advanced Welding Processes
2.	MTIP-108A	Advanced Metal Cutting
3.	MTIP-110A	Metrology

****PROGRAMME ELECTIVE - IV (MTSE) for 2nd Semester**		
1.	MTIP-112A	Sequencing and Scheduling
2.	MTIP-114A	Quality Engineering and Management
3.	MTIP-116A	Reliability Engineering

*****AUDIT COURSE–II for 2nd Semester (MTSE)**		
1.	MTAD-102A	Constitution of India
2.	MTAD-104A	Pedagogy Studies
3.	MTAD-106A	Stress Management by Yoga
4.	MTAD-108A	Personality Development through Life Enlightenment Skills

Note: 1. ***Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

2. The programme Elective III& IV and Audit Course-II are common with M.TECH. (I&P).The course starts with MTIP code is common with M.TECH. (I&P).

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MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING

(CREDIT BASED)(w. e. f. 2018-19)

SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

SEMESTER-III

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1		*Programme Elective-V	3	0	0	3	3	60	40	-	100	3
2		**Open Elective	3	0	0	3	3	60	40	-	100	3
3	MTSE-201	Dissertation Phase-I	0	0	20	20	10	-	100	-	100	--
					Total	**26**	**16**	**120**	**180**		**300**	

***PROGRAMME ELECTIVE-V (MTSE) for 3rd Semester**		
1.	MTIP-201A	Enterprise Resource Planning
2.	MTIP-203A	Design of Experiments
3.	MTIP-205A	Strategic Entrepreneurship

****OPEN ELECTIVE(MTSE) for 3rd Semester**		
1.	MTOE-201A	Business Analytics
2.	MTOE-203A	Industrial Safety
3.	MTOE-205A	Operations Research
4.	MTOE-207A	Cost Management of Engineering Projects
5.	MTOE-209A	Composite Materials
6.	MTOE-211A	Waste to Energy

Note: 1. The programme Elective-V and Open Elective are common with M.TECH. (I&P).

SEMESTER-IV

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTSE-202	Dissertation Phase-II	0	0	32	32	16	-	100	200	300	--
					Total	**32**	**16**		**100**	**200**	**300**	

Total credits = 68

INSTRUCTIONS FOR PAPER SETTER

1. The question paper is to be attempted in **THREE Hours**.
2. Maximum Marks for the paper are **60.**
3. The syllabus for the course is divided into **FOUR units.**
4. The paper will have a total of **NINE questions.**
5. **Question No. 1,** which is compulsory, shall be OBJECTIVE Type **and have content from the entire syllabus (all Four Units).**

   Q. No. 2 & 3 from Unit I

   Q. No. 4 & 5 from Unit II

   Q. No. 6 & 7 from Unit III

   Q. No. 8 & 9 from Unit IV

6. All questions will have equal **weightage of 12 marks.**
7. The candidate will attempt a total of **FIVE questions**, each of 12 marks. Q. No. 1 is compulsory. The candidate shall attempt remaining **four** questions by selecting **only one question from each unit.**
8. A question may have any number of sections labeled as 1(a), 1(b), 1(c), 1(d), ---- 2(a), 2(b), --.A section may further have any number of subsections labeled as (i), (ii), (iii),.
9. **SPECIAL INSRUCTIONS FOR Q. No. 1 ONLY**

   Question No. 1, which is compulsory, shall be OBJECTIVE/ short answer type **and have content from the entire syllabus (all Four Units).**

   Emphasis is to be given on the basic concepts, analytical reasoning and understanding of the various topics in the subject. This question may have a number of parts and/or subparts. The short questions could be combination of following types:

   i. Multiple Choice
   ii. Yes/ No choice
   iii. Fill in Blanks type
   iv. Short numerical computations
   v. Short Definitions
   vi. Matching of Tables

   The above mentioned question types is **only a Guideline**. Examiner could set the question as per the nature of the subject.

First Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP–101A	ADVANCED METAL CASTING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of moulding and casting.						
Course Outcomes							
CO1	To impart knowledge about various functional requirements of moulding materials and specifications and testing of moulding sand properties.						
CO2	To acquaint students with the phenomenon of solidification and analytics involved in solidification of Molten metal in various types of mould metal combintions.						
CO3	To impart knowledge to students about Gating system design and Riser design for getting an accurately designed defect free casting.						
CO4	To let student understand some special casting processes and testing of casting.						

UNIT-I

Functional Requirement of Moulding Materials: Principal ingredients of moulding Sands; Different Types of Sands; Clays, Different types of Clay structures, Moisture; Theories of Clay sand bonding, Sand system equipment, Flow of sand in a mechanized foundry, The Requirement of core sands,.

Specification and testing of Moulding Sands

Grain Size, Grain Shape, Clay content, Moisture Content, Bulk Density and Specific Surface Area, Acid Demand Value (ADV), Fines Content, Sintering Temperature, Mould hardness, Permeability, Strength, Deformation & toughness, Compactability, Mouldability, High Temperature Characteristics.

UNIT-II

Solidifications of Metals, Nucleation, free energy concept, critical radius of nucleus, Distribution coefficient and Constitutional Undercooling, Solidification in Pure Metals and Alloys, Directional Solidification, Casting Characteristics related to Solidification; Fluidity, Dendritic Growth, Dendrite coherency, Segregation, Inverse Segregation, Hot tearing, Hipping, Solidification under pressure.

Heat Transfer during casting process: Resistance to Heat Transfer, Centerline Feeding Resistance, Rate of solidification, Solidification of Large casting in an insulating mould, Solidification with predominant interface resistance, Solidification with constant casting surface temperature, Solidification with predominant resistance in mould and solidified Metal, Solidification Time and Chvorinov rule, Numerical Exercises.

UNIT-III

Gating System Design: Gating system defined, Types of Gating Systems, Types of Gates, Elements of Gating System, Gating System design, Factors involved in Gating design, Pouring time, Choke Area, Sprue design, Gating Ratio, Sprue runner gate ratio, Elimination of Slag and Dross, Filtration, Numerical exercises.

Riser Design: Need for riser, Basic requirements of an effective feeding system for a casting, Feeding Efficiency, Types of Risers, Effective feeding distances for simple and complex shapes. Use of chills, Directional solidification, Stresses in castings, Metal Mould reactions, Claine's Method, Modulus Method, Naval Research Laboratory (NRL) Method, Pouring rate and Temperature, Padding, Use of exothermic materials, Chills, Feeding Aids, Numerical exercises.

UNIT-IV

Special casting Processes: Shell Moulding, Investment Casting, Permanent Mould Casting, Diecasting, Centrifugal casting.

Inspection and testing of casting: Visual, Optical, Dimensional inspection, Laser Scanning, White light scanning, Radiographic Inspection, ultrasonic testing, Magnetic Particle Testing, dye penetration, Casting Defects; Classification, Causes and remedies.

RECOMMENDED BOOKS:

1 H.F. Taylor, "Foundry Engineering", John Wiley and Sons.
2 P.L. Jain, "Principles of Foundry Technology", Mc-Graw Hill.
3 Mahi Sahoo and Sudhari Sahu, "Principles of Metal Casting.
4 Amitabha Ghosh, " Manufacuring Science", Affliated East West Press.
5 P.N Rao, "Manufacturing Technology: Foundry, Forming and Welding" TMH.
6 K.P. Sinha,"Foundry Technology", Standard Publishers, Delhi.

7 Flinn, “Fundamentals of Metals Casting”, Addison Wesley.
8 Heine Loper and Resenthal, “Principles of Metal Casting”, Mc-Graw Hill.
9 Hielel and Draper, “Product Design & Process Engineering”, Mc-Graw Hill.
10 Salman & Simans, “Foundry Practice”, Issac Pitman.
11 ASME, “Metals Handbook- Metal Casting.”
12 P.C. Mukharjee, Fundamentals of Metal casting Technology, Oxford, IBH.
13 P.R.Beeley, Foundry Technology, Butterworth Heinmann.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTSE-101	INTELLIGENT MANUFACTURING SYSTEMS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of the course is to impart the students with the knowledge about the detailed study of the intelligent manufacturing systems.						
Course Outcomes							
CO1	To understand the concept and scope of machine intelligence.						
CO2	To acquaint students importance of sensors in intelligent manufacturing systems.						
CO3	To impart knowledge to students about Principles and application of sensors.						
CO4	To let student understand the Design, Analysis & other issues of smart structure.						

UNIT-I

Scope of Machine Intelligence: Modeling and control of processes and machines, Machine learning for system modeling from incomplete, Ambiguous information, Neuro fuzzy expert systems for uncertain reasoning, Concept learning, Associative memory, Connectionist learning systems, Data abstraction in parallel distributed architectures, Model based optimizations using evolutionary algorithms, Genetic algorithms.

UNIT-II

Sensors in Intelligent Manufacturing Systems: Sensor-based Robotic systems for assembly, welding, Machining, mobile robots, Task level planning, Path planning, Multi-sensor integration for environmental interaction and Error recovery.

UNIT-III

Principles and Applications of Sensors: Displacement, Force, Tactile, Temperature, Acoustic, Vision, Range sensors,Visuo-motor coordination, Navigation problems, Intelligent structures, Behavioural approach and subsumption architecture for learning from environment.

UNIT-IV

Design, Analysis and Manufacturing issues of Smart Structures: Analysis, Manufacturing, Application issues involved in integrating smart materials and devices with signal processing, Control capabilities to engineering smart structures and products, Emphasis on structures, Automation and precision manufacturing equipment, Automotives, Consumer products, Sporting products, Computer and telecommunications products.

RECOMMENDED BOOKS:

1. The Assurances Sciences - Halpern, Seigmund - Prentice Hall International, New Jersey, U.S.A - 1978.
2. Robots manufacturing and application -Paul Afonh, John Wiley.
3. Logistics Engineering and Management - Blanchard, Bejamin S. - Prentice Hall International, New Jersey, U.S.A – 1986.
4. Smart Materials and Structures- M. V. Gandhi and B. So Thompson - Chapman & Hall, London; New York - 1992.
5. Robotic technology and flexible automation -S.R Deb, TMH
6. Smart Structures and Materials-B. Cui shaw-ArtechHouse,Boston, - 1996.
7. Smart Structures: Analysis and Design-V. Srinivasan -Cambridge University Press, Cambridge; New York - 2001.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-I

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP–105A	TOOL ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to impart the students with the knowledge of various aspects of design of different types of Tools and fixtures used in Industries.						
Course Outcomes							
CO1	To impart knowledge of materials for cutting tool and design of cutting tools.						
CO2	To acquaint students with various kinds of Gages and Work holding devices.						
CO3	To impart knowledge to students about Drill jigs and Fixtures.						
CO4	To let student understand the tool design process for NC Machine tools						

UNIT-I

Cutting Tool Materials: Introduction and desirable properties, Carbon and Medium-Alloy Steels, High-Speed Steels, Cast-Cobalt Alloys, Carbides, Coated Tools, Alumina-Based Ceramics, Cubic Boron Nitride, Silicon-Nitride Based Ceramics, Diamond, Reinforced Tool Materials, Cutting-Tool Reconditioning.

Design of Cutting Tools Basic Requirements, Mechanics and Geometry of Chip Formation, General Considerations for Metal Cutting, Design of single point Cutting Tools, Design of Milling Cutters, Design of Drills and Drilling, Design of Reamers, Design of Taps, Chip Breakers.

UNIT-II

Gages and Gage Design: Limits fits and tolerances, Geometrical tolerances-specification and measurement, Types of gages, Gage design, gage tolerances, Material for Gages.

Work Holding Devices: Basic requirements of work holding devices, Location: Principles, methods and devices, Clamping: Principles, methods and devices.

UNIT-III

Drill Jigs: Definition and types of Drill Jigs, Chip Formation in Drilling, General Considerations in the Design of Drill Jigs, Drill Bushings, Drill Jigs, and Modern Manufacturing

Design of Fixtures: Fixtures and Economics , Types of Fixtures , Milling Fixtures , Boring Fixtures, Broaching Fixtures, Lathe Fixtures, Grinding

UNIT-IV

Tool Design for Numerically Controlled Machine Tools: Fixture Design for Numerically Controlled Machine Tools, Cutting Tools for Numerical Control, Tool-holding Methods for Numerical Control.

RECOMMENDED BOOKS:

1. ASTME, “Fundamentals of Tool Design”, Prentice Hall of India, 1983.
2. Donaldson, “Tool Design”, Tata-McGraw Hill, 3rd Edition, 2000.
3. Joshi P.H., “Jigs and Fixtures”, Tata-McGraw Hill, 2010.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP–107A	ADVANCED ENGINEERING MATERIALS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to impart the students with the knowledge of various advanced and smart materials.						
Course Outcomes							
CO1	To impart knowledge of Piezoelectric and shape memory alloys.						
CO2	To acquaint students with deep know how about Electro-rheological and composite materials.						
CO3	To impart knowledge to students about MEM systems and High temperature application materials.						
CO4	To let student understand the processing and characteristics of powder metallurgy processes and structural materials.						

UNIT-I

Introduction to advanced Engineering materials: Classes of Materials and their usage, Historical Perspective, Intelligent Materials, Structural Materials, Functional Materials, Primitive Functions of Intelligent Materials, Intelligence inherent in Materials, Materials Intelligently Harmonizing with humanity, Biometric.

Smart Materials and Structural Systems: Introduction, Actuator Materials, Sensing Technologies, Micro-sensors, Intelligent systems, Hybrid Smart Materials, Passive Sensory Smart Structures, Reactive Actuator based smart structures, Active Sensing and Reactive smart structures, smart skins, Aero-elastic tailoring of airfoils, Synthesis of future smart systems.

UNIT-II

Electro caloric Effect: An Introduction, History of Electrocaloric Cooling, Mechanism of working of Electrocaloric Cooling, Electro caloric Materials, Performance of Electrocaloric Materials.

Heat Resistant Steels: Conventional Heat-Resistant Steels, Silicon-Bearing High Chromium Heat-Resistant Steels, Nitride-Strengthened Reduced Activation Heat-Resistant Steels, China Low Activation Martensite Steel Nitride-Strengthened Steels, Microstructural Stability

UNIT-III

Smart Micro-systems: Silicon Capacitive Accelerometer, Piezo-resistive Pressure sensor, Conductometric Gas sensor, An Electrostatic Comb-drive, Magnetic Microrelay, Portable Blood Analyzer, Piezoelectric Inkjet Print Head.

Buckyballs to robotics: Bucky ball, Nano Structure of Fullerene, Carbon Nanotubes, Nano Diamond, Boron nitride nanotubes, Single electron transistors, Molecular machine, Nano Biometrics, Nano Robots,

UNIT-IV

Nano-Alloys: Introduction, Chemical Synthesis: General Concepts, Reduction of Metallic Salts, The Organicmetallic Route: Thermal Decomposition Method, Other Chemical Methods for synthesis of Nano-alloys,Physical Routes for synthesis of Nano-Alloys;Experimental Techniques and Examples.

Shape memory alloys (SMA): Shape memory effect and the metallurgical phenomenon of SMA, Types of SMA, One way and Two way Shape memory effect. Temperature assisted shape memory effect, Applications.

RECOMMENDED BOOKS:

1. Gandhi, M.V. and Thompson, B.S., Smart materials and Structures, Chapman & Hall, 1992.
2. AnanthaSuresh G.K., Vinoy K.J., Micro and Smart Systems, Wiley India.
3. Wei Yan, Wei Wang, 9-12 Cr Heat Resistant Steels, Engineering Material series, Springer International.
4. Damien Alloyeau, Christine Mottet, Nanoalloys Synthesis, Structure and Properties, Springer International.
5. Tatiana Correia, Qi Zhang, Electro caloric Materials: New Generation of Coolers
6. Otsuka, K. and Wayman, C. M., Shape memory materials, C.U.P,1998
7. Taylor, W., Piezoelectricity, George jorden and Breach Sc. Pub.,1985
8. Mallick, P.K., Fiber Reinforced Composites Materials, Manufacturing andDesign. Marcel Dekker Inc, New York, 1993.
9. Rama Rao, P. (ed.), Advances in Materials and their applications, Wiley EasternLtd.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)

(CREDIT BASED)(w. e. f. 2018-19)

SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP–109A	NON-CONVENTIONAL MACHINING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 hrs
Objective	To acquaint the students with the advanced technologies and processes in various streams of Non-conventional machining.						
Course Outcomes							
CO1	To impart knowledge of Various Non-conventional Mechanical Working Processes, technology, process parameters and analysis for metal removal for these processes.						
CO2	To acquaint students with deep knowhow about chemical and electrochemical machining processes,						
CO3	To impart knowledge to students about various kinds of Electric discharge machining processes, process parameters associated with these processes and various process characteristics.						
CO4	To let student understand the working and technology associated with Laser Beam machining and Electron beam machining processes.						

UNIT-I

Introduction, Need of Non-conventional machining processes, Characteristics of conventional and Non-conventional Machining processes.

Mechanical Working Processes: **Abrasive Jet Machining:** Machining setup, Abrasives, Process Parameters, Machining Characteristics, Material removal models in AJM, Process capability, Advantages, limitations, Applications

Water Jet Machining: Basic mechanism of Water jet machining setup, Process parameters, Catcher, Process capabilities, Advantages, limitations, Applications

Abrasive Water Jet Machining process: Working Principle, AWJM Machine, Process Variables, Mechanism of Metal Removal, Cutting Parameters, Process capabilities, Applications, Environmental issues.

Ultrasonic Machining: Fundamental principles, Equipment, Magnetostriation, Elements of process, Mechanics of cutting, Analysis of Process Parameters, Process capabilities, Economic considerations. Applications, Limitations

UNIT-II

Chemical Machining: Introduction, Fundamental Principles, Process Parameters; Maskants and Etchants, Advantages, Limitations, Applications.

Electrochemical Machining Processes: Introduction, Classification of ECM Processes, Fundamentals Principles of ECM, Elements of ECM, ECM Machine Tool Process, Determination of Metal Removal Rate, Evaluation of Metal Removal of an alloy, Electrochemistry of ECM, Cathode and Anode reaction, Dynamics of ECM, Self-Regulating feature of ECM, Process Parameters, Process capabilities, Electrochemical Debarring.

Electrochemical Grinding: Schematics, Electrochemistry, Process Parameters, Process capabilities, Applications, Advantages, Limitations.

UNIT-III

EDM: Introduction, Basic Principles & Schematics, Process Parameters, Characteristics of EDM, Dielectric, Electrode Material, Modeling of Material Removal, Spark Erosion Generators, Analysis and Metal Removal Rate in RC circuit, Selection of Tool Material and Tool Design, Di-Electric system, Process Variables, Dielectric Pollution and its effects, Process Characteristics, Applications, Electric Discharge Grinding and Electric Discharge Diamond Grinding;

Wire EDM: Working Principle, Wire EDM Machine, Advances in Wire-cut EDM Process Variables, Process Characteristics, Applications.

UNIT-IV

Laser Beam Machining Back Ground, Production of Laser, Working Principle of LBM, Types of LASERS, Process Characteristics, Metallurgical effects, Advantages and Limitations, Applications.

Electron Beam Machining:

Electron Beam Action, Generation and control of Electron beam, Theory of Electron Beam Machining, Process Parameters, Process capabilities, Applications.

High Energy Rate Forming, Electro-Hydraulic Forming, Explosive Forming, Hot Machining Analysis of the Process.

RECOMMENDED BOOKS:

1 V.K. Jain, Advanced Machining Processes, Allied Publishers Pvt Ltd
2 P.C. Pandey and H.S. Shan,Modern Machining Processes, Tata McGraw- Hill
3 M. K. Singh, Unconventional Manufacturing Process, New Age Publishers
4 J. A. Mcgeough, Advanced Methods of Machining,Springer.
5 Benedict, Non-Traditional Manufacturing Process, CRC pub.
6 P. K. Mishra, Non-conventional manufacturing, Narosa Publishers

Note: The paper will have a total of NINE questions. Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).
All questions will have equal weight of 12 marks. The student will attempt a total of *FIVE* questions, each of 12 marks. Q. No. 1 is compulsory. The student shall attempt remaining four questions by selecting only one question from each unit.

Programme Elective-II

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP-111A	PRODUCT DESIGN AND DEVELOPMENT						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 hrs
Objective	The objective of the course is to understand about the product design and developments with inputs from aesthetics, ergonomics, design for manufacturing ease and cost effectiveness apart from reliability and durability and other considerations.						
Course Outcomes							
CO1	To understand the concept of product design, design considerations, design practiced by the industry, production and marketing, and aesthetics.						
CO2	To provide a detailed fundamental approach to several primary processes and design guidelines for manufacturing, assembly and environment.						
CO3	To discuss the human factor engineering and the concept of value engineering.						
CO4	To study the modern approaches to product design, concept of product development and its manufacturing and economic aspects.						

UNIT-I

INTRODUCTION: Introduction to product design, Design by evolution and innovation, Essential factors of product design, Production consumption cycle, Flow and value addition in production consumption cycle, Morphology of design.

PRODUCT DESIGN PRACTICE AND INDUSTRY: Product strategies, Time to market, Analysis of the product, Basic design considerations, Role of aesthetics in product design.

UNIT-II

DESIGN FOR MANUFACTURE AND ASSEMBLY: Overview and motivation, Basic method: Design guidelines: Design for assembly, Design for piece part production, Advanced method: Manufacturing cost analysis, cost driver modeling, Critique for design for assembly method.

DESIGN FOR THE ENVIRONMENT: Environmental objectives, Basic DFE methods, Design guidelines, Life cycle assessment, Techniques to reduce environmental impact.

UNIT-III

HUMAN ENGINEERING CONSIDERATIONS IN PRODUCT DESIGN: Human being as applicator of forces, Anthropometry, the design of controls, the design of displays, Man/Machine information exchange, Workplace layout from ergonomic considerations.

VALUE ENGINEERING: Value, Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, value analysis job plan, creativity, steps to problem solving and value analysis, value analysis tests, value engineering idea generation check list, Cost reduction through value engineering-case study, materials and process selection in value engineering.

UNIT-IV

MODERN APPROACHES TO PRODUCT DESIGN: Concurrent design, Quality function deployment (QFD), Rapid prototyping, 3D printing, Introduction to 4D printing.

PRODUCT DEVELOPMENT: A modern product development process, reverse engineering and redesign product development process, product life cycle, product development teams, Product development planning, Manufacturing & economic aspects of product development.

RECOMMENDED BOOKS:

1. Kail T Ulrich and Steven D Eppinger, "Product Design and Development, TMH.
2. AK Chitale and Gupta, "Product Design and Engineering, PHI.
3. Niebel& Draper, "Product Design and Process Engineering", McGraw-Hill.
4. Kevin Otto & Kristin Wood, "Product Design-Techniques in reverse engineering and new product development"Pearson.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP–113A	SIMULATION OF INDUSTRIAL SYSTEMS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of industrial systems and its simulation.						
Course Outcomes							
CO1	To explain the concept of industrial simulation systems and its models of simulation.						
CO2	To understand the simulation of discrete and queuing systems.						
CO3	To understand the simulation if inventory systems and design of simulation experiments.						
CO4	To simulate the industrial problems like reliability problems, computer time sharing problem and understand the simulation languages.						

UNIT-I

Introduction and overview: concept of system, system environment, elements of system, system modeling, types of models, Monte Carlo method, system simulation, simulation - a management laboratory, advantages & limitations of system simulation, continuous and discrete systems.

Simulation of continuous systems: characteristics of a continuous system, comparison of numerical integration with continuous simulation system. Simulation of an integration formula.

UNIT-II

Simulation of discrete system: Time flow mechanisms, Discrete and continuous probability density functions. Generation of random numbers, testing of random numbers for randomness and for auto correlation, generation of random variants for discrete distribution, generation of random variants for continuous probability distributions-binomial, normal, exponential and beta distributions; combination of discrete event and continuous models.

Simulation of queuing systems: Concept of queuing theory, characteristic of queues, stationary and time dependent queues, queue discipline, time series analysis, measure of system performance.

Kendall's notation, auto covariance and auto correlation function, auto correlation effects in queuing systems, simulation of single server queues, multi-server queues, queues involving complex arrivals and service times with blanking and reneging.

UNIT-III

Simulation of inventory systems: Rudiments of inventory theory, MRP, in-process inventory, Necessity of simulation in inventory problems, forecasting and regression analysis, forecasting through simulation, generation of Poisson and Erlang variants, simulation of complex inventory situations.

Design of Simulation experiments: Length of run, elimination of initial bias, Variance, Variance reduction techniques, stratified sampling, antipathetic sampling, common random numbers, time series analysis, spectral analysis, model validation, optimization procedures, search methods, single variable deterministic case search, single variable non-deterministic case search, and regenerative technique.

UNIT-IV

Simulation of PERT: Simulation of - maintenance and replacement problems, capacity planning, production systems, reliability problems, computer time sharing problem, the elevator system.

Simulation Languages: Continuous and discrete simulation languages block structured continuous languages, special purpose simulation languages, SIMSCRIPT, GPSS SIMULA importance and limitations of special purpose languages.

RECOMMENDED BOOKS:

1. Loffick, Simulation and Modeling - Tata McGraw Hill
2. Deo Narsingh, System Simulation with Digital Computer - Prentice Hall
3. Hira, D.S., System Simulation-S. Chand & Co.
4. Meelamkavil, Computer Simulation and Modeling - John Willey
5. Jorden, System Simulation - Prentice hall
6. Jerry Banks and John, S. Carson II, 'Discrete – Event System Simulation', Prentice Hall Inc., New Jersey, 1984.
7. Geoffrey Gordon, 'System simulation', Prentice Hall, NJ, 1978.
8. Law, A.M. and W.D. Keltor, 'Simulation modeling analysis', McGraw Hill, 1982.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP–115A	SUPPLY CHAIN MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of Supply chain and different aspects of supply chain management.						
Course Outcomes							
CO1	To impart knowledge about basics of Supply chain management and Supply chain dynamics.						
CO2	To acquaint students with the different aspects involved in sourcing and procurement in supply chain management.						
CO3	To impart knowledge to students about Evaluating performance of Supply chain and decision making about Transportation, Storage and warehousing.						
CO4	To let student understand Quantitative tools for SCM, Information Technology in a Supply Chain:						

UNIT-I

Overview of supply chain management: Introduction, Definition, The Objective of a Supply Chain, The Importance of Supply Chain Decisions, Decision Phases in a Supply Chain, Process Views of a Supply Chain, Examples of Supply Chains.
Supply chain dynamics: Introduction, Coping with Dynamics in Supply chain. Bullwhip effect, Analysis of Bullwhip Effect, Impact of Lead time, Inventory management and Supply chain dynamics, off shoring and outsourcing Effect on SC dynamics and cost.

UNIT-II

Outsourcing and Make or Buy Decisions: Strategic Decisions and Core competencies, Tactical Decisions, Factors influencing make or buy decisions, Control of Production or Quality, Unreliable Suppliers, Suppliers Specialized knowledge and research, Small Volume Requirements, Limited Facilities, Workforce Stability, Multiple Sourcing Policy, Managerial and Procurement considerations, the Volatile nature of Make/Buy situation, Administration: Procedures and Personal.
Sourcing of Supply: Importance of Source Selection, Responsibilities for Source Selection, Evaluating a potential supplier, The criticality of Qualifying Sources, Competitive Bidding and Negotiation, Prerequisite for competitive bidding, Two step Bidding/Negotiation, Benefits and Risks of International Sourcing, Identifying and Qualifying an International Source.

UNIT-III

Supply Chain Performance: Achieving Strategic fit And Scope: Competitive and Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope**,** Challenges to Achieving and Maintaining, Strategic Fit, Supply chain drivers and metrics, Financial Measures of Performance, Drivers of Supply Chain Performance, Framework for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing.
Transportation, storage and warehousing: Introduction, Transportation mode choice, Transport operator decisions, Trucking sectors in India, Rail transport, Air Transport, Water transport, Transport network, Storage and warehousing, types of warehousing, risk pooling, IT Integration: Supply chain information system, Role of IT in SCM process, Business process Re-engineering, Internet and its applications in SCM.

UNIT-IV

Quantitative tools for SCM: Introduction, Forecasting, Demand forecast, Forecasting strategy & technique, Management of Inventories in SC, Linear programming, Routing models, pricing decisions, Introduction to MCDM approach.
Information Technology in a Supply Chain: The Role of IT in a Supply Chain, The Supply Chain IT Framework Customer Relationship Management, Internal Supply Chain Management, Supplier Relationship Management, The Transaction Management Foundation, The Future of IT in the Supply Chain, Risk Management in IT, Supply Chain IT in practice.

RECOMMENDED BOOKS:

1. Chopra, S., and Meindl, P., Supply chain Management: Strategy, Planning and Operations. Second Edition, Pearson Education (Singapore) Pte. Ltd, 2004.
2. Rangaraj, Supply Chain Management for Competitive Advantage, TMH.

3. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw-Hill Edition, 2003.
4. Doebler, D.W. and Burt, D.N., Purchasing and Supply Chain Management: Text and Cases, McGraw-Hill Publishing Company Limited, New Delhi, 1996.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unitfrom each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTRM-111A	RESEARCH METHODOLOGY AND IPR						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	2	60	40	100	3
Objective	The objective of this course is to make the students capable of formulating the research problems/ proposals and get aware about the intellectual property and patent laws.						
Course Outcomes							
CO 1	Student will be able to understand research problem formulation.						
CO 2	Student will be able to analyze research related information and follow research ethics.						
CO 3	Student will be able to understand the Patents, Designs, Trade and Copyright and able to apply the knowledge for patent.						
CO 4	Student will be able to understand the concept of Patent Rights, Licensing and transfer of technology and able to apply the knowledge in new developments in IPR.						

Unit-I

Meaning of research problem, Sources of research problem, Criteria, characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, Data collection, Analysis, Interpretation, Necessary instrumentations.

Unit-II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, How to write report, Paper. Developing a research proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit-III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit-IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology, Patent information and databases, Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and Institutions.

RECOMMENDED BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: An introduction for science & engineering students" Kenwyn, South Africa : Juta & Co. Ltd., 1996
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Juta Academic; 2nd edition (April 28, 2004)
3. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners" SAGE Publications Ltd; Fourth edition (14 January 2014)
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers; Revised edition (July 25, 2007)
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTSE-103	Metal Cutting and Tool Design Lab							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of Tool Nomenclature and Importance of Tool Design in industry.							
Course Outcomes								
CO1	To impart knowledge of practical evaluation of type of cutting forces in orthogonal and oblique cutting.							
CO2	To acquaint students with the study of changes in tool life during various processes.							
CO3	To impart knowledge to students about the tool chip interface temperature and fabrication of single point cutting tool according to tool signature.							
CO4	To let student understand the effect of tool wear on cutting tools and design of stamping dies.							

List of Experiments:

1. Measurement of shear plane angle
2. Measurement of cutting forces in orthogonal cutting
3. Measurement of cutting forces in oblique cutting
4. Study of surface conditions during grinding process
5. Calculation of tool life during machining process
6. Measurement of tool chip interface temperature
7. Fabrication of single point cutting tool as per given tool signature
8. Study of tool wear on different cutting tools.
9. Design of stamping dies.

Note: At least eight experiments must be performed from the above mentioned list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTSE-105	ADVANCED MANUFACTURING LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of advanced Manufacturing techniques useful in industries.							
Course Outcomes								
CO1	To impart knowledge of practical exercises about grinding with surface measurement and knowledge of Working of various advanced instruments.							
CO2	To acquaint students with the use of Autocollimator and Metallurgical Microscope.							
CO3	To impart knowledge to students about CNC machines and Non Destructive Testing.							
CO4	To let student Exercises on virtual instrumentation and Testing on UTM.							

List of Experiments:

1. Exercises on grinding and surface measurement.
2. Measurements in Universal Measuring Microscope, Profile Projector, and with various advanced instruments.
3. Flatness measurement using autocollimator,
4. Metallographic studies using Metallurgical Microscope,
5. Programming and measurements with CNC Coordinate Measuring Machine, surface texture analysis.
6. Experiments on non-destructive evaluation using ultrasonic testers,
7. Exercises on virtual instrumentation.
8. Preparation of standard specimen and testing on UTM.
9. Measurement of surface roughness using roughness measurement tester.

Note: At least eight experiments must be performed from the above mentioned list.

w.e.f. 2018-19

Audit Course-I

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTAD-101A	ENGLISH FOR RESEARCH PAPER WRITING						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to impart the knowledge of English for research paper writing.						
Course Outcomes							
CO1	To understand that how to improve writing skills and level of readability.						
CO2	To Learn about what to write in each section.						
CO3	To understand the skills needed when writing a title.						
CO4	To learn the skills required in writing the results, discussion and conclusions.						

Unit-I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit-II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit-III

Review of the Literature, Methods, Results, Discussion, Conclusions, and The final Check. Key skills needed when writing a Title, key skills needed when writing abstract, key skills needed when writing an Introduction, skills needed when writing a Review of the Literature.

Unit-IV

Skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions, Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

RECOMMENDED BOOKS:

1. Goldbort R, "Writing for Science", Yale University Press (available on Google Books)
2. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press
3. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM. Highman's book.
4. Adrian Wallwork, "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTAD-103A	DISASTER MANAGEMENT						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The objective of this course is to impart the knowledge of disasters management.						
Course Outcomes							
CO1	To demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.						
CO2	To critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.						
CO3	To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.						
CO4	To critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.						

Unit-I

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit-II

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.
Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Unit-III

Study of Seismic Zones, Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.
Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

Unit-IV

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation, Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies for Survival.
Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation, Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

RECOMMENDED BOOKS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTAD- 105A	SANSKRIT FOR TECHNICAL KNOWLEDGE						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to understand basic Sanskrit Language and Ancient Sanskrit literature related to science & technology.						
Course Outcomes							
CO1	Students will get a working knowledge in illustrious Sanskrit, the scientific language of the world.						
CO2	Learning of Sanskrit to improve brain functioning.						
CO3	Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.						
CO4	The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.						

Unit-I

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Unit-II

Order, Introduction of roots, Technical information about Sanskrit Literature

Unit-III

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

RECOMMENDED BOOKS:

1. Dr.Vishwas, “Abhyaspustakam” Samskrita-Bharti Publication, New Delhi
2. Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam “Teach Yourself Sanskrit” Prathama Deeksha-, New Delhi Publication
3. Suresh Soni, “India’s Glorious Scientific Tradition” Ocean books (P) Ltd., New Delhi.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTAD-107A	VALUE EDUCATION						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to understand value education, self-development, and Imbibe good values in students and Let them know about the importance of character building.						
Course Outcomes							
CO1	To get knowledge of self-development.						
CO2	To learn the importance of Human values.						
CO3	To develop the overall personality.						
CO4	To know about the importance of character.						

Unit-I

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non-moral valuation, Standards and principles, Value judgments.

Unit-II

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline.

Unit-III

Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature.

Unit-IV

Character and Competence –Holy books vs Blind faith,Self-management and Good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, studying effectively.

RECOMMENDED BOOKS:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Second Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTSE-102	MECHANICAL FORMING OF MATERIALS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of the course is to impart the students with the knowledge of mechanical working of materials i.e. Metal forming processes, forging processes, drawing, sheet metal forming, Extrusion etc.						
Course Outcomes							
CO 1	The students will be able to know about metal forming processes, stress strain relation, hot and cold working processes.						
CO 2	The students will be able to understand various forging processes and forging defects.						
CO 3	The students will be able to study about drawing and sheet metal forming processes.						
CO 4	The students will be able to know about extrusion and rolling processes.						

UNIT-I

Metal Forming Technology: Metallurgical aspects of metal forming, slip, twinning mechanics of plastic deformation, effects of temperature, strain rate, microstructure and friction in metal forming-yield criteria and their significance, Classification of Metal Forming Processes, Advantages and Limitations, Stress strain relations in elastic and plastic deformation, concept of flow stresses, deformation mechanisms, Hot and Cold Working Processes and Its Effect on Mechanical Properties.

UNIT-II

Forging Processes:- Introduction and Classification, Operation and principle of Forging Processes and Equipment, Methods of forging, Open and Close Die Forging Processes, Defects, Structure and Properties of Forged Products. Force Analysis in forging. Other Related Processes like Cold Heading, Rotary Swaging, Sizing, Coining, Embossing and Roll Forging, Homogeneous upsetting, Analysis of plane strain, Upset forging of rectangular billet , Upsetting of rectangular plate-analysis, Analysis of Axi-symmetric forging of a disk, Axi-symmetric forging of a disc-analysis, Forging die design, Forging defects, Forging die-design aspects, Forging defects, Introduction to powder forging.

UNIT-III

Drawing: Principles of Rod and wire drawing, Variables in wire drawing, Residual stresses in rod, Wire and tube drawing, Defects in Rod and wire drawing, Analysis of Wire Drawing Process and Load Calculations.

Sheet Metal Forming: Principle, process parameters, equipment and application of the following processes: spinning, stretch forming, plate, V and edge bending, Curling, Ironing, Roll Bending, Metal Spinning. Press brake forming, explosive forming, Hydro forming, electro hydraulic forming, and magnetic pulse forming, High Velocity forming of metals and High energy Rate forming.

UNIT-IV

Extrusion: Introduction and Classification, Extrusion Equipment, Forces in extrusion, Analysis of Extrusion Process, Extrusion of components including Seamless Pipes and Tubes, Extrusion of pipes by cold working, Other Related Processes like Impact Extrusion, Hydrostatic Extrusion, Piercing, Drawing, cupping and bending.

Rolling: Introduction and Classification, Types of Rolling Mills, Forces and Geometrical Relationships in Rolling, Calculation of Rolling Load, Roll Pass Design, Defects in Rolled Products, Residual stresses in rolled products, Other Related Processes like Roll Piercing, Ring Rolling, Pipe and tube production by rolling processes.

RECOMMENDED BOOKS:

1. Mechanical Working of Metals- Theory and Practice Harris J.N
2. Engineering Metallurgy and Higgens - ELBS/EA
3. Mechanical Metallurgy- Dieter G.E. - Mc Graw Hill Publications.
5. Principles of Metal Working - R.Rowe - Amold London – 1965.
6. Metals Handbook – ASM - Volume II -.ASM
7. Fundamentals of working of Metals - Sach G. - Pergamon Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTSE-104	COMPUTER INTEGRATED MANUFACTURING AND AUTOMATION						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of the course is to impart the students with the knowledge of computer integrated manufacturing, automation and automated material handling storage.						
Course Outcomes							
CO1	To understand the concept of CAD/CAM, CIM, computer process monitoring and control.						
CO2	To study the computer aided quality control methods, computerized manufacturing planning and shop floor control.						
CO3	To understand the concept of automated flow lines and design for automated assembly.						
CO4	To study the concept of automated material handling storage system.						

UNIT-I

Production Development Through CIM: Computers in Industrial manufacturing, Product cycle & Production development cycle, Introduction of CAD/CAM & CIM, sequential and concurrent engineering, soft and hard prototyping.
Computer Process Monitoring: Process control methods, direct digital control, supervisory computer control, steady state optimal control, on line search strategies, adaptive control.

UNIT-II

Computer Aided Quality Control: The computer in Q.C, automated inspection principles and methods, Contact inspection methods, non-contact inspection methods, machine vision system, optical inspection method, sensors, coordinate, measuring machine, Computer-Aided testing, Integration of CAQL with CAD/CAM.
Computer Integrated Manufacturing: Fundamentals of CAD/CAM, Computerized Manufacturing planning systems, shop floor control & automatic identification techniques. Computer Network for manufacturing and the future automated factor.

UNIT-III

Detroit Type of Automation: Flow lines, Transfer Mechanisms, work pattern transfer, Different methods, & Problems.
Analysis of Automated Flow Lines: Analysis of transfer lines without storage with storage buffer single stage, Double stage, Multistage with problems, Automated assembly systems, Design for automated assembly, parts feeding devices, analysis of Multi station assembly machine, Analysis of Single stage assembly machine.

UNIT-IV

Automated Material Handling Storage: Material functions, types of material handling equipment, analysis of material handling systems, design of system, conveyor system, automated guided vehicle systems, automated storage/retrieval systems, caroused storage systems ,work in process storage, interfacing handling & storage with manufacturing.

RECOMMENDED BOOKS:

1. **CAD/CAM** - Zimmers & Grover – PHI.
2. **CAD/CAM/CIM** - P.Radhakrishna - New Age International - 2nd edition.
3. **Automation, Production systems & Computer Aided Manufacturing** - M.P. Grover - Prentice Hall - 1984.
4. **CAD/CAM** - Zeid – Mc-Graw Hill - 2005.
5. **CAD/CAM** - P.N.Rao - TMH.- 2nd edition, 2004.
6. **Robotics for Engineering** - Koren.Y, Mc-Graw Hill - 1985.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-III

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP-106A	ADVANCED WELDING PROCESSES						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of Welding metallurgy and welding processes.						
Course Outcomes							
CO1	To impart knowledge about various Weld metallurgy and Weld arc characteristics.						
CO2	To acquaint students with the various welding power sources and their applications.						
CO3	To impart knowledge to students about Electrode coatings and Metal transfer phenomenon in weld metal transfer.						
CO4	To let student understand the basics of Solid state welding processes and some of the latest welding techniques.						

UNIT-I

WELDING METALLURGY: Introduction, Weld Metal Zone, Theory of solidification of metals and alloys, Homogeneous Nucleation, Heterogeneous Nucleation, Freezing of alloys, Epitaxial Solidification; Effect of Welding speed on Grain structure, Fusion boundary zone, Heat affected zone, Under bead zone, Grain Refined Zone, Partial transformed zone, Properties of HAZ

WELDING ARC: Definition of Arc, Structure and characteristics, Arc efficiency, arc blow, Electrical Characteristics of arc, Types of Welding Arcs, mechanism of arc initiation and maintenance, role of electrode polarity on arc behavior and arc stability, analysis of the arc, Arc length regulation in mechanized welding processes.

UNIT-II

WELDING POWER SOURCES: Requirement of an Arc welding power sources, basic characteristics of power sources for various arc welding processes, duty cycles, Selection of a static Volt-Ampere characteristic for a welding process, AC/DC welding power source, DC rectifiers, thyristor controlled rectifiers, transistorized units, inverter systems, Mathematical Problems on Static volt ampere characteristics

UNIT-III

COATED ELECTRODES: Electrode coatings, classification of coatings of electrodes for SMAW, SAW fluxes, role of flux ingredients and shielding gases, classification of solid and flux code wires.

METAL TRANSFER & MELTING RATE: Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal transfer and melting rate.

UNIT-IV

SOLID STATE WELDING: Theory and mechanism of solid state welding, techniques and scope of friction welding, diffusion welding, cold pressure welding and ultrasonic welding, high energy rate welding, analysis of the Process.

WELDING TECHNIQUES: Technique, scope and application of the electron beam and laser welding processes, under water welding - process & problem.

RECOMMENDED BOOKS:

1 Raymond Sacks, ―Welding: Principles & Practices‖ McGraw-Hill
2 R.S.Parmar, ―Welding processes & Technology, Khanna Publishers
3 R.S.Parmar, ―Welding Engineering & Technology, Khanna Publishers
4 S.V. Nandkarni, ―Modern Arc Welding Technology, Oxford & IBH publishing Co.
5 L.M.Gourd, ―Principles of Welding Technology, ELBS/ Edward Arnold.
6 Richard L. Little ―Welding & Welding Technology, Mc-Graw Hill.
7 Cary, Howard ―Modern Welding Technology', prentice Hall, 1998.
8 Rossi ―Welding Technology‖, Mc-Graw Hill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP–108A	ADVANCED METAL CUTTING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of advanced cutting tools, tools geometry, mechanisms and analysis.						
Course Outcomes							
CO1	To impart knowledge about various functional related to tools geometry.						
CO2	To acquaint with the analysis of fundamental factors affecting tool forces						
CO3	To impart knowledge about cutting tool life and mathematical modeling for wear.						
CO4	To let student understand abrasive machining and its process simulation.						

UNIT-I

Introduction: Tool nomenclature, Tool Geometry, Mechanism of Chip formation and forces in orthogonal cutting, Merchant's force diagram.

Oblique Cutting: Normal chip reduction coefficient under oblique cutting, true shear angle, effective rake, influx region consideration for deformation, direction of maximum elongation, effect of cutting variables on chip reduction co-efficient, forces system in oblique cutting, effect of wear land on force system, force system in milling, effect of helix angle.

UNIT-II

Fundamentals of Dynamometry: Theoretical determination of forces, angle relations, heat and temperature during metal cutting; distribution, measurement, analysis, theoretical estimation of work piece temperature, hot machining

Fundamental factors, which effect tool forces: Correlation of standard mechanized test. (Abuladze –relation), nature of contact and stagnant phenomenon, rates of strains, shear strain and normal strain distributions, cutting variables on cutting forces.

UNIT-III

Cutting Tools: Tools materials analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, wear of cutting tools, criterion, flank and crater wear analysis, optimum tool life, tool life equations, (Taylor's woxen etc) Tool life test, machining optimization, predominant types of wear; abrasive, adhesive, diffusion wear models, wear measurements and techniques, Major Test of tool wear oxidative mathematical modeling for wear, test of machinability and influence of metallurgy on machinability. Economics of metal machining

UNIT-IV

Abrasive Machining: Mechanics of grinding, cutting action of grit, maximum grit chip thickness, energy and grit force temperature during grinding, wheel wear, grinding, process simulation, testing of grinding wheels, mechanics of lapping and honing, free body abrasion.

RECOMMENDED BOOKS:

1. Sen.& Bhattacharya,Principles of Machine tools, New Central Book Agency.
2. Brown, Machining of Metals, Prentice Hall.
3. Shaw,Principles of Metal cutting, Oxford I.B.H.
4. Arshimov &Alekree,Metal cutting theory & Cutting tool design, MIR Publications.
5. Machining Science & Application by Knowenberg Longman Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP-110A	Metrology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs.**
Objective	The main objective of the course is to deal with the basic principles of dimensional measuring instruments and precision measurement techniques in achieving quality and reliability in the service of any product in dimensional control.						
Course Outcomes							
CO1	To understand the students about the requirement of metrology and the concepts of limit, fits and gauges.						
CO2	To study the linear and angular measurements and the optical measurement tools and techniques.						
CO3	To understand how to use surface roughness and thread measuring instruments.						
CO4	To study the comparators, measurement through comparators and the advanced metrology concepts.						

UNIT-I

Introduction to metrology: Definition, types, need of inspection, terminologies, methods of measurement, selection of instruments, measurement errors, units, Measurement standards, calibration, statistical concepts in metrology.

Systems of Limits and Fits: Introduction, nominal size, tolerance limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard Institution system – British standard system, International standard system for plain and screwed work.

Limit Gauges: Taylor's principle – Design of limit gauges, computer aided tolerance.

UNIT-II

Linear Measurement: Length standard, line and end standards, slip gauges – calibration of the slip gauges, dial indicator, micrometers. Measurement of angles and tapers: Different methods – bevel protractor – angle slip gauges – spirit levels– sine bar – sine plate, rollers and spheres.

Flat Surface Measurement: Measurement of flat surfaces – instruments used – straight edges– surface plates – optical flat and auto collimator.

Optical Measuring Instruments: Tool maker's microscope and its uses, collimators, optical projector, optical flats and their uses, interferometer.

UNIT-III

Surface Roughness Measurement: Introduction, terminology, specifying roughness on drawings, surface roughness parameters, factors affecting surface roughness, ideal surface roughness, roughness measurement methods, precautions in measurement, surface microscopy, surface finish software.

Screw Thread Measurement: Elements of measurement, errors in screw threads, measurement of effective diameter, angle of thread and thread pitch, profile thread gauges.

Measurement through Comparators: Comparator, Features of comparators, classification of comparators, different comparators, advanced comparators, thread comparators.

UNIT-IV

Metrology of machine tools: Alignment and practical tests.

Gear Measurement: Gear measuring instruments, gear tooth profile measurement, measurement of diameter, pitch, pressure angle and tooth thickness.

Advanced Metrology: Advanced measuring machines, CNC systems, Laser vision, In-process gauging, 3D metrology, metrology software, Nano technology instrumentation, stage position metrology, testing and certification services, optical system design, lens design, coating design, precision lens assembly techniques, complex mechanical assemblies, contact bonding and other joining technologies.

RECOMMENDED BOOKS:

1. K.J. Hume, Engineering Metrology, Macdonald and Co. (publisher) London.
2. Czichos, the Springer handbook of metrology and Testing, 2011.
3. Jay. L. Bucher, the Metrology Hand book, American Society for Quality, 2004.
4. Smith GT, Industrial Metrology, Springer.
5. John W. Greve, Frank W. Wilson,Hand book of industrial metrology, PHI – New Delhi.
6. D.M. Anthony, Engineering Metrology, Pergamon Press.
7. Khare MK,Dimensional Metrology, OXFORD-IBH Publishers.
8. I C Gupta, "Engineering Metrology", 5th Edition, Dhanapat Rai & Co, 2008.
9. R.K. Jain, "Engineering Metrology". 20th Edition, Khanna Publishers, 2007.
10. M. Mahajan, "Engineering Metrology", Dhanapati Rai publications, 2007.
11. BIS standards on Limits & Fits (IS 919), Surface Finish (IS 2073), Machine Tool Alignment, 1993.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-IV

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP–112A	SEQUENCING AND SCHEDULING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of different production and machine models of sequencing and scheduling.						
Course Outcomes							
CO1	To understand the concept of sequencing and scheduling.						
CO2	To study and practice for the extension of basic models and parallel machine models.						
CO3	To understand the concepts of the flow shop scheduling and practice for the flow shop scheduling models.						
CO4	To understand the job shop problems and simulation models for dynamic job shop problem.						

UNIT-I

Single-Machine Sequencing: Introduction, Preliminaries, Problems without Due Dates, Problems with Due Dates

Optimization Methods for the Single-Machine Problem: Introduction, Adjacent Pair wise Interchange Methods, A Dynamic Programming Approach, Dominance Properties, A Branch and Bound Approach.

Earliness and Tardiness Costs: Introduction, Minimizing Deviations from a Common Due Date, The Restricted Version, Asymmetric Earliness and Tardiness Costs, Quadratic Costs, Job-Dependent Costs, Distinct Due Dates, Sequencing for Stochastic Scheduling.

UNIT-II

Extensions of the Basic Model: Introduction, Non-simultaneous Arrivals, Related Jobs, Sequence-Dependent Setup Times, Stochastic Models with Sequence-Dependent Setup Times.

Parallel machine models: Introduction, Minimizing the Makespan, Minimizing Total Flow time, Stochastic Models.

UNIT-III

Flow Shop Scheduling: Introduction, Permutation Schedules, The Two-Machine Problem, Special Cases of The Three-Machine Problem, Minimizing the Makespan, Variations of the *m*-Machine Model, Stochastic flow shop scheduling.

UNIT-IV

The Job Shop Problem: Introduction, Types of Schedules, Schedule Generation, The Shifting Bottleneck Procedure, Neighborhood Search Heuristics.

Simulation Models for the Dynamic Job Shop: Introduction, Model Elements, Types of Dispatching Rules, Reducing Mean Flowtime, Meeting Due Dates.

RECOMMENDED BOOKS:

1. Michael Pinedoo, Scheduling: theory, algorithms and systems, Prentice Hall, New Delhi, 1995.

2. King, J.R. Production planning and control, Pergamon International Library, 1975.

3. Kenneth R. Baker, Introduction to sequencing and scheduling, John Wiley and Sons, 1974.

4. Kenneth R. Baker and Dan Trietsch, Principles of sequencing and scheduling, John Wiley and Sons, 2009.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP–114A	QUALITY ENGINEERING AND MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of quality tools and engineering for the improvement of product quality.						
Course Outcomes							
CO1	To understand the statistical concepts of quality and quality statistics.						
CO2	To study the quality control charts in production process and practice for its use in problem solving.						
CO3	To understand the quality improvement tools.						
CO4	To study the ISO systems, failure analysis and testing.						

Unit-I

Introduction to Quality: An Historical Overview: Defining Quality, Total Quality System, Total Quality Management, Economics of Quality, Quality, Productivity, and Competitive Position, Quality Costs, Success Stories.

Statistics for Quality: Variability in Populations, Some Definitions, Quality vs. Variability, Section I: Empirical Methods for Describing Populations, Section II: Mathematical Models for Describing Populations, Section III: Inference of Population Quality from a Sample.

Unit-II

Quality in Design: Planning for Quality, Product Planning, Product Design, Process Design.

Quality in Production-Process Control I: Process Control, Control Charts, Measurement Control Charts, Attribute Control Charts, Summary on Control Charts, Process Capability, Measurement System Analysis,

Quality in Production-Process Control II: Derivation of Limits, Operating Characteristics of Control Charts, Measurement Control Charts for Special Situations.

Unit-III

Quality in Procurement: Importance of Quality in Supplies, Establishing a Good Supplier Relationship, Choosing and Certifying Suppliers, Specifying the Supplies Completely, Auditing the Supplier, Supply Chain Optimization Using Statistical Sampling for Acceptance,

Continuous Improvement of Quality: The Need for Continuous Improvement, The Problem-Solving Methodology, Quality Improvement Tools, Lean Manufacturing.

Unit-IV

A System for Quality: The Systems Approach, Dr. Deming's System, Dr. Juran's System, Dr. Feigenbaum's System, Baldrige Award Criteria, ISO 9000 Quality Management Systems, ISO 9001:2008 Requirements, The Six Sigma System.

RECOMMENDED BOOKS:

1. Grant & Leave worth, Statistical Quality Control, McGraw Hill
2. Duncan, Quality Control & Industrial Statistics, Irwin Press
3. Juran, Quality Control Handbook, McGraw Hill.
4. Hansen, Quality Control, Prentice Hall
5. Thomason, An Introduction to reliability & control, Machinery Publishing.
6. A.V. Taylor, Total Quality Control, McGraw-Hill
7. K.S. Krishnamoorthi, V. Ram Krishnamoorthi, A First Course in Quality Engineering: Integrating Statistical and Management Methods of Quality, Second Edition, CRC Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weight of 12 marks*.

The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP–116A	RELIABILITY ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of reliability analysis in industrial system. Students can get acquainted with different reliability calculation models.						
Course Outcomes							
CO1	To understand the concepts of reliability in industrial systems.						
CO2	To study the reliability determination methods and advanced evaluation techniques.						
CO3	To understand various reliability prediction and evolution methods.						
CO4	To acquaint the fundamentals of reliability management and risk assessment.						

UNIT-I

Reliability Engineering: Reliability function, failure rate, Mean time between failures (MTBF), Mean time to failure (MTTF), mortality curve, useful life availability, maintainability, system effectiveness, Introduction to probability distributions.

Time to failure distributions: Exponential, normal, Gamma, ranking of data, probability plotting techniques, Hazard plotting Concept of Bathtub Hazard Rate curve, Reliability evaluation of two-state device networks-series, parallel, k-out-of-m systems; Standby redundant systems, Reliability evaluation of three-state device networks-series and parallel.

UNIT-II

Reliability Determination and Prediction: Reliability Determination Methods: Network reduction technique, Path tracing technique, Decomposition technique, Delta-Star method.

Advanced Reliability Evaluation Concepts: Supplementary variables technique, Interference theory, Human reliability, Common cause failures, Fault trees, Failure mode and effect analysis

UNIT-III

Reliability Prediction Models: Series and parallel systems - RBD approach - Standby systems - m/n configuration - Application of Baye's theorem - cut and tie set method - Markov analysis - FTA - Limitations.

UNIT-IV

Reliability testing: Time acceleration factor, influence of acceleration factor in test planning, application to acceleration test, high temperature operating life acceleration model, temperature humidity bias acceleration model, temperature cycle acceleration model, vibration accelerator model, failure free accelerated test planning, Accelerated reliability growth.

Risk Assessment: Definition and measurement of risk, risk analysis techniques, risk reduction resources, industrial safety and risk assessment.

RECOMMENDED BOOKS:

1. Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", TMH, 2000.
2. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2007.
3. Sharma S C, Inspection Quality Control and Reliability, Khanna Publishers.
4. Connor P.D.T.O. Practical Reliability Engineering", John Wiley.
5. Naikan V N A Reliability Engineering and Life Testing", PHI Learning Private Limited.
6. Prabhakar Murthy D N and Marvin R, "Product Reliability", Springer-Verlag.
7. Dana Crowe and Alec Feinberg, Design for Reliability, CRC Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weight of 12 marks*.

The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)

(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTSE-106	Computer Integrated Manufacturing Lab							
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Practical	Total	Time
0	0	4	2	-	40	60	100	3 hrs
Objective	The main objective of the course is to impart the students with the knowledge of hardware and software of CAD system, creating 2-D and 3-D models using pro-E software, converting 3-D model into 2-D model using pro-E and case study of automotive component industry in FMS system.							
Course Outcomes								
CO1	To impart knowledge of practical evaluation of the hardware and software of cad system, different robot configuration and creating 2-D model in pro-E software.							
CO2	To acquaint students with the study of different commands in the part model.							
CO3	To impart knowledge to students about creating the 3-D model using pro-E software and converting the 3-D model into 2-D model.							
CO4	To let student understand of generating NC program for machining a 3-D model using pro-E.							

LIST OF EXPERIMENTS

1. To study the hardware and software of cad system.
2. To study the different configuration of robots and their application.
3. To create the 2-D models in the sketch mode by using Pro-E software.
4. To study the different commands in the part mode
5. To create the 3-D model in part mode by using pro-E software.
6. To assemble the 3-D model in assemble mode by using Pro-E software.
7. To create the surface model in the part mode by using Pro-E software.
8. To convert the 3-D model in 2-D model by using Pro-E software.
9. To generate a NC program for machining a 3 D model generated by Pro E.
10. To study the different elements of FMS system take a case study of automotive component industry.

Note: At Least eight experiments need to be performed by the students from the above mentioned list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTSE-108	ADVANCE WELDING LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of advance welding methods used in modern industries.							
Course Outcomes								
CO1	To understand the working of Arc welding setup and spot welding setup.							
CO2	To understand the working of TIG welding, plasma welding, cutting & Brazing.							
CO3	To understand the working of SMAW, GMAW, FCAW welding methods.							
CO4	To understand the working of GTAW welding, Inspection and testing of weld joints.							

LIST OF EXPERIMENTS

1. To perform Exercise on Arc welding setup for V Butt joint arrangement.
2. To perform Exercise on Arc welding setup for V Lap joint arrangement.
3. To perform Exercise on spot welding in Lap joint arrangement.
4. To perform Experimental study on TIG welding.
5. To perform Exercise on plasma welding, cutting & brazing.
6. To study and perform exercise on Shielded metal arc welding (SMAW).
7. To study and perform exercise on Gas metal arc welding (GMAW).
8. To study and perform exercise on flux cored arc welding (FCAW).
9. To study and perform exercise on gas tungsten arc welding (GTAW).
10. To study the welding inspection and testing of weld joint.

Note: Atleast eight experiments need to be performed by the students from the above mentioned list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTSE-110	MINI PROJECT							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Practical**	**Time (Hrs.)**
0	**0**	**4**	**2**	**-**	**100**	**100**		**3**
Objective	In case of mini project, they will solve a live problem using software/analytical/computational tools or fabricate an experimental setup.							
Course Outcomes								
CO 1	Students will learn to write technical reports.							
CO 2	Students will develop skills to present and defend their work in front of technically qualified audience.							

Students can take up small problems in the field of manufacturing science & engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Students will be required to submit a brief synopsis of 3-4 pages related to the topic by the first week of September.

w.e.f. 2018-19

Audit Course-II

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTAD- 102A	CONSTITUTION OF INDIA						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The main objective of the course is to impart the students with the knowledge of informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.						
Course Outcomes							
CO1	To discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.						
CO2	To discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.						
CO3	To discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.						
CO4	To discuss the passage of the Hindu Code Bill of 1956.						

Unit-I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features

Unit-II

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality, Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit-III

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit-IV

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners, State Election Commission, Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

RECOMMENDED BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "framing of Indian Constitution", 1st Edition, 2015.
3. M. P. Jain, "Indian Constitution Law", 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTAD-104A	PEDAGOGY STUDIES						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The main objective of the course is to review existing evidence on the review topic to inform Programme design and policy making undertaken by the DFID, other agencies and researchers and Identify critical evidence gaps to guide the development.						
Course Outcomes							
CO1	Understand the pedagogical practices being used by teachers in formal and informal classrooms in developing countries.						
CO2	Become aware of the evidence on the effectiveness of these pedagogical practices, in different conditions and with different population of learners.						
CO3	Understand the significance of teacher education (curriculum and practicum) and the school curriculum and guidance materials for effective pedagogy.						

Unit-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

Unit-II

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage, quality assessment of included studies, How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy, Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.

Unit-III

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning, limited resources and large class sizes.

Unit-IV

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

RECOMMENDED BOOKS:

1. Ackers J, Hardman F, "Classroom interaction in Kenyan primary schools", Compare, 31 (2): 245-261.
2. Agrawal M, "Curricular reform in schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K, "Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of basic math and reading in Africa: Does teacher preparation count?" International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ, "Culture and pedagogy: International comparisons in primary education". Oxford and Boston: Blackwell.
6. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign"

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTAD-106A	STRESS MANAGEMENT BY YOGA						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The main objective of the course is to achieve overall health of body and mind and to overcome stress						
Course Outcomes							
CO1	Develop healthy mind in a healthy body thus improving social health.						
CO2	Improve efficiency						
CO3	Learn the Yogasan						
CO4	Learn the Pranayam						

Unit-I

Definitions of Eight parts of yog. (Ashtanga)

Unit-II

Yam and Niyam. Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit-III

Asan and Pranayam

i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam

RECOMMENDED BOOKS:

1. Janardan Swami Yogabhyasi Mandal, "Yogic Asanas for Group Tarining-Part-I" : Nagpur
2. Swami Vivekananda, "Rajayoga or conquering the Internal Nature" Advaita Ashrama (Publication Department), Kolkata

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTAD-108A	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	To learn to achieve the highest goal happily. To become a person with stable mind, pleasing personality and determination. To awaken wisdom in students.						
Course Outcomes							
CO1	Students become aware about leadership.						
CO2	Students will learn how to improve communication skills						
CO3	Understand the team building and conflict						
CO4	Student will learn how to manage the time.						

Neetisatakam-Holistic development of personality

i) Verses- 19,20,21,22 (wisdom)
ii) Verses- 29,31,32 (pride & heroism)
iii) Verses- 26,28,63,65 (virtue)
iv) Verses- 52,53,59 (dont's)
v) Verses- 71,73,75,78 (do's)

Approach to day to day work and duties.

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47, 48,
Chapter 3-Verses 13, 21, 27, 35,
Chapter 6-Verses 5, 13, 17, 23, 35,
Chapter 18-Verses 45, 46, 48.

Statements of basic knowledge.

Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16, 17, 18

Personality of Role model. Shrimad Bhagwad Geeta:

Chapter 2-Verses 17,

Chapter 3-Verses 36, 37, 42,

Chapter 4-Verses 18, 38, 39

Chapter18 – Verses 37, 38, 63

RECOMMENDED BOOKS:

1. Swami Swarupananda, "Srimad Bhagavad Gita" Advaita Ashram (PublicationDepartment), Kolkata
2. P.Gopinath, "Bhartrihari's Three Satakam (Niti-sringar-vairagya) by, Rashtriya Sanskrit Sansthanam, New Delhi.

Third Semester
(Programme Elective-V)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP-201A	ENTERPRISE RESOURCE PLANNING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3
Objective	The main objective of the course is to impart the students with the knowledge of integrated applications to manage the business and automate many back office functions related to technology, services and human resources.						
Course Outcomes							
CO1	To study the basic principles and models of an enterprise.						
CO2	To understand the concepts of technology and architecture in ERP.						
CO3	To study ERP system packages.						
CO4	To study the ERP procurement issues.						

UNIT I

ENTERPRISE RESOURCE PLANNING:
Introduction, Evolution of ERP, Principle of ERP, Enabling Technologies, ERP Characteristics, Features of ERP, The advantages of ERP, Reasons for the Failure of ERP Implementation, Risk and governance issues in an ERP, ERP Framework, Business Blueprint, Business Engineering Vs. Business Process Re-Engineering, ERP Tools and Software, Demand Chain, Value Chain, and Supply Chain.

UNIT-II

ERP ARCHITECTURE: Need to Study ERP Architecture**,** Layered Architecture, Types of ERP Architecture, Two-tier Implementations, Three-tier Client/Server Implementations, Web-based architecture, Service-Oriented Architectures, Logical Architecture of an ERP System, Physical Architecture of an ERP System, and Evaluation Framework for ERP Acquisition.

UNIT III

ERP PACKAGE INTEGRATION AND IMPLEMENTATION: ERP market, SAP, People soft, BAAN company, ORACLE corporation, A comparative assessment and selection of ERP packages and modules, Sales Force Automation, Integration of ERP, Integration of ERP and the Internet, ERP implementation strategies, Comparison of Big Bang vs. Phased Approach, Implementation Strategy in Small and Medium Enterprise, Post Implementation Issues.

UNIT IV

OVERVIEW OF ARCHITECTURE OF DIFFERENT ERP SOFTWARES: Oracle overview, Architecture, A.I.M. and applications, SAP Software architecture overview, ERP before and after Y2K, Impact of Y2K on ERP Development, Risk and Governance Issues in an ERP

ERP MODULES: Finance module, Sales & Distribution module, Human Resources module, Plant Maintenance module, Quality Management module, Material management module, manufacturing management module.

RECOMMENDED BOOKS:

1. Sadagopan. S, ERP-A Managerial Perspective, Tata Mcgraw Hill,1999.
2. Jose Antonio Fernandez, the SAP R/3 Handbook, Tata Mcgraw Hill,1998.
3. Vinod Kumar Crag and N.K. Venkitakrishnan, Enterprise Resource Planning- Concepts and Practice, Prentice Hall of India,1998.
4. Garg & Venkitakrishnan,ERPWARE, ERP Implementation Framework, Prentice Hall,1999.
5. Thomas E Vollmann and Bery Whybark, Manufacturing and Control Systems, Galgothia Publications,1998.
6. Alexis Leon,Enterprise resource planning, Tata Mcgraw-Hill

Note: The paper will have a total of *NINE questions.* QuestionNo.1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all FourUnits).

All questions will have equal *weight of 12 marks.* The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP-203A	DESIGN OF EXPERIMENTS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 hrs
Objective	To understand the various design of experiments techniques for optimization of problems.						
Course Outcomes							
CO1	To understand the concepts of Design of Experiment and statistical Methods.						
CO2	To understand the ANOVA and factorial design and fitting response curves and surfaces.						
CO3	To study the application of Taguchi Method and testing of hypothesis						
CO4	To study and implement the Response Surface Methodology.						

UNIT-I

Introduction to Designed Experiments: Introduction,Strategyofexperimentation,Sometypicalapplicationsofexperimentaldesign, Basic principles, Guidelines for designing experiments, Using statistical design in experimentation, A Checklist for Planning experiments, *Introduction to Minitab, Interface of Minitab, Customizing Minitab, Entering Data, Graphing Data, Printing Data and Graphs, Saving and Retrieving information.*

Basic Statistical Methods: Introduction, Basic statistical concepts, Types of Data, Graphical Presentation of Data.
Descriptive Statistics: Measure of Location, Measure of Variation, The Normal Distribution, Counting, Minitab Commands to Calculate Descriptive Statistics.

Inferential Statistics: The Distribution of Sample Means (R Known), Confidence Interval for the Population Mean (σ Known), Hypothesis testing for one sample mean (σ Known), Hypothesis test for two sample means, Testing for Normality, *Hypothesis test and Confidence Intervals with Minitab.*

UNIT-II

Analysis of Variance: Introduction to Analysis of Variance, ANOVA assumptions and Validation, ANOVA Table, The sum of square approach to ANOVA calculations, Analysis of the fixed Effect model, Decomposition of the Total sum of squares. Statistical analysis, Estimation of the Model Parameters, Unbalanced Data, Model Accuracy Check, Practical interpretation of results. *ANOVA with Minitab*

Factorial Experiments: Basic definition and principles, Advantages of factorials, Two level factorial design, The 2^1 Factorial Experiment, The 2^2 Factorial Experiment, The 2^3 Factorial Design, Addition of Centre Cells to 2^k Designs. General Procedure for Analysis of 2^k designs. 2^k Factorial Designs in Minitab.

UNIT-III

Introduction to Taguchi Method: Introduction, Taguchi Quality loss function, Orthogonal Array, Properties of Orthogonal Array, Minimum number of experiments to be conducted, Static Problems, Dynamic Problems, Assumptions of the Taguchi method, Steps in Taguchi Method, Assessment of Factors and Interactions, Selection and Application of Orthogonal arrays, Data Analysis from Taguchi Experiments, Variable Data with main factors only, Variable Data with Interactions, Attribute Data Analysis, Confirmation Experiment, Confidence Intervals, Robust Design Approach. *Applications of Taguchi Method using Minitab*.

UNIT-IV

Introduction to Response Surface Methodology: Introduction, Terms in Quadratic Models, The method of steepest ascent, Analysis of Second order response surfaces, Experimental design for fitting response surfaces, 2k Designs with Centers, 3^k Factorial Designs, Box- Behnken Designs, Central Composite Designs, Analysis of Data from RSM Designs, Design Considerations for Response Surface Experiments. *Response Surface Designs in Minitab.*

RECOMMENDED BOOKS:

1. Douglas C Montgomery,Design and Analysis of Experiments, John Wiley
2. Paul G. Mathews,Design of Experiments with MINITAB, New Age International Publishers.
3. K. Krishnaiah, P. Shahabudeen,Applied Design of Experiments and Taguchi Methods,PHI.
4. Angela Dean and Daniel Voss,Design and Analysis of Experiments, Springer.
5. John P.W.M., Statistical Design and Analysis of Experiments, John Wiley
6. Montgomery D.C., Runger G. C., Introduction to Linear Regression Analysis, John Wiley

7. Myres R.H. and Montgomery D.C.,Response Surface Methodology Process and Product Optimization Using Designed Experiments, Wiley
8. G UNIPUB, White Plains,Introduction to Quality Engineering Taguchi, New York.
9. https://www.ee.iitb.ac.in/~apte/CV_PRA_TAGUCHI_INTRO.htm
10. www.ecs.umass.edu/mie/labs/mda/fea/sankar/chap2.html

Note: The paper will have a total of *NINE questions.*QuestionNo.1, which is compulsory, shall be Objective Type and have contents from the entire syllabus (all Four Units).
All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTIP–205A	STRATEGIC ENTREPRENEURSHIP						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To provide knowledge to the students about entrepreneurship concepts and various development programme and policies.						
Course Outcomes							
CO1	To know about the small scale industries, scopes and the causes of their sickness.						
CO2	To know about the EDP and different government policies.						
CO3	To learn about business incubations and its future perspectives.						
CO4	To learn E-business marketing and developments.						

UNIT-I

Small Scale Industries: Definition and types of SSI's; Role, scope and performance in national economy; Problems of small scale industries.

Industrial Sickness: Definition; Causes of sickness; Indian scenario, Government help; Management strategies; Need for trained entrepreneurs

UNIT-II

Entrepreneurship Development Programme: Introduction, Origin of EDP's , Organizations involved in EDP's, Objectives of EDPs, Implementation of EDP's, Short comings of EDP's, Role in entrepreneurship development.

Step: Introduction, Origin, Status in India, Success and failure factors, Govt. polices and incentives, future prospects in India.

UNIT-III

Business Incubation: Introduction, Origin and development of business incubators in India and other countries, types of incubators, success parameters for a business incubator, Benefits to industries, institutes, government and society, future prospects, A few case studies (at least 2).

Project Management: Concept, Characteristics and Significance of Project Management, Components of Project Management, Project Life Cycle, Project Identification and Selection, Project Formulation and Appraisal.

UNIT-IV

Special Aspects of Entrepreneurship: Entrepreneurship, Social entrepreneurship, International entrepreneurship, Rural entrepreneurship, Community Development, Women entrepreneurship.

Network Marketing: Introduction, E-business, E-commerce, E-auction, A basic internet e-business architecture, A multi-tier e-business architecture.

RECOMMENDED BOOKS:

1. P.K. Gupta,Strategic Entrepreneurship, Everest Publishing House.
2. David Cleland,Project Management –Strategic Design and Implementation, McGraw Hill.
3. David H Holl,Entrepreneurship-New Venture Creation, Prentice Hall of India.
4. Steed & Steed,Sustainable Strategic Management, Prentice Hall of India.
5. Kotler,Marketing Management by Prentice Hall of India.
6. Tarek Khalil,Management of Technology, McGraw Hill.
7. Henry Steiner,Engineering Economic Principles, McGraw Hill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Open Elective

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTOE-201A	BUSINESS ANALYTICS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes							
CO1	Able to have knowledge of various business analysis techniques.						
CO2	Learn the requirement specification and transforming the requirement into different models.						
CO3	Learn the requirement representation and managing requirement assets.						
CO4	Learn the Recent Trends in Embedded and collaborative business						

Unit-I

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.
Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit-II

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.
Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit-III

Finalizing Requirements, Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements, Managing Requirements Assets: Change Control, Requirements Tools

Unit-IV

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

RECOMMENDED BOOKS:

1. James Cadle, "Business Analysis", BCS, The Chartered Institute for IT.
2. Erik Larson and, Clifford Gray, "Project Management: The Managerial Process", McGraw-Hill Education.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTOE-203A	INDUSTRIAL SAFETY						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to aware students about the industrial safety maintenance and fault findings.						
Course Outcomes							
CO1	Understand the industrial safety.						
CO2	Analyze fundamentals of maintenance engineering.						
CO3	Understand the wear and corrosion and fault tracing.						
CO4	Understanding when to do periodic inceptions and apply the preventing maintenance.						

Unit-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-II

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion, Types of corrosion, Corrosion prevention methods.

Unit-III

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-IV

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

RECOMMENDED BOOKS:

1. Higgins & Morrow, "Maintenance Engineering Handbook", Da Information Services.
2. H. P. Garg, "Maintenance Engineering", S. Chand and Company.
3. Audels, "Pump-hydraulic Compressors", Mcgraw Hill Publication.
4. Winterkorn, Hans, "Foundation Engineering Handbook", Chapman & Hall London.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTOE-205A	OPERATIONS RESEARCH						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to aware students about the dynamic programming to solve problems of discrete and continuous variables and model the real world problem and simulate it.						
Course Outcomes							
CO1	Students should be able to apply the dynamic programming to solve problems of discreet and continuous variables.						
CO2	Students should be able to apply the concept of non-linear programming						
CO3	Students should be able to carry out sensitivity analysis						
CO4	Student should be able to model the real world problem and simulate it.						

Unit-I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit-II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit-III

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit-IV

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

RECOMMENDED BOOKS:

1. H.A. Taha, "Operations Research, An Introduction", PHI, 2008
2. H.M. Wagner, "Principles of Operations Research", PHI, Delhi, 1982.
3. J.C. Pant, "Introduction to Optimisation: Operations Research", Jain Brothers, Delhi, 2008
4. Hitler Libermann, "Operations Research", McGraw Hill Pub. 2009
5. Pannerselvam, "Operations Research", Prentice Hall of India 2010
6. Harvey M Wagner, "Principles of Operations Research", Prentice Hall of India 2010

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTOE-207A	COST MANAGEMENT OF ENGINEERING PROJECTS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the students with the knowledge of cost management for the engineering project and apply cost models to the real world projects.						
Course Outcomes							
CO1	Students should be able to learn the strategic cost management process.						
CO2	Students should be able to understand types of project and project team types						
CO3	Students should be able to carry out Cost Behavior and Profit Planning analysis.						
CO4	Student should be able to learn the quantitative techniques for cost management.						

Unit-I

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making, relevant cost, Differential cost, Incremental cost and Opportunity cost, Objectives of a Costing System, Inventory valuation, Creation of a Database for operational control, Provision of data for Decision-Making.

Unit-II

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning, Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents Project team, Role of each member, Importance Project site, Data required with significance, Project contracts, Types and contents, Project execution Project cost control, Bar charts and Network diagram, Project commissioning, mechanical and process.

Unit-III

Cost Behavior and Profit Planning Marginal Costing, Distinction between Marginal Costing and Absorption Costing, Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Standard Costing and Variance Analysis, Pricing strategies, Pareto Analysis, Target costing, Life Cycle Costing, Costing of service sector, Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control, Flexible Budgets, Performance budgets, Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-IV

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

RECOMMENDED BOOKS:

1. Charles Thomas Horngren, "Cost Accounting a Managerial Emphasis", Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, "Advanced Management Accounting"
3. Robert S Kaplan Anthony A. Alkinson, "Management & Cost Accounting"
4. Ashish K. Bhattacharya, "Principles & Practices of Cost Accounting", A. H. Wheeler publisher
5. N.D. Vohra, "Quantitative Techniques in Management", Tata McGraw Hill Book Co. Ltd.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTOE-209A	COMPOSITE MATERIALS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the students with the knowledge of composites, its materials, analysis, fabrication, and performance analysis.						
Course Outcomes							
CO1	Students should be able to learn the classification and characteristics of composite materials.						
CO2	Students should be able to understand about different fabrication techniques related to metal matrix composites.						
CO3	Students should be able to understand about different fabrication techniques related to polymer matrix composites.						
CO4	Student should be able to do the analyses of the composite materials under different loading conditions.						

UNIT–I

INTRODUCTION: Definition – Classification and characteristics of Composite materials, Advantages and application of composites, Functional requirements of reinforcement and matrix, Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures, Iso-strain and Iso-stress conditions.

UNIT – II

Manufacturing of Metal Matrix Composites: Casting, Solid State diffusion technique, Cladding, Hot iso static pressing, Properties and applications.

Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration, Liquid phase sintering, Manufacturing of Carbon, Carbon composites, Knitting, Braiding, Weaving. Properties and applications.

UNIT–III

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs, hand layup method, Autoclave method, Filament winding method, Compression moulding, Reaction injection moulding, Properties and applications.

UNIT – IV

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

RECOMMENDED BOOKS:

1. R.W.Cahn, "Material Science and Technology" VCH, West Germany.
2. WD Callister, Jr, "Materials Science and Engineering, An introduction"
3. Balasubramaniam, "John Wiley & Sons", NY, Indian edition, 2007.
4. Lubin, "Hand Book of Composite Materials"
5. K.K.Chawla, "Composite Materials"
6. Deborah D.L. Chung, "Composite Materials Science and Applications"
7. Danial Gay, Suong V. Hoa, and Stephen W. Tasi, "Composite Materials Design and Applications"

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTOE-211A	WASTE TO ENERGY						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the students with the knowledge of generation of energy from the waste.						
Course Outcomes							
CO1	Students should be able to learn the classification of waste as a fuel and biomass pyrolysis.						
CO2	Students should be able to learn gasification process and different types of gasifiers.						
CO3	Students should be able to learn different combustors for biomass.						
CO4	Student should be able to learn the Biogas plant technology different biomass conversions processes for different applications.						

Unit-I

Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW, Conversion devices, Incinerators, gasifiers, digestors.

Biomass Pyrolysis: Pyrolysis, Types, slow fast, Manufacture of charcoal, Methods, Yields and application, Manufacture of pyrolytic oils and gases, yields and applications.

Unit-II

Biomass Gasification: Gasifiers, Fixed bed system, Downdraft and updraft gasifies, Fluidized bed gasifiers, Design, construction and operation, Gasifier burner arrangement for thermal heating, Gasifier engine arrangement and electrical power, Equilibrium and kinetic consideration in gasifier operation.

Unit-III

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-IV

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

RECOMMENDED BOOKS:

1. Desai, Ashok V, "Non-Conventional Energy", Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. and Mahdi, S. S., "Biogas Technology - A Practical Hand Book - Vol. I & II", Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Challal, D. S, "Food, Feed and Fuel from Biomass", IBH Publishing Co. Pvt. Ltd., 1991.
4. C. Y. WereKo-Brobby and E. B. Hagan, "Biomass Conversion and Technology", John Wiley & Sons, 1996.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTSE-201	DISSERTATION PHASE – I							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical Marks**	**Total**	**Time (Hrs.)**
0	**0**	**20**	**10**	**-**	**100**	**-**	**100**	**-**
Objective	The main objective of this course is to plan a research work (which includes the problem formulation/literature review, proposed objectives, proposed methodologies and references) in the field of Industrial and Manufacturing Engineering or interrelated fields of applications.							
Course Outcomes								
CO 1	Students will be exposed to various self-learning topics.							
CO 2	Students will be exposed to an exhaustive survey of the literature such as books, national/international refereed journals, resource persons and industrial surveys for the selection/ identification of engineering/research problem.							
CO 3	Students will be able to set the research objectives of the identified engineering/research problem.							
CO 4	Students will learn modern tools/techniques related to the identified engineering/research problem for the solution and able to learn technical report writing skills.							
CO 5	Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.							

The students will start their research work in third semester with a research problem having research potential involving scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.

The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his/her supervisor and the topic of dissertation must be mutually decided by the supervisor and student.

The students will be required to submit a progress report related to their dissertation work by the end of September. The progress report will cover the following:

- The goal set for the period.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.

The progress report must be at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The students will be required to appear for comprehensive Seminar & Viva-voce and submit a synopsis report based on their progress related to the dissertation as per the presentation date mentioned in the academic calendar for the session. The synopsis report will be submitted in the same format as that of the thesis and will contain the following:

1. Introduction
2. Literature Survey
3. Gaps in Literature
4. Objectives of the Proposed Work
5. Methodology
6. References

*** Student will choose his/her guide in the end of second semester.**

Fourth Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (4th semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SCIENCE & ENGINEERING

MTSE-202	DISSERTATION PHASE -II							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical	Total	Time (Hrs.)
0	0	32	16	-	100	200	300	-
Objective	The main objective of the course is to make the students able to do some good research in the field of their interests related to Industrial and Manufacturing Engineering or interrelated fields of applications.							
Course Outcomes								
CO 1	Students will be able to design solutions for engineering problems that meet the specified needs with appropriate considerations.							
CO 2	Students will be able to conduct investigations of engineering problems using research-based knowledge and experimental/research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.							
CO 3	Students will be able to apply resources and modern engineering tools and techniques with an understanding of the limitations.							
CO 4	Students will be able to either work in a research environment or in an industrial environment.							
CO 5	Students will be conversant with technical report writing, professional ethics, responsibilities and norms of the engineering practice.							
CO 6	Students will be able to present and convince their topic of study to the engineering community.							

The students are required to continue Analytical/Experimental/Computational/Industrial Problems or Case studies investigations in the field of Industrial and Production Engineering or other related fields which have been finalized in the third semester. They would be working under the supervision of a faculty member.

The students will be required to submit a progress report duly signed by their respective supervisors to the department, related to their dissertation work in the last week of March. The progress report will cover the following:

- The goal set for the period.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.
- References

The progress report must be of at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The candidate has to prepare a detailed dissertation report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up/numerical details/industrial case study etc. as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study.

The final dissertation will be submitted in the end of semester as per academic calendar for the session, which will be evaluated by internal as well as external examiners based upon his/her research work. At least one publication is

expected before final submission of the dissertation from every student in peer reviewed referred journals or reputed conference from the work done by them in their dissertation. The dissertation should be presented in standard format as provided by the department.

The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a supervisor, co-supervisor etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his supervisor.

w.e.f. 2018-19

KURUKSHETRA UNIVERSITY, KURUKSHETRA
Established by the State Legislature Act XII of 1956
('A+' Grade, NAAC Accredited)
MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: CAD/CAM
SEMESTER-I

Sr. No.	Course Code	Course Name	L	T	P	Hrs/ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTCM-101	Design of Hydraulic and Pneumatic System	3	0	0	3	3	60	40	-	100	3
2	MTIP-103A	Computer Aided Design and Manufacturing	3	0	0	3	3	60	40	-	100	3
3		*Programme Elective-I	3	0	0	3	3	60	40	-	100	3
4		**Programme Elective-II	3	0	0	3	3	60	40	-	100	3
5	MTRM-111A	Research Methodology and IPR	2	0	0	2	2	60	40	-	100	3
6	MTCM-103	Modern Machining Technology Lab	0	0	4	4	2	-	40	60	100	3
7	MTIP-119A	Computer Aided Design and Manufacturing Lab	0	0	4	4	2	-	40	60	100	3
8		***Audit Course-I	2	0	0	2	-	-	100	-	100	3
					Total	**24**	**18**	**300**	**280**	**120**	**700**	

***PROGRAMME ELECTIVE- I for 1st Semester (CAD/CAM)**		
1.	MTIP-105A	Tool Engineering
2.	MTIP-107A	Advanced Engineering Materials
3.	MTIP-109A	Non-Conventional Machining

****PROGRAMME ELECTIVE- II for 1st Semester (CAD/CAM)**		
1.	MTIP-111A	Product Design and Development
2.	MTIP-113A	Simulation of Industrial Systems
3.	MTIP-115A	Supply Chain Management

*****AUDIT COURSE – I for 1st Semester (CAD/CAM)**		
1.	MTAD-101A	English for Research Paper Writing
2.	MTAD-103A	Disaster Management
3.	MTAD-105A	Sanskrit for Technical Knowledge
4.	MTAD-107A	Value Education

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2.*** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

3. The programme Elective I & II and Audit Course-I are common with M.TECH. (I&P).The course starts with MTIP code is common with M.TECH (I&P).

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SPECIALIZATION: CAD/CAM
SEMESTER-II

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTIP-102A	Mechatronics	3	0	0	3	3	60	40	-	100	3
2	MTCM-102	Design, Optimization and Simulation of Engineering Systems	3	0	0	3	3	60	40	-	100	3
3		*Programme Elective-III	3	0	0	3	3	60	40	-	100	3
4		**Programme Elective-IV	3	0	0	3	3	60	40	-	100	3
5	MTIP-118A	Mechatronics Lab	0	0	4	4	2	-	40	60	100	3
6	MTCM- 104	Simulation Lab	0	0	4	4	2	-	40	60	100	3
7	MTCM-106	Mini Project	0	0	4	4	2		-	100	100	3
8		***Audit Course-II	2	0	0	2	-	-	100	-	100	3
					Total	**26**	**18**	**240**	**240**	**220**	**700**	

***PROGRAMME ELECTIVE-III for 2nd Semester (CAD/CAM)**		
1.	MTIP-106A	Advanced Welding Processes
2.	MTIP-108A	Advanced Metal Cutting
3.	MTIP-110A	Metrology

****PROGRAMME ELECTIVE - IV for 2nd Semester (CAD/CAM)**		
1.	MTIP-112A	Sequencing and Scheduling
2.	MTIP-114A	Quality Engineering and Management
3.	MTIP-116A	Reliability Engineering
*****AUDIT COURSE–II for 2nd Semester (CAD/CAM)**		
1.	MTAD-102A	Constitution of India
2.	MTAD-104A	Pedagogy Studies
3.	MTAD-106A	Stress Management by Yoga
4.	MTAD-108A	Personality Development through Life Enlightenment Skills

Note: 1. ***Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

2. The programme Elective III& IV and Audit Course-II are common with M.TECH. (I&P).The course starts with MTIP code is common with M.TECH. (I&P).

w.e.f. 2018-19

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SPECIALIZATION: CAD/CAM
SEMESTER-III

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1		*Programme Elective-V	3	0	0	3	3	60	40	-	100	3
2		**Open Elective	3	0	0	3	3	60	40	-	100	3
3	MTCM-201	Dissertation Phase-I	0	0	20	20	10	-	100	-	100	--
Total						**26**	**16**	**120**	**180**		**300**	

***PROGRAMME ELECTIVE-V for 3rd Semester (CAD/CAM)**		
1.	MTIP-201A	Enterprise Resource Planning
2.	MTIP-203A	Design of Experiments
3.	MTIP-205A	Strategic Entrepreneurship

****OPEN ELECTIVE for 3rd Semester (CAD/CAM)**		
1.	MTOE-201A	Business Analytics
2.	MTOE-203A	Industrial Safety
3.	MTOE-205A	Operations Research
4.	MTOE-207A	Cost Management of Engineering Projects
5.	MTOE-209A	Composite Materials
6.	MTOE-211A	Waste to Energy

Note: 1. The programme Elective-V and Open Elective are common with M.TECH. (I&P).

SEMESTER-IV

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTCM-202	Dissertation Phase-II	0	0	32	32	16	-	100	200	300	--
Total						**32**	**16**		**100**	**200**	**300**	

Total credits = 68

INSTRUCTIONS FOR PAPER SETTER

1. The question paper is to be attempted in **THREE Hours**.
2. Maximum Marks for the paper are **60.**
3. The syllabus for the course is divided into **FOUR units.**
4. The paper will have a total of **NINE questions.**
5. **Question No. 1,** which is compulsory, shall be OBJECTIVE Type **and have content from the entire syllabus (all Four Units).**

   Q. No. 2 & 3 from Unit I

   Q. No. 4 & 5 from Unit II

   Q. No. 6 & 7 from Unit III

   Q. No. 8 & 9 from Unit IV

6. All questions will have equal **weightage of 12 marks.**
7. The candidate will attempt a total of **FIVE questions**, each of 12 marks. Q. No. 1 is compulsory. The candidate shall attempt remaining **four** questions by selecting **only one question from each unit.**
8. A question may have any number of sections labeled as 1(a), 1(b), 1(c), 1(d), ---- 2(a), 2(b), --.A section may further have any number of subsections labeled as (i), (ii), (iii),.
9. **SPECIAL INSRUCTIONS FOR Q. No. 1 ONLY**

   Question No. 1, which is compulsory, shall be OBJECTIVE/ short answer type **and have content from the entire syllabus (all Four Units).**

   Emphasis is to be given on the basic concepts, analytical reasoning and understanding of the various topics in the subject. This question may have a number of parts and/or subparts. The short questions could be combination of following types:

   i. Multiple Choice
   ii. Yes/ No choice
   iii. Fill in Blanks type
   iv. Short numerical computations
   v. Short Definitions
   vi. Matching of Tables

   The above mentioned question types is **only a Guideline**. Examiner could set the question as per the nature of the subject.

w.e.f. 2018-19

First Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTCM–101	Design of Hydraulic and Pneumatic System						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the design of hydraulic and pneumatic systems.						
Course Outcomes							
CO1	To understand basic components of hydaulic systems.						
CO2	To demontrate control regulation elements and design of hydaulic circuits.						
CO3	To understand design of pneumatic systems.						
CO4	To aware of the associated design of installation, maintenance and special circuit.						

UNIT I

Hydraulic systems: Hydraulic power generations-selection and specification of pumps, pump characteristics.

Hydraulic actuators: Linear and Rotary Actuators-Selection, Specification and Characteristics.

UNIT II

Control and regulation elements: Pressure-direction and flow control valves-relief valves, non return and safety valves-actuation systems.

Hydraulic circuits: Reciprocation, quick return, Sequencing synchronizing circuits-accumulator circuits-industrial circuits-press circuits-hydraulic milling machine-grinding, planning, copying, fork lift, earth mover circuits-design and selection of components-safety and emergency mandrels.

UNIT III

Pneumatic systems and circuits: Pneumatic fundamentals-control elements, position and pressure sensing-logic circuits-switching circuits-fringe condition modules and their integration-sequential circuits-cascade methods-mapping methods-step counter method-compound circuit design-combination circuit design.

UNIT IV

Installation, maintenance and special circuits: Pneumatic equipments-selection of components-design calculations-application-fault finding-hydro pneumatic circuits-use of micro-processors for sequencing – PLC – Low cost automation-Robotic circuits.

Recommended Books:

1. Antony Espossito, “Fluid power with Applications”, Prentice Hall, 1980.
2. Dudleyt, A.Pease and John J. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.
3. Andrew Parr, “Hydraulics and Pneumatics”, (HB), Jaico Publishing House, 1999.
4. Bolton, W. “Pneumatic and Hydraulic systems”, Butterworth-Heinneman, 1997.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTIP–103A	COMPUTER AIDED DESIGN AND MANUFACTURING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to understand about the technology of computers for the design, process planning and manufacturing the products.						
Course Outcomes							
CO1	To understand the fundamentals and applications of computers in the field of designing and manufacturing and the transformation of geometric models.						
CO2	To understand the concepts of G.T. and FMS.						
CO3	To know the use of computers in process planning and shop floor control.						
CO4	To learn the basics of AGV and coding systems for CNC.						

UNIT I

Fundamentals of CAD: Introduction to CAD/CAM, Historical Development, Industrial Look at CAD/CAM, Application of computers in design, Creating manufacturing database, Benefits of CAD. Computer Hardware, Graphic input devices, display devices, Graphics output devices, Central processing unit (CPU).

Geometric transformations: 2D and 3D; transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous representations, concatenated representation; Orthographic projections, Numerical Problems

UNIT II

Group Technology and Cellular Manufacturing

Part families, parts classifications and coding, Production flow Analysis, cellular Manufacturing- composite part concept, machine cell design, applications of group technology, Grouping parts and machines by Rank order clustering technique, Arranging machines in a G.T. cell.

Flexible Manufacturing

Introduction, FMS components, Flexibility in Manufacturing – machine, Product, Routing, Operation, types of FMS, FMS layouts, FMS planning and control issues, deadlock in FMS, FMS benefits and applications.

UNIT III

Process Planning

Introduction, Manual process planning, Computer aided process planning – variant, generative, Decision logic-decision tables, decision trees, Introduction to Artificial intelligence.

Shop Floor Control

Introduction, Shop floor control features, Major displays, Major reports, Phases of SFC Order Release, Order Scheduling, Order Progress, Manufacturing control, Methodology, Applications, Shop floor data collections, Types of data collection system, Data input techniques, Automatic data, Collection system.

UNIT IV

CNC Basics and Part Programming

Introduction, Historical Background, Basic Components of an NC, Steps in NC, Verifications of Numerical control machine tool programs, Classification of NC Machine tool, Basics of motion control and feedback for NC M/C, NC part programming, Part programming methods, Modern Machining system, Automatically programmed tools, DNC, Adaptive control

Automated Guided Vehicle

Introduction, History, Features, Functions of AGV, Types of AGV, Safety consideration for AGV, Design of AGV.

RECOMMENDED BOOKS:

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
3. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.

6. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
7. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
8. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall
9. Chang, Wang & Wysk Computer Aided Manufacturing. Prentice Hall
10. Kundra &Rao, Numerical Control and Computer Aided Manufacturing by, Rao and Tiwari, Tata Mc-Graw Hill.
11. Mattson, CNC programming Principles and applications, Cengage Learning India Pvt. Ltd. Delhi

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-I

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTIP–105A	TOOL ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to impart the students with the knowledge of various aspects of design of different types of Tools and fixtures used in Industries.						
Course Outcomes							
CO1	To impart knowledge of materials for cutting tool and design of cutting tools.						
CO2	To acquaint students with various kinds of Gages and Work holding devices.						
CO3	To impart knowledge to students about Drill jigs and Fixtures.						
CO4	To let student understand the tool design process for NC Machine tools						

UNIT-I

Cutting Tool Materials: Introduction and desirable properties, Carbon and Medium-Alloy Steels, High-Speed Steels, Cast-Cobalt Alloys, Carbides, Coated Tools, Alumina-Based Ceramics, Cubic Boron Nitride, Silicon-Nitride Based Ceramics, Diamond, Reinforced Tool Materials, Cutting-Tool Reconditioning.

Design of Cutting Tools Basic Requirements, Mechanics and Geometry of Chip Formation, General Considerations for Metal Cutting, Design of single point Cutting Tools, Design of Milling Cutters, Design of Drills and Drilling, Design of Reamers, Design of Taps, Chip Breakers.

UNIT-II

Gages and Gage Design: Limits fits and tolerances, Geometrical tolerances-specification and measurement, Types of gages, Gage design, gage tolerances, Material for Gages.

Work Holding Devices: Basic requirements of work holding devices, Location: Principles, methods and devices, Clamping: Principles, methods and devices.

UNIT-III

Drill Jigs: Definition and types of Drill Jigs, Chip Formation in Drilling, General Considerations in the Design of Drill Jigs, Drill Bushings, Drill Jigs, and Modern Manufacturing

Design of Fixtures: Fixtures and Economics , Types of Fixtures , Milling Fixtures , Boring Fixtures, Broaching Fixtures, Lathe Fixtures, Grinding

UNIT-IV

Tool Design for Numerically Controlled Machine Tools: Fixture Design for Numerically Controlled Machine Tools, Cutting Tools for Numerical Control, Tool-holding Methods for Numerical Control.

RECOMMENDED BOOKS:

1. ASTME, "Fundamentals of Tool Design", Prentice Hall of India, 1983.
2. Donaldson, "Tool Design", Tata-McGraw Hill, 3rd Edition, 2000.
3. Joshi P.H., "Jigs and Fixtures", Tata-McGraw Hill, 2010.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTIP–107A	ADVANCED ENGINEERING MATERIALS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 hrs
Objective	The objective of the course is to impart the students with the knowledge of various advanced and smart materials.						
Course Outcomes							
CO1	To impart knowledge of Piezoelectric and shape memory alloys.						
CO2	To acquaint students with deep know how about Electro-rheological and composite materials						
CO3	To impart knowledge to students about MEMS systems and High temperature application materials.						
CO4	To let student understand the processing and characteristics of powder metallurgy processes and structural materials.						

UNIT-I

Introduction to advanced Engineering materials: Classes of Materials and their usage, Historical Perspective, Intelligent Materials, Structural Materials, Functional Materials, Primitive Functions of Intelligent Materials, Intelligence inherent in Materials, Materials Intelligently Harmonizing with humanity, Biomimetic.

Smart Materials and Structural Systems: Introduction, Actuator Materials, Sensing Technologies, Micro-sensors, Intelligent systems, Hybrid Smart Materials, Passive Sensory Smart Structures, Reactive Actuator based smart structures, Active Sensing and Reactive smart structures, smart skins, Aero-elastic tailoring of airfoils, Synthesis of future smart systems.

UNIT-II

Electrocaloric Effect: An Introduction, History of Electrocaloric Cooling,Mechanism of working of Electrocaloric Cooling, Electrocaloric Materials, Performance of Electrocaloric Materials.

Heat Resistant Steels: Conventional Heat-Resistant Steels, Silicon-Bearing High Chromium Heat-Resistant Steels, Nitride-Strengthened Reduced Activation Heat-Resistant Steels, China Low Activation Martensitic SteelNitride-Strengthened Steels, Microstructural Stability

UNIT-III

Smart Micro-systems: Silicon Capacitive Accelerometer, Piezo-resistive Pressure sensor, Conductometric Gas sensor, An Electrostatic Comb-drive, Magnetic Microrelay, Portable Blood Analyser, Piezoelectric Inkjet Print Head.

Buckyballs to robotics: Bucky ball, Nano Structure of Fullerene, Carbon Nanotubes, Nano Diamond, Boron nitride nanotubes, Single electron transistors, Molecular machine, Nano Biometrics, Nano Robots,

UNIT-IV

Nano-Alloys: Introduction, Chemical Synthesis: General Concepts, Reduction of Metallic Salts, The Organometallic Route: Thermal Decomposition Method, Other Chemical Methods for synthesis of Nano-alloys,Physical Routes for synthesis of Nano-Alloys; Experimental Techniques and Examples.

Shape memory alloys (SMA): Shape memory effect and the metallurgical phenomenon of SMA, Types of SMA, One way and Two way Shape memory effect. Temperature assisted shape memory effect, Applications.

RECOMMENDED BOOKS:

1. Gandhi, M.V. and Thompson, B.S., Smart materials and Structures, Chapman & Hall,1992.
2. Ananthasuresh G.K., Vinoy K.J., Micro and Smart Systems, Wiley India.
3. Wei Yan, Wei Wang, 9-12 Cr Heat Resistant Steels, Engineering Material series, Springer International.
4. Damien Alloyeau, Christine Mottet, Nanoalloys Synthesis, Structure and Properties, Springer International.
5. Tatiana Correia, Qi Zhang, Electrocaloric Materials: New Generation of Coolers
6. Otsuka, K. and Wayman, C. M., Shape memory materials, C.U.P,1998
7. Taylor, W., Pizoelectricity, George Gorden and Breach Sc. Pub.,1985
8. Mallick, P.K., Fiber Reinforced Composites Materials, Manufacturing andDesign. Marcel Dekker Inc, New York, 1993.
9. Rama Rao, P. (ed.), Advances in Materials and their applications, Wiley EasternLtd.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTIP–109A	NON-CONVENTIONAL MACHINING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To acquaint the students with the advanced technologies and processes in various streams of Non-conventional machining.						
Course Outcomes							
CO1	To impart knowledge of Various Non-conventional Mechanical Working Processes, technology, process parameters and analysis for metal removal for these processes.						
CO2	To acquaint students with deep knowhow about chemical and electrochemical machining processes,						
CO3	To impart knowledge to students about various kinds of Electric discharge machining processes, process parameters associated with these processes and various process characteristics.						
CO4	To let student understand the working and technology associated with Laser Beam machining and Electron beam machining processes.						

UNIT-I

Introduction, Need of Non-conventional machining processes, Characteristics of conventional and Non-conventional Machining processes. **Mechanical Working Processes**: **Abrasive Jet Machining:** Machining setup, Abrasives, Process Parameters, Machining Characteristics, Material removal models in AJM, Process capability, Advantages, limitations, Applications

Water Jet Machining: Basic mechanism of Water jet machining setup, Process parameters, Catcher, Process capabilities, Advantages, limitations, Applications **Abrasive Water Jet Machining process:** Working Principle, AWJM Machine, Process Variables, Mechanism of Metal Removal, Cutting Parameters, Process capabilities, Applications, Environmental issues.

Ultrasonic Machining: Fundamental principles, Equipment, Magnetostriction, Elements of process, Mechanics of cutting, Analysis of Process Parameters, Process capabilities, Economic considerations. Applications, Limitations

UNIT-II

Chemical Machining: Introduction, Fundamental Principles, Process Parameters; Maskants and Etchants, Advantages, Limitations, Applications.

Electrochemical Machining Processes: Introduction, Classification of ECM Processes, Fundamentals Principles of ECM, Elements of ECM, ECM Machine Tool Process, Determination of Metal Removal Rate, Evaluation of Metal Removal of an alloy, Electrochemistry of ECM, Cathode and Anode reaction, Dynamics of ECM, Self-Regulating feature of ECM, Process Parameters, Process capabilities, Electrochemical Deburring. **Electrochemical Grinding:** Schematics, Electrochemistry, Process Parameters, Process capabilities, Applications, Advantages, Limitations.

UNIT-III

EDM: Introduction, Basic Principles & Schematics, Process Parameters, Characteristics of EDM, Dielectric, Electrode Material, Modelling of Material Removal, Spark Erosion Generators, Analysis and Metal Removal Rate in RC circuit, Selection of Tool Material and Tool Design, Di-Electric system, Process Variables, Dielectric Pollution and its effects, Process Characteristics, Applications, Electric Discharge Grinding and Electric Discharge Diamond Grinding; **Wire EDM**: Working Principle, Wire EDM Machine, Advances in Wire-cut EDM Process Variables, Process Characteristics, Applications.

UNIT-IV

Laser Beam Machining Back Ground, Production of Laser, Working Principle of LBM, Types of LASERS, Process Characteristics, Metallurgical effects, Advantages and Limitations, Applications.

Electron Beam Machining:

Electron Beam Action, Generation and control of Electron beam, Theory of Electron Beam Machining, Process Parameters, Process capabilities, Applications.

High Energy Rate Forming, Elctro-Hydraulic Forming, Explosive Forming, Hot Machining Analysis of the Process.

RECOMMENDED BOOKS:

1 V.K. Jain, Advanced Machining Processes, Allied Publishers Pvt Ltd
2 P.C. Pandey and H.S. Shan,Modern Machining Processes, Tata McGraw- Hill
3 M. K. Singh, Unconventional Manufacturing Process, New Age Publishers

4 J. A. Mcgeough, Advanced Methods of Machining, Springer.
5 Benedict, Non-Traditional Manufacturing Process, CRC pub.
6 P. K. Mishra, Nonconventional manufacturing, Narosa Publishers

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).
All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-II

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTIP-111A	PRODUCT DESIGN AND DEVELOPMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to understand about the product design and developments with inputs from aesthetics, ergonomics, design for manufacturing ease and cost effectiveness apart from reliability and durability and other considerations.						
Course Outcomes							
CO1	To understand the concept of product design, design considerations, design practiced by the industry, production and marketing, and aesthetics.						
CO2	To provide a detailed fundamental approach to several primary processes and design guidelines for manufacturing, assembly and environment.						
CO3	To discuss the human factor engineering and the concept of value engineering.						
CO4	To study the modern approaches to product design, concept of product development and its manufacturing and economic aspects.						

UNIT-I

INTRODUCTION: Introduction to product design, Design by evolution and innovation, Essential factors of product design, Production consumption cycle, Flow and value addition in production consumption cycle, Morphology of design.

PRODUCT DESIGN PRACTICE AND INDUSTRY: Product strategies, Time to market, Analysis of the product, Basic design considerations, Role of aesthetics in product design.

UNIT-II

DESIGN FOR MANUFACTURE AND ASSEMBLY: Overview and motivation, Basic method: Design guidelines: Design for assembly, Design for piece part production, Advanced method: Manufacturing cost analysis, cost driver modeling, Critique for design for assembly method.

DESIGN FOR THE ENVIRONMENT: Environmental objectives, Basic DFE methods, Design guidelines, Life cycle assessment, Techniques to reduce environmental impact.

UNIT-III

HUMAN ENGINEERING CONSIDERATIONS IN PRODUCT DESIGN: Human being as applicator of forces, Anthropometry, the design of controls, the design of displays, Man/Machine information exchange, Workplace layout from ergonomic considerations.

VALUE ENGINEERING: Value, Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, value analysis job plan, creativity, steps to problem solving and value analysis, value analysis tests, value engineering idea generation check list, Cost reduction through value engineering-case study, materials and process selection in value engineering.

UNIT-IV

MODERN APPROACHES TO PRODUCT DESIGN: Concurrent design, Quality function deployment (QFD), Rapid prototyping, 3D printing, Introduction to 4D printing.

PRODUCT DEVELOPMENT: A modern product development process, reverse engineering and redesign product development process, product life cycle, product development teams, Product development planning, Manufacturing & economic aspects of product development.

RECOMMENDED BOOKS:

1. Kail T Ulrich and Steven D Eppinger, "Product Design and Development, TMH.
2. AK Chitale and Gupta, "Product Design and Engineering, PHI.
3. Niebel & Draper, "Product Design and Process Engineering", McGraw-Hill.
4. Kevin Otto & Kristin Wood, "Product Design-Techniques in reverse engineering and new product development" Pearson.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTIP–113A	SIMULATION OF INDUSTRIAL SYSTEMS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of industrial systems and its simulation.						
Course Outcomes							
CO1	To explain the concept of industrial simulation systems and its models of simulation.						
CO2	To understand the simulation of discrete and queueing systems.						
CO3	To understand the simulation if inventory systems and design of simulation experiments.						
CO4	To simulate the industrial problems like reliability problems, computer time sharing problem and understand the simulation languages.						

UNIT-I

Introduction and overview: concept of system, system environment, elements of system, system modeling, types of models, Monte Carlo method, system simulation, simulation - a management laboratory, advantages & limitations of system simulation, continuous and discrete systems.

Simulation of continuous systems: characteristics of a continuous system, comparison of numerical integration with continuous simulation system. Simulation of an integration formula.

UNIT-II

Simulation of discrete system: Time flow mechanisms, Discrete and continuous probability density functions. Generation of random numbers, testing of random numbers for randomness and for auto correlation, generation of random variates for discrete distribution, generation of random variates for continuous probability distributions-binomial, normal, exponential and beta distributions; combination of discrete event and continuous models.

Simulation of queuing systems: Concept of queuing theory, characteristic of queues, stationary and time dependent queues, queue discipline, time series analysis, measure of system performance.

Kendall's notation, auto covariance and auto correlation function, auto correlation effects in queuing systems, simulation of single server queues, multi-server queues, queues involving complex arrivals and service times with blanking and reneging.

UNIT-III

Simulation of inventory systems: Rudiments of inventory theory, MRP, in-process inventory. Necessity of simulation in inventory problems, forecasting and regression analysis, forecasting through simulation, generation of Poisson and Erlang variates, simulation of complex inventory situations.

Design of Simulation experiments: Length of run, elimination of initial bias, Variance, Variance reduction techniques, stratified sampling, antipathetic sampling, common random numbers, time series analysis, spectral analysis, model validation, optimization procedures, search methods, single variable deterministic case search, single variable non-deterministic case search, and regenerative technique.

UNIT-IV

Simulation of PERT: Simulation of - maintenance and replacement problems, capacity planning, production systems, reliability problems, computer time sharing problem, the elevator system.

Simulation Languages: Continuous and discrete simulation languages, block structured continuous languages, special purpose simulation languages, SIMSCRIPT, GPSS SIMULA importance and limitations of special purpose languages.

RECOMMENDED BOOKS:

1. Loffick, Simulation and Modelling - Tata McGraw Hill
2. Deo Narsingh, System Simulation with Digital Computer - Prentice Hall
3. Hira, D.S., System Simulation-S. Chand & Co.
4. Meelamkavil, Computer Simulation and Modelling - John Willey
5. Gorden, System Simulation - Prentice hall
6. Jerry Banks and John, S. Carson II, 'Discrete – Event System Simulation', Prentice Hall Inc., NewJersey, 1984.

7. Geoffrey Gordon, 'System simulation', Prentice Hall, NJ, 1978.
8. Law, A.M. and W.D. Keltor, 'Simulation modelling analysis', McGraw Hill, 1982.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTIP–115A	SUPPLY CHAIN MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of Supply chain and different aspects of supply chain management.						
Course Outcomes							
CO1	To impart knowledge about basics of Supply chain management and Supply chain						
CO2	To acquaint students with the different aspects involved in sourcing and procurement in supply chain management.						
CO3	To impart knowledge to students about Evaluating performance of Supply chain and decision making about Transportation, Storage and warehousing.						
CO4	To let student understand Quantitative tools for SCM, Information Technology in a Supply Chain:						

UNIT-I

Overview of supply chain management: Introduction, Definition, The Objective of a Supply Chain, The Importance of Supply Chain Decisions, Decision Phases in a Supply Chain, Process Views of a Supply Chain, Examples of Supply Chains.

Supply chain dynamics: Introduction, Coping with Dynamics in Supply chain. Bullwhip effect, Analysis of Bullwhip Effect, Impact of Lead time, Inventory management and Supply chain dynamics, offshoring and outsourcing Effect on SC dynamics and cost.

UNIT-II

Outsourcing and Make or Buy Decisions: Strategic Decisions and Core competencies, Tactical Decisions, Factors influencing make or buy decisions, Control of Production or Quality, Unreliable Suppliers, Suppliers Specialized knowledge and research, Small Volume Requirements, Limited Facilities, Workforce Stability, Multiple Sourcing Policy, Managerial and Procurement considerations, the Volatile nature of Make/Buy situation, Administration: Procedures and Personal.

Sourcing of Supply: Importance of Source Selection, Responsibilities for Source Selection, Evaluating a potential supplier, The criticality of Qualifying Sources, Competitive Bidding and Negotiation, Prerequisite for competitive bidding, Two step Bidding/Negotiation, Benefits and Risks of International Sourcing, Identifying and Qualifying an International Source.

UNIT-III

Supply Chain Performance: Achieving Strategic fit And Scope: Competitive and Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope**,** Challenges to Achieving and Maintaining, Strategic Fit, Supply chain drivers and metrics, Financial Measures of Performance, Drivers of Supply Chain Performance, Framework for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing.

Transportation, storage and warehousing: Introduction, Transportation mode choice, Transport operator decisions, Trucking sectors in India, Rail transport, Air Transport, Water transport, Transport network, Storage and warehousing, types of warehousing, risk pooling, IT Integration: Supply chain information system, Role of IT in SCM process, Business process Re-engineering, Internet and its applications in SCM.

UNIT-IV

Quantitative tools for SCM: Introduction, Forecasting, Demand forecast, Forecasting strategy & technique, Management of Inventories in SC, Linear programming, Routing models, pricing decisions, Introduction to MCDM approach.

Information Technology in a Supply Chain: The Role of IT in a Supply Chain, The Supply Chain IT Framework Customer Relationship Management, Internal Supply Chain Management, Supplier Relationship Management, The Transaction Management Foundation, The Future of IT in the Supply Chain, Risk Management in IT, Supply Chain IT in practice.

RECOMMENDED BOOKS:

1. Chopra, S., and Meindl, P., Supply chain Management: Strategy, Planning and Operations. Second Edition, Pearson Education (Singapore) Pte. Ltd, 2004.
2. Rangaraj, Supply Chain Management for Competitive Advantage, TMH.
3. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw-Hill Edition, 2003.
4. Doebler, D.W. and Burt, D.N., Purchasing and Supply Chain Management: Text and Cases, McGraw-Hill Publishing Company Limited, New Delhi, 1996.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.from each unit.*

w.e.f. 2018-19

RECOMMENDED BOOKS:

1. Chopra, S., and Meindl, P., Supply chain Management: Strategy, Planning and Operations. Second Edition, Pearson Education (Singapore) Pte. Ltd, 2004.
2. Rangaraj, Supply Chain Management for Competitive Advantage, TMH.
3. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw-Hill Edition, 2003.
4. Doebler, D.W. and Burt, D.N., Purchasing and Supply Chain Management: Text and Cases, McGraw-Hill Publishing Company Limited, New Delhi, 1996.

Note: The paper will have a total of *NINE questions*. Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.from each unit.*

w.e.f. 2018-19

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.
2. C.R. Kothari, "Research Methodology: Methods & Techniques, 2nd edition or above, New Age Publishers.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

w.e.f. 2018-19

MTRM-111A	Research Methodology and IPR						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	0	2	60	40	100	3 Hrs.
Program Objective (PO)	To enable students to Research Methodology and IPR for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.						
Course Outcomes (CO)							
CO1	Understand research problem formulation.						
CO2	Analyze research related information						
CO3	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.						
CO4	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.						

Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2

Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper.Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 3

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 4

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTIP-111A	RESEARCH METHODOLOGY AND IPR						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**2**	**60**	**40**	**100**	**3**
Objective	The objective of this course is to make the students capable of formulating the research problems/ proposals and get aware about the intellectual property and patent laws.						
Course Outcomes							
CO 1	Student will be able to understand research problem formulation.						
CO 2	Student will be able to analyze research related information and follow research ethics.						
CO 3	Student will be able to understand the Patents, Designs, Trade and Copyright and able to apply the knowledge for patent.						
CO 4	Student will be able to understand the concept of Patent Rights, Licensing and transfer of technology and able to apply the knowledge in new developments in IPR.						

Unit-I

Meaning of research problem, Sources of research problem, Criteria, characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit-II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit-III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit-IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and Institutions.

RECOMMENDED BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: An introduction for science & engineering students" Kenwyn, South Africa : Juta & Co. Ltd., 1996
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Juta Academic; 2nd edition (April 28, 2004)
3. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners" SAGE Publications Ltd; Fourth edition (14 January 2014)
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers; Revised edition (July 25, 2007)
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTCM-103	MODERN MACHINING TECHNOLOGY LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of advanced machining technology and processes.							
Course Outcomes								
CO1	To impart basic knowledge about CNC components and coding.							
CO2	Use of CNC coding to manufacture various parts.							
CO3	To study the mechanism of electric discharge machining.							
CO4	To find out the material removal rate for various materials using EDM.							

List of Experiments:

1. To study different codes on CNC machine (G and M codes).
2. To prepare a program on CNC Lathe for simple turning.
3. To prepare a program on CNC Lathe for multiple operation.
4. To prepare a program for threading operation.
5. To find out surface finish of Mild steel specimen using EDM machine.
6. To find out Surface roughness on Aluminum alloy specimen on EDM.
7. To find Material Removal Rate on Mild steel specimen using Copper and Graphite electrodes.
8. To find out surface roughness on Aluminum alloy specimen using different types of dielectric fluids.
9. To find material removal rate on Aluminum alloy specimen using Brass and Tungsten electrodes.

Note: At Least eight experiments need to be performed by the students according to the course outcomes.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTIP-119A	COMPUTER AIDED DESIGN AND MANUFACTURING LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	To acquaint the students with 2-D and 3-D modeling using design softwares.							
Course Outcomes								
CO1	To understand the basic solid modeling and applied features of the softwares.							
CO2	To learn and practice of surface techniques and surface creations using software.							
CO3	To learn and practice of assembly and detailed drafting.							
CO4	To let student understand how to prepare MMCs using Stir Casting process.							

List of Experiments:

The students will be required to carry out the following exercises or their equivalent tasks using a 3-D modeling software package (e.g. Solid-works/ Creo/ Ideas/ Solid Edge/UG/CATIA/ etc.). Practical must be performed on licensed version (Preferably the latest version) of any one of above mentioned software.

1 BASIC SOLID MODELING

Introduction & sketcher tools

a) CAD Tools and Applications: CAD - CAM - CAE
b) Parametric Feature Based Modelling and Parent-Child Relation
c) Design Intent and Associativity between 3 Modes
d) Modelling Software - Getting Started & Graphical User Interface
e) Sketch Entities and Tools
f) Dimensioning and Adding Relations to define the Sketch

Sketched Features (Boss / Base and Cut)

a) Base Features
b) Extrude & Revolve
c) Reference Geometry, Curves & 3D Sketch
d) Sweep & Loft

Editing & Refining Model

a) Editing Sketch, Sketch Plane and Editing Feature
b) Suppress / Un-Suppress Feature and Reordering Feature

2 ADVANCE FEATURES APPLIED FEATURES

a) Patterns & Mirror
b) Fillet/Round & Chamfer
c) Hole & Hole Wizard
d) Draft, Shell, Rib and Scale
e) Dome, Flex and Wrap

Multi Body

a) Indent Tool
b) Combine Bodies – Boolean Operations
c) Split, Move/Copy and Delete Bodies

Other Tools & Options

a) Design Table and Configurations
b) Adding Equations and Link Values
c) Tools - Measure and Mass Properties
d) Appearance - Edit Material, Colour and Texture
e) Options - System and Document Properties

3 SURFACING TECHNIQUES BASIC SURFACE CREATIONS

a) Extrude & Revolve
b) Sweep & Loft
c) Boundary Surface
d) Planar Surface

Other Derived Techniques

a) Offset Surface
b) Radiate Surface
c) Ruled Surface
d) Fill Surface
e) Mid Surface

Modify / Edit Surfaces

a) Fillet/Round
b) Extend
c) Trim & Untrim
d) Knit Surfaces
e) Delete and Patch

Surfaces for Hybrid Modelling

a) Thicken – Boss / Base and Cut
b) Replace face
c) End condition for Sketched feature - Up to Surface or Offset from Surface.
d) Solid body from closed surfaces

4 ASSEMBLY & MECHANISMS BOTTOM UP ASSEMBLY APPROACH

a) Inserting Components/Sub-Assemblies
b) Adding Mates - Standard & Advance
c) Editing Mates, Part and Replacing Components

Top down Approach & Mechanisms

a) Inserting New Part to Existing Assembly
b) Use of Layout Sketching
c) External References - In-context and Out-of-context, Locked and Broken

Assembly Features

a) Component Patterns & Mirrors
b) Cuts & Holes
c) Belt/Chain and Weld Bead

Representations of Assembly Components

a) Light Weight, Suppressed and Resolved
b) Hide, Transparency and Isolate
c) Exploded View

Assembly Check

a) Interference Detection,
b) Collision Detection and Physical Dynamics

Motion Study

c) Assembly Motion & Physical Simulation
d) Animation Wizard & Save as AVI file
e) Mechanism Analysis – Plot Displacement, Velocity and Acceleration Diagram

5 DETAILED DRAFTING

Introduction to Engineering Drawings

a) General Procedure for Drafting & Detailing
b) Inserting Drawing Views, Dimensioning and Adding Annotations
c) Drawing Templates & Sheet Format
d) Setting Options

Drawing Views

a) Model View & Standard 3 View
b) Projected View & Auxiliary View
c) Section & Aligned Section View
d) Detail View, Broken-out Section and Crop View.

Dimensioning

a) Standards, Rules and Guidelines
b) Dimension Insertion/Creation - Insert Model Items & Dimension tool

Annotations

a) Notes & Holes Callout
b) Datum & Geometric Tolerances
c) Surface Finish & Weld Symbols,Centre Mark & Centre line,BOM Balloon & Bill of Material

w.e.f. 2018-19

Audit Course-I

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTAD-101A	ENGLISH FOR RESEARCH PAPER WRITING						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to impart the knowledge of English for research paper writing.						
Course Outcomes							
CO1	To understand that how to improve writing skills and level of readability.						
CO2	To Learn about what to write in each section.						
CO3	To understand the skills needed when writing a title.						
CO4	To learn the skills required in writing the results, discussion and conclusions.						

Unit-I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit-II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit-III

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. Key skills needed when writing a Title, key skills needed when writing an abstract, key skills needed when writing an Introduction, skills needed when writing a Review of the Literature.

Unit-IV

Skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions, Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

RECOMMENDED BOOKS:

1. Goldbort R, "Writing for Science", Yale University Press (available on Google Books)
2. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press
3. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM. Highman's book.
4. Adrian Wallwork, "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTAD-103A	DISASTER MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to impart the knowledge of disasters management.						
Course Outcomes							
CO1	To demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.						
CO2	To critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.						
CO3	To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.						
CO4	To critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.						

Unit-I

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit-II

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Unit-III

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

Unit-IV

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

RECOMMENDED BOOKS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies '"New Royal book Company.
2. Sahni, Pardeep (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTAD- 105A	SANSKRIT FOR TECHNICAL KNOWLEDGE						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to understand basic Sanskrit Language and Ancient Sanskrit literature related to science & technology.						
Course Outcomes							
CO1	Students will get a working knowledge in illustrious Sanskrit, the scientific language of the world.						
CO2	Learning of Sanskrit to improve brain functioning.						
CO3	Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.						
CO4	The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.						

Unit-I

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Unit-II

Order, Introduction of roots, Technical information about Sanskrit Literature

Unit-III

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

RECOMMENDED BOOKS:

1. Dr.Vishwas, “Abhyaspustakam” Samskrita-Bharti Publication, New Delhi
2. Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam “Teach Yourself Sanskrit” Prathama Deeksha-, New Delhi Publication
3. Suresh Soni, “India’s Glorious Scientific Tradition” Ocean books (P) Ltd., New Delhi.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(CAD/CAM)

MTAD-107A	VALUE EDUCATION						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The objective of this course is to understand value education, self-development, Imbibe good values in students and Let them know about the importance of character building.						
Course Outcomes							
CO1	To get knowledge of self-development.						
CO2	To learn the importance of Human values.						
CO3	To develop the overall personality.						
CO4	To know about the importance of character.						

Unit-I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

Unit-II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

Unit-III

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

Unit-IV

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively

RECOMMENDED BOOKS:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Second Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTIP-102A	MECHATRONICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to acquaint the knowledge of electronic devices and electromechanical systems, hydraulic and pneumatic systems, CNC, Robotics and PLC's.						
Course Outcomes							
CO1	To understand the concepts of Mechatronics, fundamental of electronics and digital circuits and electrical actuating circuits.						
CO2	To acquaint the knowledge of hydraulic system with its practical applications.						
CO3	To acquaint the knowledge of pneumatic system with its practical applications.						
CO4	To study the fundamentals of CNC, Robotics and programmable logic controllers (PLC's) and their use.						

UNIT-I

Introduction: The Mechatronics approach: A methodology for integrated design of Mechanical, Electronics and Electrical Control, Computer and Instrumentation.

Fundamentals of Electronics and digital circuits: Number systems: Binary, Octal, Hexadecimal, Conversion from Binary to Decimal, Octal and Hexadecimal and vice–versa, Binary arithmetic: Addition, subtraction, Multiplication and division, Boolean Algebra: Laws, De-Morgan's laws, Logic Gates, Truth tables, Karnaugh maps and logic circuits. Generation of Boolean function from truth tables and simplification, **Electrical actuating system:** Basic principle of electrical switching, Solenoids, Electrical relays, Representation of output devices, Electrical motors: A.C. motors, Stepper motors, Induction motor speed control.

UNIT-II

HYDRAULIC SYSTEMS:

Direction Control Valves: Poppet Valve, Spool Valve, Sliding Spool type DCV, Check Valve, Pilot operated check valve, Restriction check valve, 2 Way vale, 3 way valve, 4 way valve, Manually actuated valve, Mechanically actuated valve, Pilot operated DCV, Solenoid Actuated valve, Rotary Valve, Centre flow path configurations for three position four way valve, Shuttle valve

Pressure Control Valve: Simple and compound pressure Relief Valve, Pressure Reducing Valve, Unloading valve, sequence valve, counterbalance valve, Brake Valve

Flow Control Valves: Fixed and non-adjustable valve, adjustable, throttling, non-pressure compensated pressure control valve, Pressure/temperature compensated flow control valve, Shuttle and Fast exhaust valve, Time delay valve, Flow Control Valves, Fluid Conditioners, Hydraulic Symbols (ANSI),Hydraulic Circuit design: Control of Single and double acting cylinders, double pump Hydraulic System

UNIT-III

PNEUMATIC SYSTEM:

Air Generation and distribution: Air compressors, Air Receiver, Filters, intercoolers, After-coolers, Relief Valve, Air dryers, Primary and secondary lines, Piping layouts, Air Filters, Air Regulators, Air Lubricator, Actuators and output devices, Direction control valves, Flow control valves, junction elements, Pneumatic circuits, Control of Single and double acting cylinders.

UNIT-IV

INTRODUCTION TO CNC MACHINES AND ROBOTICS:

CNC Machines: NC machines, CNC machines, DNC machines, Machine structure, Slidways, Guideways, Slide Drives, Spindle, Robotics:Components of robots, Classification of robots, Robots application

PROGRAMMABLE LOGIC CONTROLLERS

Introduction - Principles of operation - PLC Architecture and specifications - PLC hardware Components, Analog & digital I/O modules, CPU & memory module - Programming devices - PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram. PLC programming Simple instructions - Manually operated switches - Mechanically operated Proximity switches - Latching relays, Applications of PLC.

RECOMMENDED BOOKS:

1. W. Bolton,Mechatronics, Pearson Education.
2. Majumdar,Pneumatic system, TMH.
3. Andrew Parr, Hydraulic and Pneumatic systems,TMH.
4. M.P. Groover,Automation, Production systems and computer integrated manufacturing, TMH.
5. Shetty and Kolk,Mechatronics system design, Thomson learning.
6. Mahalik,Mechatronics, TMH.
7. Anthony Esposito,Fluid power with application,Pearson Education.
8. K.P Ramachandran, M.S Balasundaram,Mechatronics, Wiley India.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks.* The student will attempt a total of *FIVE questions,* each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining/our questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTCM-102	Design Optimization & Simulation of Engineering Systems						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	To study about the optimization and simulation of various engineering system.						
Course Outcomes							
CO 1	Students will be able to understand the optimization Techniques.						
CO 2	Students will be able to understand the optimization of thermal system.						
CO 3	Students will be able to study design synthesis and application in different areas.						
CO 4	Students will be able to learn different optimization methods and how to formulate a problem for optimization .						

UNIT I

Introduction

Engineering Design, Design vs Analysis, Synthesis for Design, Selection vs design, Design as part of Engg, enterprise- Need, evolution & market analysis, feasibility & change of success, Engineering Design, R & D, Need for optimization, Fabrication, Testing & production; Thermal systems-Basic characteristics, Analysis, Types.

Basic Considerations in Design

Formulation of design problem; Conceptual design; Steps in design - Physical systems, modeling & simulation; Evaluation - Acceptable Design; Optimal design; Safety Features, Automation & control; Communicating the Design, Patents in Copy Rights; CAD; Material Selection.

UNIT II

Modeling of Thermal Systems

Introduction; Types of models; Mathematical Modeling; Physical modeling & dimensional analysis; Curve fitting.

Numerical Modeling & Simulation: Numerical modeling; Solution procedures; Numerical model for a system; System simulation; Methods for numerical simulation.

UNIT III

Synthesis of Different Design steps

Introduction; Initial Design; Design Strategies; Design of systems from different application areas; Additional considerations for large practical systems.

Economic Considerations:

Introduction; Calculation of interest; Time value of money; Raising capital; Taxes; Economic factor in design; Application of thermal systems.

UNIT IV

Problem Formulation for optimization

Introduction; Basic concepts; Optimization methods; Optimization of thermal systems; Practical aspects in optimal design.

Optimization methods

Review of various methods; Lagrange multiplier methods for optimization of un-constrained & constrained problems; Search methods for multi- variable un-constrained & constrained optimization; Geometric, linear, dynamic & other methods.

Recommended Books:

1. Design & Optimization of Thermal Systems-Yogesh Jaluria, MH, New York.
2. Design of Thermal Systems- W. F. Stockers, MH, New York.
3. Principles of Design- N.P. Suh, Oxford Uni., New York.
4. Analysis & Design of Energy Systems- PH, Anglewood, New York.
5. Applied Numerical Methods- Carnahan, B.H, Luther, H.A. and Wilkes, J.O,Wiley, N.Y.
6. Numerical Methods – Hornbeck, R.W., PH, Anglewood, New York.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-III

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTIP-106A	ADVANCED WELDING PROCESSES						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of Welding metallurgy and welding processes.						
Course Outcomes							
CO1	To impart knowledge about various Weld metallurgy and Weld arc characteristics.						
CO2	To acquaint students with the various welding power sources and their applications.						
CO3	To impart knowledge to students about Electrode coatings and Metal transfer phenomenon in weld metal transfer.						
CO4	To let student understand the basics of Solid state welding processes and some of the latest welding techniques.						

UNIT-I

WELDING METALLURGY: Introduction, Weld Metal Zone, Theory of solidification of metals and alloys, Homogeneous Nucleation, Heterogeneous Nucleation, Freezing of alloys, Epitaxial Solidification; Effect of Welding speed on Grain structure, Fusion boundary zone, Heat affected zone, Under bead zone, Grain Refined Zone, Partial transformed zone, Properties of HAZ

WELDING ARC: Definition of Arc, Structure and characteristics, Arc efficiency, arc blow, Electrical Characteristics of arc, Types of Welding Arcs, mechanism of arc initiation and maintenance, role of electrode polarity on arc behaviour and arc stability, analysis of the arc. Arc length regulation in mechanized welding processes.

UNIT-II

WELDING POWER SOURCES: Requirement of an Arc welding power sources, basic characteristics of power sources for various arc welding processes, duty cycles, Selection of a static Volt-Ampere characteristic for a welding process, AC/DC welding power source, DC rectifiers, thyristor controlled rectifiers, transistorized units, inverter systems, Mathematical Problems on Static volt ampere characteristics

UNIT-III

COATED ELECTRODES: Electrode coatings, classification of coatings of electrodes for SMAW, SAW fluxes, role of flux ingredients and shielding gases, classification of solid and flux code wires.

METAL TRANSFER & MELTING RATE: Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal transfer and melting rate.

UNIT-IV

SOLID STATE WELDING: Theory and mechanism of solid state welding,techniques and scope of friction welding, diffusion welding, cold pressure welding and ultrasonic welding, high energy rate welding,analysis of the Process.

WELDING TECHNIQUES: Technique, scope and application of the electron beam and laser welding processes,under water welding - process & problem.

RECOMMENDED BOOKS:

1Raymond Sacks, ―Welding: Principles & Practicesǁ McGraw-Hill
2 R.S.Parmar, ―Welding processes & Technologyǁ, Khanna Publishers
3 S.V. Nandkarni, ―Modern Arc Welding Technology, Oxford & IBH publishing Co.
4 L.M.Gourd, ―Principles of Welding Technologyǁ, ELBS/ Edward Arnold.
5 Richard L. Little ―Welding & Welding Technologyǁ, Mc-Graw Hill.
6 Cary, Howard ―Modern Welding Technology', prentice Hall, 1998.
7 Rossi ―Welding Technologyǁ, Mc-Graw Hill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTIP–108A	ADVANCED METAL CUTTING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of advanced cutting tools, tools geometry, mechanisms and analysis.						
Course Outcomes							
CO1	To impart knowledge about various functional related to tools geometry.						
CO2	To acquaint with the analysis of fundamental factors affecting tool forces						
CO3	To impart knowledge about cutting tool life and mathematical modelling for wear.						
CO4	To let student understand abrasive machining and its process simulation.						

UNIT-I

Introduction system of Tool nomenclature, Tool Geometry, Mechanism of Chip formation and forces in orthogonal cutting, Merchant's force diagram.

Oblique Cutting: Normal chip reduction coefficient under oblique cutting, true shear angle, effective rake, influx region consideration for deformation, direction of maximum elongation, effect of cutting variables on chip reduction co-efficient, forces system in oblique cutting, effect of wear land on force system, force system in milling, effect of helix angle.

UNIT-II

Fundamentals of Dynamometry, Theoretical determination of forces, angle relations, heat and temperature during metal cutting; distribution, measurement, analysis, theoretical estimation of work piece temperature, hot machining

Fundamental factors, which effect tool forces: Correlation of standard mechanized test. (Abuladze –relation), nature of contact and stagnant phenomenon, rates of strains, shear strain and normal strain distributions, cutting variables on cutting forces.

UNIT-III

Cutting Tools: Tools materials analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, wear of cutting tools, criterion, flank and crater wear analysis, optimum tool life, tool life equations, (Taylor's woxen etc) Tool life test, machining optimization, predominant types of wear; abrasive, adhesive, diffusion wear models, wear measurements and techniques, Major Test of tool wear oxidative mathematical modelling for wear, test of machinability and influence of metallurgy on machinability. Economics of metal machining

UNIT-IV

Abrasive Machining: Mechanics of grinding, cutting action of grit, maximum grit chip thickness, energy and grit force temperature during grinding, wheel wear, grinding, process simulation, testing of grinding wheels, mechanics of lapping and honing, free body abrasion.

RECOMMENDED BOOKS:

1. Sen & Bhattacharya,Principles of Machine tools, New Central Book Agency.
2. Brown,Machining of Metals, Prentice Hall.
3. Shaw,Principles of Metal cutting, Oxford I.B.H.
4. Arshimov & Alekree,Metal cutting theory & Cutting tool design, MIR Publications.
5. Machining Science & Application by Knowenberg Longman Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTIP-110A	Metrology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs.**
Objective	The main objective of the course is to deal with the basic principles of dimensional measuring instruments and precision measurement techniques in achieving quality and reliability in the service of any product in dimensional control.						
Course Outcomes							
CO1	To understand the students about the requirement of metrology and the concepts of limit, fits and gauges.						
CO2	To study the linear and angular measurements and the optical measurement tools and techniques.						
CO3	To understand how to use surface roughness and thread measuring instruments.						
CO4	To study the comparators, measurement through comparators and the advanced metrology concepts.						

UNIT-I

Introduction to metrology: Definition, types, need of inspection, terminologies, methods of measurement, selection of instruments, measurement errors, units, Measurement standards, calibration, statistical concepts in metrology.

Systems of Limits and Fits: Introduction, nominal size, tolerance limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard Institution system – British standard system, International standard system for plain and screwed work.

Limit Gauges: Taylor's principle – Design of limit gauges, computer aided tolerancing.

UNIT-II

Linear Measurement: Length standard, line and end standards, slip gauges – calibration of the slip gauges, dial indicator, micrometres. Measurement of angles and tapers: Different methods – bevel protractor – angle slip gauges – spirit levels– sine bar – sine plate, rollers and spheres.

Flat Surface Measurement: Measurement of flat surfaces – instruments used – straight edges– surface plates – optical flat and auto collimator.

Optical Measuring Instruments: Tool maker's microscope and its uses, collimators, optical projector, optical flats and their uses, interferometer.

UNIT-III

Surface Roughness Measurement: Introduction, terminology, specifying roughness on drawings, surface roughness parameters, factors affecting surface roughness, ideal surface roughness, roughness measurement methods, precautions in measurement, surface microscopy, surface finish softwares.

Screw Thread Measurement: Elements of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch, profile thread gauges.

Measurement through Comparators: Comparator: Features of comparators, classification of comparators, different comparators, advanced comparators, thread comparators.

UNIT-IV

Metrology of machine tools: Alignment and practical tests.

Gear Measurement: Gear measuring instruments, gear tooth profile measurement, measurement of diameter, pitch, pressure angle and tooth thickness.

Advanced Metrology: Advanced measuring machines, CNC systems, Laser vision, In-process gauging, 3D metrology, metrology softwares, Nano technology instrumentation, stage position metrology, testing and certification services, optical system design, lens design, coating design, precision lens assembly techniques, complex opto mechanical assemblies, contact bonding and other joining technologies.

RECOMMENDED BOOKS:

1. K.J. Hume,Engineering Metrology, Macdonald and Co. (publisher) London.
2. Czichos, The Springer handbook of metrology and Testing, 2011.
3. Jay. L. Bucher, The Metrology Hand book, American Society for Quality, 2004.
4. Smith GT,Industrial Metrology, Spinger.
5. John W. Greve, Frank W. Wilson,Hand book of industrial metrology, PHI – New Delhi.
6. D.M. Anthony, Engineering Metrology, Pergamon Press.
7. Khare MK,Dimensional Metrology, OXFORD-IBH Publishers.
8. I C Gupta, "Engineering Metrology", 5th Edition, Danapath Rai & Co, 2008.
9. R.K. Jain, "Engineering Metrology". 20th Edition, Khanna Publishers, 2007.
10. M. Mahajan, "Engineering Metrology", Dhanapati Rai publications, 2007.
11. BIS standards on Limits & Fits (IS 919), Surface Finish (IS 2073), Machine Tool Alignment, 1993.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-IV

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTIP–112A	SEQUENCING AND SCHEDULING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of different production and machine models of sequencing and scheduling.						
Course Outcomes							
CO1	To understand the concept of sequencing and scheduling.						
CO2	To study and practice for the extension of basic models and parallel machine models.						
CO3	To understand the concepts of the flow shop scheduling and practice for the flow shop scheduling models.						
CO4	To understand the job shop problems and simulation models for dynamic job shop problem.						

UNIT-I

Single-Machine Sequencing: Introduction, Preliminaries, Problems without Due Dates, Problems with Due Dates
Optimization Methods for the Single-Machine Problem: Introduction, Adjacent Pairwise Interchange Methods, A Dynamic Programming Approach, Dominance Properties, A Branch and Bound Approach.
Earliness and Tardiness Costs: Introduction, Minimizing Deviations from a Common Due Date, The Restricted Version, Asymmetric Earliness and Tardiness Costs, Quadratic Costs, Job-Dependent Costs, Distinct Due Dates, Sequencing for Stochastic Scheduling.

UNIT-II

Extensions of the Basic Model: Introduction, Non-simultaneous Arrivals, Related Jobs, Sequence-Dependent Setup Times, Stochastic Models with Sequence-Dependent Setup Times.
Parallel machine models: Introduction, Minimizing the Makespan, Minimizing Total Flow time, Stochastic Models.

UNIT-III

Flow Shop Scheduling: Introduction, Permutation Schedules, The Two-Machine Problem, Special Cases of The Three-Machine Problem, Minimizing the Makespan, Variations of the *m*-Machine Model, Stochastic flow shop scheduling.

UNIT-IV

The Job Shop Problem: Introduction, Types of Schedules, Schedule Generation, The Shifting Bottleneck Procedure, Neighborhood Search Heuristics.
Simulation Models for the Dynamic Job Shop: Introduction, Model Elements, Types of Dispatching Rules, Reducing Mean Flowtime, Meeting Due Dates.

RECOMMENDED BOOKS:

1. Michael Pinedoo, Scheduling: theory, algorithms and systems, Prentice Hall, New Delhi, 1995.
2. King, J.R. Production planning and control, Pergamon International Library, 1975.
3. Kenneth R. Baker, Introduction to sequencing and scheduling, John Wiley and Sons, 1974.
4. Kenneth R. Baker and Dan Trietsch, Principles of sequencing and scheduling, John Wiley and Sons, 2009.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTIP–114A	QUALITY ENGINEERING AND MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of quality tools and engineering for the improvement of product quality.						
Course Outcomes							
CO1	To understand the statistical concepts of quality and quality statistics.						
CO2	To study the quality control chartsin production process and practice for its use in problem solving.						
CO3	To understand the quality improvement tools.						
CO4	To study the ISO systems, failure analysis and testing.						

Unit-I

Introduction to Quality: An Historical Overview: Defining Quality, The Total Quality System, Total Quality Management, Economics of Quality, Quality, Productivity, and Competitive Position, Quality Costs, Success Stories.

Statistics for Quality: Variability in Populations, Some Definitions, Quality vs. Variability, Section I: Empirical Methods for Describing Populations, Section II: Mathematical Models for Describing Populations, Section III: Inference of Population Quality from a Sample.

Unit-II

Quality in Design: Planning for Quality, Product Planning, Product Design, Process Design.

Quality in Production-Process Control I: Process Control, The Control Charts, Measurement Control Charts, Attribute Control Charts, Summary on Control Charts, Process Capability, Measurement System Analysis,

Quality in Production-Process Control II: Derivation of Limits, Operating Characteristics of Control Charts, Measurement Control Charts for Special Situations.

Unit-III

Quality in Procurement: Importance of Quality in Supplies, Establishing a Good Supplier Relationship, Choosing and Certifying Suppliers, Specifying the Supplies Completely, Auditing the Supplier, Supply Chain Optimization Using Statistical Sampling for Acceptance,

Continuous Improvement of Quality: The Need for Continuous Improvement, The Problem-Solving Methodology, Quality Improvement Tools, Lean Manufacturing.

Unit-IV

A System for Quality: The Systems Approach, Dr. Deming's System, Dr. Juran's System, Dr. Feigenbaum's System, Baldrige Award Criteria, ISO 9000 Quality Management Systems, ISO 9001:2008 Requirements, The Six Sigma System.

RECOMMENDED BOOKS:

1. Grant & Leaveworth, Statistical Quality Control, McGraw Hill
2. Duncan,Quality Control & Industrial Statistics, Irwin Press
3. Juran,Quality Control Handbook, McGraw Hill.
4. Hansen,Quality Control, Prentice Hall
5. Thomason,An Introduction to reliability & control, Machinery Publishing.
6. A.V. Taylor, Total Quality Control, McGraw-Hill
7. K.S.Krishnamoorthi, V. Ram Krishnamoorthi,A First Course in Quality Engineering: Integrating Statistical and Management Methods of Quality, Second Edition, CRC Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weight of 12 marks*.

The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTIP–116A	RELIABILITY ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of reliability analysis in industrial system. Students can get acquainted with different reliability calculation models.						
Course Outcomes							
CO1	To understand the concepts of reliability in industrial systems.						
CO2	To study the reliability determination methods and advanced evaluation techniques.						
CO3	To understand various reliability prediction and evolution methods.						
CO4	To acquaint the fundamentals of reliability management and risk assessment.						

UNIT-I

Reliability Engineering: Reliability function, failure rate, Mean time between failures (MTBF), Mean time to failure (MTTF), mortality curve, useful life availability, maintainability, system effectiveness. Introduction to probability distributions.

Time to failure distributions: Exponential, normal, Gamma, Weibull; ranking of data, probability plotting techniques, Hazard plotting Concept of Bathtub Hazard Rate curve, Reliability evaluation of two-state device networks-series, parallel, k-out-of-m systems; Standby redundant systems, Reliability evaluation of three-state device networks-series and parallel.

UNIT-II

Reliability Determination and Prediction: Reliability Determination Methods: Network reduction technique, Path tracing technique, Decomposition technique, Delta-Star method.

Advanced Reliability Evaluation Concepts: Supplementary variables technique, Interference theory, Human reliability, Common cause failures, Fault trees, Failure mode and effect analysis

UNIT-III

Reliability Prediction Models: Series and parallel systems - RBD approach - Standby systems - m/n configuration - Application of Baye's theorem - cut and tie set method - Markov analysis - FTA - Limitations.

UNIT-IV

Reliability testing: Time acceleration factor, influence of acceleration factor in test planning, application to acceleration test, high temperature operating life acceleration model, temperature humidity bias acceleration model, temperature cycle acceleration model, vibration accelerator model, failure free accelerated test planning. Accelerated reliability growth.

Risk Assessment: Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.

RECOMMENDED BOOKS:

1. Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", TMH, 2000.
2. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2007.
3. Sharma S C, Inspection Quality Control and Reliability, Khanna Publishers.
4. Connor P.D.T.O. Practical Reliability Engineering", John Wiley.
5. Naikan V N A Reliability Engineering and Life Testing", PHI Learning Private Limited.
6. Prabhakar Murthy D N and Marvin R, "Product Reliability", Springer-Verlag.
7. Dana Crowe and Alec Feinberg, Design for Reliability, CRC Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weight of 12 marks*.

The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTIP–118A	MECHATRONICS LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	To practice on electrical circuits, hydraulic and pneumatic systems and PLC's for their practical implications.							
Course Outcomes								
CO1	To understand the PLC using PLC simulators.							
CO2	To demonstrate and actuate the positioning using sensors, actuators and programming.							
CO3	To study the pneumatic and electro-pneumatic training system with simulation software.							
CO4	To design and test on hydraulic and pneumatic circuits.							

List of Experiments

1. To study and conduct exercises on PLC Simulator.
2. Control of conveyor manually and through programming, also programming using sensors and conveyor.
3. To study and conduct exercise on CNC lathe.
4. To study and conduct exercises on Robotic simulation software.
5. To study and conduct exercises on Pneumatic & Electro-Pneumatic Training System.
6. To study the stepper motor interface with PLC.
7. **Design and testing of hydraulic circuits such as**
   i) Pressure control
   ii) Flow control
   iii) Direction control
   iv)Design of circuit with programmed logic sequence, using an optional PLC in hydraulic.
   Electro hydraulic Trainer.
8. **Design and testing of pneumatic circuits such as**
   i. Pressure control
   ii. Flow control
   iii. Direction control
   iv. Circuits with logic controls
   v. Circuits with timers
   vi. Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.
9. To perform exercises on process control trainer.

Note: At least eight experiments should be performed from the above list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTCM–104	SIMULATION LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	To study simulation using MATLAB in various mechanical system.							
Course Outcomes								
CO1	To understand the basics of MATLAB software.							
CO2	To learn the simulation of Thermal system in MATLAB.							
CO3	To learn the simulation of Pneumatic system in MATLAB.							
CO4	To learn the simulation of Hydraulic system in MATLAB.							

List of Experiments:

1. MAT LAB basics, dealing with matrices, Graphing-functions of one variable and two variables.
2. Use of MATLAB to solve simple problems in vibration.
3. Use of MATLAB to solve simple problems in Hydraulic system.
4. Analysis of force and stress using four link elements in trusses.
5. Use of MATLAB to solve problems in Pneumatic system.
6. Use of MATLAB to solve problems in Thermal system.
7. Model analysis of cantilever beam without load.
8. Model analysis of cantilever beam with load.
9. Simulation of cam and follower mechanism using MATLAB.
10. Simulation of spring-mass system using MATLAB.

Note: At least eight experiments should be performed by the students.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTCM-106	MINI PROJECT							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**4**	**2**	**-**	**-**	**100**	**100**	**3**
Objective	In case of mini project, they will solve a live problem using software/analytical/computational tools or fabricate an experimental setup.							
Course Outcomes								
CO 1	Students will learn to write technical reports.							
CO 2	Students will develop skills to present and defend their work in front of technically qualified audience.							

Students can take up small problems in the field of Design/Industrial and Production engineering/Thermal engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Students will be required to submit a brief synopsis of 3-4 pages related to the topic by the first week of September.

w.e.f. 2018-19

Audit Course-II

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTAD- 102A	CONSTITUTION OF INDIA						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The main objective of the course is to impart the students with the knowledge of informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.						
Course Outcomes							
CO1	To discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.						
CO2	To discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.						
CO3	To discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.						
CO4	To discuss the passage of the Hindu Code Bill of 1956.						

Unit-I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)
Philosophy of the Indian Constitution: Preamble, Salient Features

Unit-II

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality, Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit-III

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit-IV

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

RECOMMENDED BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "framing of Indian Constitution", 1st Edition, 2015.
3. M. P. Jain, "Indian Constitution Law", 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTAD-104A	PEDAGOGY STUDIES						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The main objective of the course is to review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers and Identify critical evidence gaps to guide the development.						
Course Outcomes							
CO1	Understand the pedagogical practices being used by teachers in formal and informal classrooms in developing countries.						
CO2	Become aware of the evidence on the effectiveness of these pedagogical practices, in different conditions and with different population of learners.						
CO3	Understand the significance of teacher education (curriculum and practicum) and the school curriculum and guidance materials for effective pedagogy.						

Unit-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions. Overview of methodology and Searching.

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

Unit-II

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit-III

Professional development: alignment with classroom practices and follow-up support, Peer support

Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Unit-IV

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education

Curriculum and assessment, Dissemination and research impact.

RECOMMENDED BOOKS:

1. Ackers J, Hardman F, "Classroom interaction in Kenyan primary schools", Compare, 31 (2): 245-261.
2. Agrawal M, "Curricular reform in schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K, "Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?" International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ, "Culture and pedagogy: International comparisons in primary education". Oxford and Boston: Blackwell.
6. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign"

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTAD-106A	STRESS MANAGEMENT BY YOGA						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The main objective of the course is to achieve overall health of body and mind and to overcome stress						
Course Outcomes							
CO1	Develop healthy mind in a healthy body thus improving social health.						
CO2	Improve efficiency						
CO3	Learn the Yogasan						
CO4	Learn the Pranayam						

Unit-I

Definitions of Eight parts of yog. (Ashtanga)

Unit-II

Yam and Niyam. Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit-III

Asan and Pranayam

i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam

RECOMMENDED BOOKS:

1. Janardan Swami Yogabhyasi Mandal, "Yogic Asanas for Group Tarining-Part-I" : Nagpur
2. Swami Vivekananda, "Rajayoga or conquering the Internal Nature" Advaita Ashrama (Publication Department), Kolkata

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(CAD/CAM)

MTAD-108A	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	To learn to achieve the highest goal happily. To become a person with stable mind, pleasing personality and determination. To awaken wisdom in students.						
Course Outcomes							
CO1	Students become aware about leadership.						
CO2	Students will learn how to improve communication skills						
CO3	Understand the team building and conflict						
CO4	Student will learn how to manage the time.						

Neetisatakam-Holistic development of personality

i) Verses- 19,20,21,22 (wisdom)
ii) Verses- 29,31,32 (pride & heroism)
iii) Verses- 26,28,63,65 (virtue)
iv) Verses- 52,53,59 (dont's)
v) Verses- 71,73,75,78 (do's)

Approach to day to day work and duties.

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47, 48,
Chapter 3-Verses 13, 21, 27, 35,
Chapter 6-Verses 5, 13, 17, 23, 35,
Chapter 18-Verses 45, 46, 48.

Statements of basic knowledge.

Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16, 17, 18

Personality of Role model. Shrimad Bhagwad Geeta:

Chapter 2-Verses 17,

Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

RECOMMENDED BOOKS:

1. Swami Swarupananda, "Srimad Bhagavad Gita" Advaita Ashram (PublicationDepartment), Kolkata
2. P.Gopinath, "Bhartrihari's Three Satakam (Niti-sringar-vairagya) by, Rashtriya Sanskrit Sansthanam, New Delhi.

Third Semester
(Programme Elective-V)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: CAD/CAM

MTIP-201A	ENTERPRISE RESOURCE PLANNING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3
Objective	The main objective of the course is to impart the students with the knowledge of integrated applications to manage the business and automate many back office functions related to technology, services and human resources.						
Course Outcomes							
CO1	To study the basic principles and models of an enterprise.						
CO2	To understand the concepts of technology and architecture in ERP.						
CO3	To study ERP system packages.						
CO4	To study the ERP procurement issues.						

UNIT I

ENTERPRISE RESOURCE PLANNING:
Introduction, Evolution of ERP, Principle of ERP, Enabling Technologies, ERP Characteristics, Features of ERP, The advantages of ERP, Reasons for the Failure of ERP Implementation, Risk and governance issues in an ERP, ERP Framework, Business Blueprint, Business Engineering Vs. Business Process Re-Engineering, ERP Tools and Software, Demand Chain, Value Chain, and Supply Chain.

UNIT-II

ERP ARCHITECTURE: Need to Study ERP Architecture**,** Layered Architecture, Types of ERP Architecture, Two-tier Implementations, Three-tier Client/Server Implementations, Web-based architecture, Service-Oriented Architectures, Logical Architecture of an ERP System, Physical Architecture of an ERP System, and Evaluation Framework for ERP Acquisition.

UNIT III

ERP PACKAGE INTEGRATION AND IMPLEMENTATION: ERP market, SAP, People soft, BAAN company, ORACLE corporation, A comparative assessment and selection of ERP packages and modules, Sales Force Automation, Integration of ERP, Integration of ERP and the Internet, ERP implementation strategies, Comparison of Big Bang vs. Phased Approach, Implementation Strategy in Small and Medium Enterprise, Post Implementation Issues.

UNIT IV

OVERVIEW OF ARCHITECTURE OF DIFFERENT ERP SOFTWARES: Oracle overview, Architecture, A.I.M. and applications, SAP Software architecture overview, ERP before and after Y2K, Impact of Y2K on ERP Development, Risk and Governance Issues in an ERP

ERP MODULES: Finance module, Sales & Distribution module, Human Resources module, Plant Maintenance module, Quality Management module, Material management module, manufacturing management module.

RECOMMENDED BOOKS:

1. Sadagopan. S, ERP-A Managerial Perspective, Tata Mcgraw Hill,1999.
2. Jose Antonio Fernandez, the SAP R/3 Handbook, Tata Mcgraw Hill,1998.
3. Vinod Kumar Crag and N.K. Venkitakrishnan, Enterprise Resource Planning- Concepts and Practice, Prentice Hall of India,1998.
4. Garg & Venkitakrishnan,ERPWARE, ERP Implementation Framework, Prentice Hall,1999.
5. Thomas E Vollmann and Bery Whybark, Manufacturing and Control Systems, Galgothia Publications,1998.
6. Alexis Leon,Enterprise resource planning, Tata Mcgraw-Hill

Note: The paper will have a total of *NINE questions.* QuestionNo.1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all FourUnits).
All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: CAD/CAM

MTIP-203A	DESIGN OF EXPERIMENTS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 hrs
Objective	To understand the various design of experiments techniques for optimization of problems.						
Course Outcomes							
CO1	To understand the concepts of Design of Experiment and statistical Methods.						
CO2	To understand the ANOVA and factorial design and fitting response curves and surfaces.						
CO3	To study the application of Taguchi Method and testing of hypothesis						
CO4	To study and implement the Response Surface Methodology.						

UNIT-I

Introduction to Designed Experiments:
Introduction,Strategyofexperimentation,Sometypicalapplicationsofexperimentaldesign, Basic principles, Guidelines for designing experiments, Using statistical design in experimentation, A Checklist for Planning experiments, *Introduction to Minitab, Interface of Minitab, Customizing Minitab, Entering Data, Graphing Data, Printing Data and Graphs, Saving and Retrieving information.*

Basic Statistical Methods: Introduction, Basic statistical concepts, Types of Data, Graphical Presentation of Data. Descriptive Statistics: Measure of Location, Measure of Variation, The Normal Distribution, Counting, Minitab Commands to Calculate Descriptive Statistics.

Inferential Statistics: The Distribution of Sample Means (R Known), Confidence Interval for the Population Mean (σ Known), Hypothesis testing for one sample mean (σ Known), Hypothesis test for two sample means, Testing for Normality, *Hypothesis test and Confidence Intervals with Minitab.*

UNIT-II

Analysis of Variance: Introduction to Analysis of Variance, ANOVA assumptions and Validation, ANOVA Table, The sum of square approach to ANOVA calculations, Analysis of the fixed Effect model, Decomposition of the Total sum of squares. Statistical analysis, Estimation of the Model Parameters, Unbalanced Data, Model Accuracy Check, Practical interpretation of results. *ANOVA with Minitab*

Factorial Experiments: Basic definition and principles, Advantages of factorials, Two level factorial design, The 2^1 Factorial Experiment, The 2^2 Factorial Experiment, The 2^3 Factorial Design, Addition of Centre Cells to 2^k Designs. General Procedure for Analysis of 2^k designs. 2^k Factorial Designs in Minitab.

UNIT-III

Introduction to Taguchi Method: Introduction, Taguchi Quality loss function, Orthogonal Array, Properties of Orthogonal Array, Minimum number of experiments to be conducted, Static Problems, Dynamic Problems, Assumptions of the Taguchi method, Steps in Taguchi Method, Assessment of Factors and Interactions, Selection and Application of Orthogonal arrays, Data Analysis from Taguchi Experiments, Variable Data with main factors only, Variable Data with Interactions, Attribute Data Analysis, Confirmation Experiment, Confidence Intervals, Robust Design Approach. *Applications of Taguchi Method using Minitab*.

UNIT-IV

Introduction to Response Surface Methodology: Introduction, Terms in Quadratic Models, The method of steepest ascent, Analysis of Second order response surfaces, Experimental design for fitting response surfaces, 2k Designs with Centers, 3^k Factorial Designs, Box- Behnken Designs, Central Composite Designs, Analysis of Data from RSM Designs, Design Considerations for Response Surface Experiments. *Response Surface Designs in Minitab.*

RECOMMENDED BOOKS:

1. Douglas C Montgomery,Design and Analysis of Experiments, John Wiley
2. Paul G. Mathews,Design of Experiments with MINITAB, New Age International Publishers.
3. K. Krishnaiah, P. Shahabudeen,Applied Design of Experiments and Taguchi Methods,PHI.

4. Angela Dean and Daniel Voss,Design and Analysis of Experiments, Springer.
5. John P.W.M., Statistical Design and Analysis of Experiments, John Wiley
6. Montgomery D.C., Runger G. C., Introduction to Linear Regression Analysis, John Wiley
7. Myres R.H. and Montgomery D.C.,Response Surface Methodology Process and Product Optimization Using Designed Experiments, Wiley
8. G UNIPUB, White Plains,Introduction to Quality Engineering Taguchi, New York.
9. https://www.ee.iitb.ac.in/~apte/CV_PRA_TAGUCHI_INTRO.htm
10. www.ecs.umass.edu/mie/labs/mda/fea/sankar/chap2.html

Note: The paper will have a total of *NINE questions.*QuestionNo.1, which is compulsory, shall be Objective Type and have contents from the entire syllabus (all Four Units).
All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: CAD/CAM

MTIP–205A	STRATEGIC ENTREPRENEURSHIP						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To provide knowledge to the students about entrepreneurship concepts and various development programme and policies.						
Course Outcomes							
CO1	To know about the small scale industries, scopes and the causes of their sickness.						
CO2	To know about the EDP and different government policies.						
CO3	To learn about business incubations and its future perspectives.						
CO4	To learn E-business marketing and developments.						

UNIT-I

Small Scale Industries: Definition and types of SSI's; Role, scope and performance in national economy; Problems of small scale industries.

Industrial Sickness: Definition; Causes of sickness; Indian scenario, Government help; Management strategies; Need for trained entrepreneurs

UNIT-II

Entrepreneurship Development Programme: Introduction, Origin of EDP's , Organizations involved in EDP's, Objectives of EDPs, Implementation of EDP's, Short comings of EDP's, Role in entrepreneurship development.

Step: Introduction, Origin, Status in India, Success and failure factors, Govt. polices and incentives, future prospects in India.

UNIT-III

Business Incubation: Introduction, Origin and development of business incubators in India and other countries, types of incubators, success parameters for a business incubator, Benefits to industries, institutes, government and society, future prospects, A few case studies (at least 2).

Project Management: Concept, Characteristics and Significance of Project Management, Components of Project Management, Project Life Cycle, Project Identification and Selection, Project Formulation and Appraisal.

UNIT-IV

Special Aspects of Entrepreneurship: Entrepreneurship, Social entrepreneurship, International entrepreneurship, Rural entrepreneurship, Community Development, Women entrepreneurship.

Network Marketing: Introduction, E-business, E-commerce, E-auction, A basic internet e-business architecture, A multi-tier e-business architecture.

RECOMMENDED BOOKS:

1. P.K. Gupta,Strategic Entrepreneurship, Everest Publishing House.
2. David Cleland,Project Management –Strategic Design and Implementation, McGraw Hill.
3. David H Holl,Entrepreneurship-New Venture Creation, Prentice Hall of India.
4. Steed & Steed,Sustainable Strategic Management, Prentice Hall of India.
5. Kotler,Marketing Management by Prentice Hall of India.
6. Tarek Khalil,Management of Technology, McGraw Hill.
7. Henry Steiner,Engineering Economic Principles, McGraw Hill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Open Elective

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: CAD/CAM

MTOE-201A	BUSINESS ANALYTICS						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes							
CO1	Able to have knowledge of various business analysis techniques.						
CO2	Learn the requirement specification and transforming the requirement into different models.						
CO3	Learn the requirement representation and managing requirement assets.						
CO4	Learn the Recent Trends in Embedded and collaborative business						

Unit-I

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.
Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit-II

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.
Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit-III

Finalizing Requirements, Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements, Managing Requirements Assets: Change Control, Requirements Tools

Unit-IV

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

RECOMMENDED BOOKS:

1. James Cadle, "Business Analysis", BCS, The Chartered Institute for IT.
2. Erik Larson and, Clifford Gray, "Project Management: The Managerial Process", McGraw-Hill Education.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: CAD/CAM

MTOE-203A	INDUSTRIAL SAFETY						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to aware students about the industrial safety maintenance and fault findings.						
Course Outcomes							
CO1	Understand the industrial safety.						
CO2	Analyze fundamentals of maintenance engineering.						
CO3	Understand the wear and corrosion and fault tracing.						
CO4	Understanding when to do periodic inceptions and apply the preventing maintenance.						

Unit-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-II

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion, Types of corrosion, Corrosion prevention methods.

Unit-III

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-IV

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

RECOMMENDED BOOKS:

1. Higgins & Morrow, "Maintenance Engineering Handbook", Da Information Services.
2. H. P. Garg, "Maintenance Engineering", S. Chand and Company.
3. Audels, "Pump-hydraulic Compressors", Mcgraw Hill Publication.
4. Winterkorn, Hans, "Foundation Engineering Handbook", Chapman & Hall London.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).
All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: CAD/CAM

MTOE-205A	OPERATIONS RESEARCH						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to aware students about the dynamic programming to solve problems of discrete and continuous variables and model the real world problem and simulate it.						
Course Outcomes							
CO1	Students should be able to apply the dynamic programming to solve problems of discreet and continuous variables.						
CO2	Students should be able to apply the concept of non-linear programming						
CO3	Students should be able to carry out sensitivity analysis						
CO4	Student should be able to model the real world problem and simulate it.						

Unit-I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit-II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit-III

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit-IV

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

RECOMMENDED BOOKS:

1. H.A. Taha, "Operations Research, An Introduction", PHI, 2008
2. H.M. Wagner, "Principles of Operations Research", PHI, Delhi, 1982.
3. J.C. Pant, "Introduction to Optimisation: Operations Research", Jain Brothers, Delhi, 2008
4. Hitler Libermann, "Operations Research", McGraw Hill Pub. 2009
5. Pannerselvam, "Operations Research", Prentice Hall of India 2010
6. Harvey M Wagner, "Principles of Operations Research", Prentice Hall of India 2010

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: CAD/CAM

MTOE-207A	COST MANAGEMENT OF ENGINEERING PROJECTS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the students with the knowledge of cost management for the engineering project and apply cost models to the real world projects.						
Course Outcomes							
CO1	Students should be able to learn the strategic cost management process.						
CO2	Students should be able to understand types of project and project team types						
CO3	Students should be able to carry out Cost Behavior and Profit Planning analysis.						
CO4	Student should be able to learn the quantitative techniques for cost management.						

Unit-I

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making, relevant cost, Differential cost, Incremental cost and Opportunity cost, Objectives of a Costing System, Inventory valuation, Creation of a Database for operational control, Provision of data for Decision-Making.

Unit-II

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning, Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents Project team, Role of each member, Importance Project site, Data required with significance, Project contracts, Types and contents, Project execution Project cost control, Bar charts and Network diagram, Project commissioning, mechanical and process.

Unit-III

Cost Behavior and Profit Planning Marginal Costing, Distinction between Marginal Costing and Absorption Costing, Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Standard Costing and Variance Analysis, Pricing strategies, Pareto Analysis, Target costing, Life Cycle Costing, Costing of service sector, Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control, Flexible Budgets, Performance budgets, Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-IV

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

RECOMMENDED BOOKS:

1. Charles Thomas Horngren, "Cost Accounting a Managerial Emphasis", Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, "Advanced Management Accounting"
3. Robert S Kaplan Anthony A. Alkinson, "Management & Cost Accounting"
4. Ashish K. Bhattacharya, "Principles & Practices of Cost Accounting", A. H. Wheeler publisher
5. N.D. Vohra, "Quantitative Techniques in Management", Tata McGraw Hill Book Co. Ltd.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: CAD/CAM

MTOE-209A	COMPOSITE MATERIALS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the students with the knowledge of composites, its materials, analysis, fabrication, and performance analysis.						
Course Outcomes							
CO1	Students should be able to learn the classification and characteristics of composite materials.						
CO2	Students should be able to understand about different fabrication techniques related to metal matrix composites.						
CO3	Students should be able to understand about different fabrication techniques related to polymer matrix composites.						
CO4	Student should be able to do the analyses of the composite materials under different loading conditions.						

UNIT–I

INTRODUCTION: Definition – Classification and characteristics of Composite materials, Advantages and application of composites, Functional requirements of reinforcement and matrix, Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures, Iso-strain and Iso-stress conditions.

UNIT – II

Manufacturing of Metal Matrix Composites: Casting, Solid State diffusion technique, Cladding, Hot iso static pressing, Properties and applications.

Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration, Liquid phase sintering, Manufacturing of Carbon, Carbon composites, Knitting, Braiding, Weaving. Properties and applications.

UNIT–III

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs, hand layup method, Autoclave method, Filament winding method, Compression moulding, Reaction injection moulding, Properties and applications.

UNIT – IV

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

RECOMMENDED BOOKS:

1. R.W.Cahn, “Material Science and Technology” VCH, West Germany.
2. WD Callister, Jr, “Materials Science and Engineering, An introduction”
3. Balasubramaniam, “John Wiley & Sons”, NY, Indian edition, 2007.
4. Lubin, “Hand Book of Composite Materials”
5. K.K.Chawla, “Composite Materials”
6. Deborah D.L. Chung, “Composite Materials Science and Applications”
7. Danial Gay, Suong V. Hoa, and Stephen W. Tasi, “Composite Materials Design and Applications”

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: CAD/CAM

MTOE-211A	WASTE TO ENERGY						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the students with the knowledge of generation of energy from the waste.						
Course Outcomes							
CO1	Students should be able to learn the classification of waste as a fuel and biomass pyrolysis.						
CO2	Students should be able to learn gasification process and different types of gasifiers.						
CO3	Students should be able to learn different combustors for biomass.						
CO4	Student should be able to learn the Biogas plant technology different biomass conversions processes for different applications.						

Unit-I

Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW, Conversion devices, Incinerators, gasifiers, digestors.

Biomass Pyrolysis: Pyrolysis, Types, slow fast, Manufacture of charcoal, Methods, Yields and application, Manufacture of pyrolytic oils and gases, yields and applications.

Unit-II

Biomass Gasification: Gasifiers, Fixed bed system, Downdraft and updraft gasifies, Fluidized bed gasifiers, Design, construction and operation, Gasifier burner arrangement for thermal heating, Gasifier engine arrangement and electrical power, Equilibrium and kinetic consideration in gasifier operation.

Unit-III

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-IV

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

RECOMMENDED BOOKS:

1. Desai, Ashok V, "Non-Conventional Energy", Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. and Mahdi, S. S., "Biogas Technology - A Practical Hand Book - Vol. I & II", Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Challal, D. S, "Food, Feed and Fuel from Biomass", IBH Publishing Co. Pvt. Ltd., 1991.
4. C. Y. WereKo-Brobby and E. B. Hagan, "Biomass Conversion and Technology", John Wiley & Sons, 1996.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: CAD/CAM

MTCM-201	DISSERTATION PHASE – I							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical Marks	Total	Time (Hrs.)
0	0	20	10	-	100	-	100	-
Objective	The main objective of this course is to plan a research work (which includes the problem formulation/literature review, proposed objectives, proposed methodologies and references) in the field of Industrial and Production Design and Engineering issues or interrelated fields of applications.							
Course Outcomes								
CO 1	Students will be exposed to various self-learning topics.							
CO 2	Students will be exposed to an exhaustive survey of the literature such as books, national/international refereed journals, resource persons and industrial surveys for the selection/ identification of engineering/research problem.							
CO 3	Students will be able to set the research objectives of the identified engineering/research problem.							
CO 4	Students will learn modern tools/techniques related to the identified engineering/research problem for the solution and able to learn technical report writing skills.							
CO 5	Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.							

The students will start their research work in third semester with a research problem having research potential involving scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.

The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his/her supervisor and the topic of dissertation must be mutually decided by the supervisor and student.

The students will be required to submit a progress report related to their dissertation work by the end of September. The progress report will cover the following:

- The goal set for the period.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.

The progress report must be at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The students will be required to appear for comprehensive Seminar & Viva-voce and submit a synopsis report based on their progress related to the dissertation as per the presentation date mentioned in the academic calendar for the session. The synopsis report will be submitted in the same format as that of the thesis and will contain the following:

1. Introduction
2. Literature Survey
3. Gaps in Literature
4. Objectives of the Proposed Work
5. Methodology
6. References

*** Student will choose his/her guide in the end of second semester.**

w.e.f. 2018-19

Fourth Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (4th semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: CAD/CAM

MTCM-202	DISSERTATION PHASE -II							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**32**	**16**	**-**	**100**	**200**	**300**	**-**
Objective	The main objective of the course is to make the students able to do some good research in the field of their interests related to Industrial and Production Design and Engineering issues or interrelated fields of applications.							
Course Outcomes								
CO 1	Students will be able to design solutions for engineering problems that meet the specified needs with appropriate considerations.							
CO 2	Students will be able to conduct investigations of engineering problems using research-based knowledge and experimental/research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.							
CO 3	Students will be able to apply resources and modern engineering tools and techniques with an understanding of the limitations.							
CO 4	Students will be able to either work in a research environment or in an industrial environment.							
CO 5	Students will be conversant with technical report writing, professional ethics, responsibilities and norms of the engineering practice.							
CO 6	Students will be able to present and convince their topic of study to the engineering community.							

The students are required to continue Analytical/Experimental/Computational/Industrial Problems or Case studies investigations in the field of Industrial and Production Engineering or other related fields which have been finalized in the third semester. They would be working under the supervision of a faculty member.

The students will be required to submit a progress report duly signed by their respective supervisors to the department, related to their dissertation work in the last week of March. The progress report will cover the following:

- The goal set for the period.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.
- References

The progress report must be of at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The candidate has to prepare a detailed dissertation report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up/numerical details/industrial case study etc. as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study.

The final dissertation will be submitted in the end of semester as per academic calendar for the session, which will be evaluated by internal as well as external examiners based upon his/her research work. At least one publication is expected before final submission of the dissertation from every student in peer reviewed referred journals or reputed conference from the work done by them in their dissertation. The dissertation should be presented in standard format as provided by the department.

The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a supervisor, co-supervisor etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his supervisor.

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SPECIALIZATION: MANUFACTURING SYSTEMS
SEMESTER-1

S. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTMS-101	Tribology	3	0	0	3	3	60	40	-	100	3
2	MTMS-103	Advanced Manufacturing Technology	3	0	0	3	3	60	40	-	100	3
3		*Programme Elective-I	3	0	0	3	3	60	40	-	100	3
4		**Programme Elective-II	3	0	0	3	3	60	40	-	100	3
5	MTRM-111A	Research Methodology and IPR	2	0	0	2	2	60	40	-	100	3
6	MTMS-105	Tribology Lab	0	0	4	4	2	-	40	60	100	3
7	MTMS-107	Advanced Manufacturing Lab	0	0	4	4	2	-	40	60	100	3
8		***Audit Course-I	2	0	0	2	-	-	100	-	100	3
Total						**24**	**18**	**300**	**280**	**120**	**700**	

*PROGRAMME ELECTIVE- I for (MTMS) 1st Semester		
1.	MTIP-105A	Tool Engineering
2.	MTIP-107A	Advanced Engineering Materials
3.	MTIP-109A	Non-Conventional Machining

**PROGRAMME ELECTIVE- II for (MTMS) 1st Semester		
1.	MTIP-111A	Product Design and Development
2.	MTIP-113A	Simulation of Industrial Systems
3.	MTIP-115A	Supply Chain Management

***AUDIT COURSE – I for 1st Semester (MTMS)		
1.	MTAD-101A	English for Research Paper Writing
2.	MTAD-103A	Disaster Management
3.	MTAD-105A	Sanskrit for Technical Knowledge
4.	MTAD-107A	Value Education

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2.*** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

3. The programme Elective I & II and Audit Course-I are common with M.TECH. (I&P).The course starts with MTIP code is common with M.TECH. (I&P).

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SPECIALIZATION: MANUFACTURING SYSTEMS
SEMESTER-II

S. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTIP-102A	Mechatronics	3	0	0	3	3	60	40	-	100	3
2	MTMS-102	Optimization Techniques	3	0	0	3	3	60	40	-	100	3
3		*Programme Elective-III	3	0	0	3	3	60	40	-	100	3
4		**Programme Elective-IV	3	0	0	3	3	60	40	-	100	3
5	MTIP-118A	Mechatronics Lab	0	0	4	4	2	-	40	60	100	3
6	MTMS- 104	Optimization Techniques Lab	0	0	4	4	2	-	40	60	100	3
7	MTMS-106	Mini Project	0	0	4	4	2	-		100	100	3
8		***Audit Course-II	2	0	0	2	-	-	100	-	100	3
Total						**26**	**18**	**240**	**240**	**220**	**700**	

*PROGRAMME ELECTIVE-III for (MTMS) 2nd Semester		
1.	MTIP-106A	Advanced Welding Processes
2.	MTIP-108A	Advanced Metal Cutting
3.	MTIP-110A	Metrology

**PROGRAMME ELECTIVE-IV for (MTMS) 2nd Semester		
1.	MTIP-112A	Sequencing and Scheduling
2.	MTIP-114A	Quality Engineering and Management
3.	MTIP-116A	Reliability Engineering

***AUDIT COURSE–II for (MTMS)2nd Semester		
1.	MTAD-102A	Constitution of India
2.	MTAD-104A	Pedagogy Studies
3.	MTAD-106A	Stress Management by Yoga
4.	MTAD-108A	Personality Development through Life Enlightenment Skills

Note: 1. ***Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

2. The programme Elective III& IV and Audit Course-II are common with M.TECH. (I&P).The course starts with MTIP code is common with M.TECH. (I&P).

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SPECIALIZATION: MANUFACTURING SYSTEMS
SEMESTER-III

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1		*Programme Elective-V	3	0	0	3	3	60	40	-	100	3
2		**Open Elective	3	0	0	3	3	60	40	-	100	3
3	MTMS-201	Dissertation Phase-I	0	0	20	20	10	-	100	-	100	--
Total						**26**	**16**	**120**	**180**		**300**	

*PROGRAMME ELECTIVE-V for (MTMS) 3rd Semester		
1.	MTIP-201A	Enterprise Resource Planning
2.	MTIP-203A	Design of Experiments
3.	MTIP-205A	Strategic Entrepreneurship

**OPEN ELECTIVE for (MTMS) 3rd Semester		
1.	MTOE-201A	Business Analytics
2.	MTOE-203A	Industrial Safety
3.	MTOE-205A	Operations Research
4.	MTOE-207A	Cost Management of Engineering Projects
5.	MTOE-209A	Composite Materials
6.	MTOE-211A	Waste to Energy

Note: 1. The programme Elective-V and Open Elective are common with M.TECH. (I&P).

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SPECIALIZATION: MANUFACTURING SYSTEMS

SEMESTER-IV

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTMS-202	Dissertation Phase-II	0	0	32	32	16	-	100	200	300	--
Total						**32**	**16**		**100**	**200**	**300**	

Total credits = 68

INSTRUCTIONS FOR PAPER SETTER

1. The question paper is to be attempted in **THREE Hours**.
2. Maximum Marks for the paper are **60.**
3. The syllabus for the course is divided into **FOUR units.**
4. The paper will have a total of **NINE questions.**
5. **Question No. 1,** which is compulsory, shall be OBJECTIVE Type **and have content from the entire syllabus (all Four Units).**

   Q. No. 2 & 3 from Unit I

   Q. No. 4 & 5 from Unit II

   Q. No. 6 & 7 from Unit III

   Q. No. 8 & 9 from Unit IV

6. All questions will have equal **weightage of 12 marks.**
7. The candidate will attempt a total of **FIVE questions**, each of 12 marks. Q. No. 1 is compulsory. The candidate shall attempt remaining **four** questions by selecting **only one question from each unit.**
8. A question may have any number of sections labeled as 1(a), 1(b), 1(c), 1(d), ---- 2(a), 2(b), --.A section may further have any number of subsections labeled as (i), (ii), (iii),.
9. **SPECIAL INSRUCTIONS FOR Q. No. 1 ONLY**

   Question No. 1, which is compulsory, shall be OBJECTIVE/ short answer type **and have content from the entire syllabus (all Four Units).**

   Emphasis is to be given on the basic concepts, analytical reasoning and understanding of the various topics in the subject. This question may have a number of parts and/or subparts. The short questions could be combination of following types:

   i. Multiple Choice
   ii. Yes/ No choice
   iii. Fill in Blanks type
   iv. Short numerical computations
   v. Short Definitions
   vi. Matching of Tables

The above mentioned question types is **only a Guideline**. Examiner could set the question as per the nature of the subject.

w.e.f. 2018-19

First Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTMS–101	TRIBOLOGY						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To develop a solution oriented approach by in depth knowledge of Tribology and address the underlying concepts, methods and application of Tribology.						
Course Outcomes							
CO1	Students will be able to understand to fundamentals of Tribology, friction mechanisms in contacts between different materials.						
CO2	Students will be able to understand wear mechanisms and lubrication fundamentals.						
CO3	Students will be able to design different types of bearing.						
CO4	Students will be able to study rolling friction, Reynolds slip and Heathe cote concepts for selection of rolling bearing.						

Unit-I

Friction: Friction, Wear and Lubrication, Types of Engineering Contacts: conforming and non-conforming. Types of motion; rubbing, sliding, oscillating, rolling and Surface of interactions: elastic and plastic deformations, properties of materials, surface energy and flash temperature theory, Law of solid friction, concept of adhesion, Taylor's model of friction elastic thermo friction, rolling friction, measurement of friction.

Unit-II

Wear and Lubrication: Laws of wear, Types of wear such as adhesive, declamination, abrasive, fatigue, corrosive, fretting, erosive, electrical and oxidative. Measurement of wear in dry atmosphere and different environments. Prevention and control of wear and friction in machines, wear of cutting tool and dies, study of abrasion in grinding, lapping and honing,

Mechanisms of lubrication, Boundary, squeeze film hydrodynamic and elasto hydro-dynamic and hydro static lubrications plasto hydrodynamic lubrication, solution of Reynolds's equation in two and three dimensional flow. Pressure distribution load carrying capacity friction forces in oil film and Co-efficient of friction in journal bearing. Sold lubricants types and applications.

Unit-III

Bearing Design: Design of bearing: clearance in journal bearing, minimum film thickness, sommar-field Number, Oil grooves and flow of oil in axial and circumferential grooves cavitations and turbulence in oil bearings. Heat generation and cooling or bearing Hydrostatic and dynamic and their applications in machine tools. Design of air bearing and other gas bearing.

Unit-IV

Rolling Friction: Reynold's slip, Heathe cote concept selection of roller bearing and their methods of lubrication design aspects and modes of bearing failures and elasto hydro dynamic lubrication.

RECOMMENDED BOOKS:

1. Friction & Wear by **Robinoqiz**.
2. Basic Lubrication theory, **Cameron**
3. Industrial Tribology, Tribology failure and their analysis by **Dr. B.S. Prabhu**.
4. Main Engg. Handbook, A M/C Design, McGrawHill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTMS–103	ADVANCED MANUFACTURING TECHNOLOGY						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of this course is to impart knowledge about various machining and forming processes.						
Course Outcomes							
CO1	To impart knowledge about various functional requirements of metal machining, tool life, cutting angles of tools.						
CO2	To impart knowledge about various requirements of casting, cooling and solidification and inspection of casting.						
CO3	To impart knowledge to students about principles of fusion welding, various processes of welding.						
CO4	To let student understand some metal forming process and selection of stress and strain curves for hot and cold working.						

Unit-I

Metal Machining: Tool geometry; Different systems of representation; Mechanics of metal cutting—chip formation, types of chips, cutting ratio, shear angle, shear strain; Orthogonal cutting; Heat generation and cutting tool temperature; Tool wear, geometry of tool wear, wear measurement; Analysis of shaping & turning; Tool life and machinability; Cutting fluids; Surface finish in machining.

Unit-II

Casting Processes: Melting of metals—furnaces, gases in metals; Gating design—aspiration effect, friction effect and velocity distribution; Cooling & solidification—mechanism of solidification, rate of solidification; Riser design and placement; Continuous casting; Investment casting; Centrifugal casting; Die casting; CO_2 casting; Inspection of castings.

Unit-III

Welding: Principles of solid phase welding; Principles of fusion welding—Modes of metal transfer in arc welding, Gas metal reaction, Cooling of fusion weld; Advanced welding techniques—Thermit welding, Ultrasonic welding, Electron beam welding, Laser beam welding, Explosive welding; Welding defects and inspection; Soldering; Brazing; Adhesive bonding

Unit-IV

Metal Forming: True stress, true strain; True stress-strain curves; Selection of stress strain curves for hot working and cold working; Tresca and Von Mises yield criteria; Temperature in metal working; Analysis of metal forming processes—Forging, Rolling, Wire and Tube drawing; Extrusion; Numerical problems relating to analysis of metal forming; Defects in forming processes.

RECOMMENDED BOOKS:

1. Manufacturing Science; Ghosh A., Mallik A.K., East West Press New Delhi, 2002
2. Production technology; Gangopadhyay A.K., Ramananda B.S., Ranganathan M.V., HMT Bangalore, Tata McGraw-Hili Publishing Co. Ltd., New Delhi, 1991
3. Manufacturing Science, Rao P.N., Tata McGraw-Hili Publishing Co. Ltd., New Delhi,
4. A Text Book of Production Engineering, Sharma P.C., S. Chand & Co., New Delhi, 2005
5. Fundamentals of Metal Casting, Flin, Addison Wesley
6. Principles of Metal Cutting, Shaw, Oxford IBH

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-I

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTIP–105A	TOOL ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to impart the students with the knowledge of various aspects of design of different types of Tools and fixtures used in Industries.						
Course Outcomes							
CO1	To impart knowledge of materials for cutting tool and design of cutting tools.						
CO2	To acquaint students with various kinds of Gages and Work holding devices.						
CO3	To impart knowledge to students about Drill jigs and Fixtures.						
CO4	To let student understand the tool design process for NC Machine tools						

UNIT-I

Cutting Tool Materials: Introduction and desirable properties, Carbon and Medium-Alloy Steels, High-Speed Steels, Cast-Cobalt Alloys, Carbides, Coated Tools, Alumina-Based Ceramics, Cubic Boron Nitride, Silicon-Nitride Based Ceramics, Diamond, Reinforced Tool Materials, Cutting-Tool Reconditioning.

Design of Cutting Tools Basic Requirements, Mechanics and Geometry of Chip Formation, General Considerations for Metal Cutting, Design of single point Cutting Tools, Design of Milling Cutters, Design of Drills and Drilling, Design of Reamers, Design of Taps, Chip Breakers.

UNIT-II

Gages and Gage Design: Limits fits and tolerances, Geometrical tolerances-specification and measurement, Types of gages, Gage design, gage tolerances, Material for Gages.

Work Holding Devices: Basic requirements of work holding devices, Location: Principles, methods and devices, Clamping: Principles, methods and devices.

UNIT-III

Drill Jigs: Definition and types of Drill Jigs, Chip Formation in Drilling, General Considerations in the Design of Drill Jigs, Drill Bushings, Drill Jigs, and Modern Manufacturing

Design of Fixtures: Fixtures and Economics , Types of Fixtures , Milling Fixtures , Boring Fixtures, Broaching Fixtures, Lathe Fixtures, Grinding

UNIT-IV

Tool Design for Numerically Controlled Machine Tools: Fixture Design for Numerically Controlled Machine Tools, Cutting Tools for Numerical Control, Tool-holding Methods for Numerical Control.

RECOMMENDED BOOKS:

1. ASTME, “Fundamentals of Tool Design”, Prentice Hall of India, 1983.
2. Donaldson, “Tool Design”, Tata-McGraw Hill, 3rd Edition, 2000.
3. Joshi P.H., “Jigs and Fixtures”, Tata-McGraw Hill, 2010.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTIP–107A	ADVANCED ENGINEERING MATERIALS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 hrs
Objective	The objective of the course is to impart the students with the knowledge of various advanced and smart materials.						
Course Outcomes							
CO1	To impart knowledge of Piezoelectric and shape memory alloys.						
CO2	To acquaint students with deep know how about Electro-rheological and composite materials						
CO3	To impart knowledge to students about MEMS systems and High temperature application materials.						
CO4	To let student understand the processing and characteristics of powder metallurgy processes and structural materials.						

UNIT-I

Introduction to advanced Engineering materials: Classes of Materials and their usage, Historical Perspective, Intelligent Materials, Structural Materials, Functional Materials, Primitive Functions of Intelligent Materials, Intelligence inherent in Materials, Materials Intelligently Harmonizing with humanity, Biomimetic.

Smart Materials and Structural Systems: Introduction, Actuator Materials, Sensing Technologies, Micro-sensors, Intelligent systems, Hybrid Smart Materials, Passive Sensory Smart Structures, Reactive Actuator based smart structures, Active Sensing and Reactive smart structures, smart skins, Aero-elastic tailoring of airfoils, Synthesis of future smart systems.

UNIT-II

Electrocaloric Effect: An Introduction, History of Electrocaloric Cooling,Mechanism of working ofElectrocaloric Cooling, Electrocaloric Materials, Performance of Electrocaloric Materials.

Heat Resistant Steels: Conventional Heat-Resistant Steels, Silicon-Bearing High Chromium Heat-Resistant Steels,Nitride-Strengthened Reduced Activation Heat-Resistant Steels, China Low Activation Martensitic SteelNitride-Strengthened Steels,Microstructural Stability

UNIT-III

Smart Micro-systems: Silicon Capacitive Accelerometer, Piezo-resistive Pressure sensor, Conductometric Gas sensor, An Electrostatic Comb-drive, Magnetic Microrelay, Portable Blood Analyser, Piezoelectric Inkjet Print Head.

Buckyballs to robotics: Bucky ball, Nano Structure of Fullerene, Carbon Nanotubes, Nano Diamond, Boron nitride nanotubes, Single electron transistors, Molecular machine, Nano Biometrics, Nano Robots,

UNIT-IV

Nano-Alloys: Introduction, Chemical Synthesis: General Concepts, Reduction of Metallic Salts, The Organometallic Route: Thermal Decomposition Method, Other Chemical Methods for synthesis of Nano-alloys, Physical Routes for synthesis of Nano-Alloys; Experimental Techniques and Examples.

Shape memory alloys (SMA): Shape memory effect and the metallurgical phenomenon of SMA, Types of SMA, One way and Two way Shape memory effect. Temperature assisted shape memory effect, Applications.

RECOMMENDED BOOKS:

1. Gandhi, M.V. and Thompson, B.S., Smart materials and Structures, Chapman & Hall,1992.
2. Ananthasuresh G.K., Vinoy K.J., Micro and Smart Systems, Wiley India.
3. Wei Yan, Wei Wang, 9-12 Cr Heat Resistant Steels, Engineering Material series, Springer International.
4. Damien Alloyeau, Christine Mottet, Nanoalloys Synthesis, Structure and Properties, Springer International.
5. Tatiana Correia, Qi Zhang, Electrocaloric Materials: New Generation of Coolers
6. Otsuka, K. and Wayman, C. M., Shape memory materials, C.U.P,1998
7. Taylor, W., Pizoelectricity, George Gorden and Breach Sc. Pub.,1985
8. Mallick, P.K., Fiber Reinforced Composites Materials, Manufacturing andDesign. Marcel Dekker Inc, New York,1993.
9. Rama Rao, P. (ed.), Advances in Materials and their applications, Wiley EasternLtd.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTIP–109A	NON-CONVENTIONAL MACHINING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To acquaint the students with the advanced technologies and processes in various streams of Non-conventional machining.						
Course Outcomes							
CO1	To impart knowledge of Various Non-conventional Mechanical Working Processes, technology, process parameters and analysis for metal removal for these processes.						
CO2	To acquaint students with deep knowhow about chemical and electrochemical machining processes,						
CO3	To impart knowledge to students about various kinds of Electric discharge machining processes, process parameters associated with these processes and various process characteristics.						
CO4	To let student understand the working and technology associated with Laser Beam machining and Electron beam machining processes.						

UNIT-I

Introduction, Need of Non-conventional machining processes, Characteristics of conventional and Non-conventional Machining processes. **Mechanical Working Processes**: **Abrasive Jet Machining:** Machining setup, Abrasives, Process Parameters, Machining Characteristics, Material removal models in AJM, Process capability, Advantages, limitations, Applications

Water Jet Machining: Basic mechanism of Water jet machining setup, Process parameters, Catcher, Process capabilities, Advantages, limitations, Applications **Abrasive Water Jet Machining process:** Working Principle, AWJM Machine, Process Variables, Mechanism of Metal Removal, Cutting Parameters, Process capabilities, Applications, Environmental issues.

Ultrasonic Machining: Fundamental principles, Equipment, Magnetostriction, Elements of process, Mechanics of cutting, Analysis of Process Parameters, Process capabilities, Economic considerations. Applications, Limitations

UNIT-II

Chemical Machining: Introduction, Fundamental Principles, Process Parameters; Maskants and Etchants, Advantages, Limitations, Applications.

Electrochemical Machining Processes: Introduction, Classification of ECM Processes, Fundamentals Principles of ECM, Elements of ECM, ECM Machine Tool Process, Determination of Metal Removal Rate, Evaluation of Metal Removal of an alloy, Electrochemistry of ECM, Cathode and Anode reaction, Dynamics of ECM, Self-Regulating feature of ECM, Process Parameters, Process capabilities, Electrochemical Deburring. **Electrochemical Grinding:** Schematics, Electrochemistry, Process Parameters, Process capabilities, Applications, Advantages, Limitations.

UNIT-III

EDM: Introduction, Basic Principles & Schematics, Process Parameters, Characteristics of EDM, Dielectric, Electrode Material, Modelling of Material Removal, Spark Erosion Generators, Analysis and Metal Removal Rate in RC circuit, Selection of Tool Material and Tool Design, Di-Electric system, Process Variables, Dielectric Pollution and its effects, Process Characteristics, Applications, Electric Discharge Grinding and Electric Discharge Diamond Grinding; **Wire EDM**: Working Principle, Wire EDM Machine, Advances in Wire-cut EDM Process Variables, Process Characteristics, Applications.

UNIT-IV

Laser Beam Machining Back Ground, Production of Laser, Working Principle of LBM, Types of LASERS, Process Characteristics, Metallurgical effects, Advantages and Limitations, Applications.

Electron Beam Machining:

Electron Beam Action, Generation and control of Electron beam, Theory of Electron Beam Machining, Process Parameters, Process capabilities, Applications.

High Energy Rate Forming, Elctro-Hydraulic Forming, Explosive Forming, Hot Machining Analysis of the Process.

RECOMMENDED BOOKS:

1 V.K. Jain, Advanced Machining Processes, Allied Publishers Pvt Ltd
2 P.C. Pandey and H.S. Shan,Modern Machining Processes, Tata McGraw- Hill
3 M. K. Singh, Unconventional Manufacturing Process, New Age Publishers
4 J. A. Mcgeough, Advanced Methods of Machining,Springer.
5 Benedict, Non-Traditional Manufacturing Process, CRC pub.
6 P. K. Mishra, Nonconventional manufacturing, Narosa Publishers

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).
All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-II

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTIP-111A	PRODUCT DESIGN AND DEVELOPMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to understand about the product design and developments with inputs from aesthetics, ergonomics, design for manufacturing ease and cost effectiveness apart from reliability and durability and other considerations.						
Course Outcomes							
CO1	To understand the concept of product design, design considerations, design practiced by the industry, production and marketing, and aesthetics.						
CO2	To provide a detailed fundamental approach to several primary processes and design guidelines for manufacturing, assembly and environment.						
CO3	To discuss the human factor engineering and the concept of value engineering.						
CO4	To study the modern approaches to product design, concept of product development and its manufacturing and economic aspects.						

UNIT-I

INTRODUCTION: Introduction to product design, Design by evolution and innovation, Essential factors of product design, Production consumption cycle, Flow and value addition in production consumption cycle, Morphology of design.

PRODUCT DESIGN PRACTICE AND INDUSTRY: Product strategies, Time to market, Analysis of the product, Basic design considerations, Role of aesthetics in product design.

UNIT-II

DESIGN FOR MANUFACTURE AND ASSEMBLY: Overview and motivation, Basic method: Design guidelines: Design for assembly, Design for piece part production, Advanced method: Manufacturing cost analysis, cost driver modeling, Critique for design for assembly method.

DESIGN FOR THE ENVIRONMENT: Environmental objectives, Basic DFE methods, Design guidelines, Life cycle assessment, Techniques to reduce environmental impact.

UNIT-III

HUMAN ENGINEERING CONSIDERATIONS IN PRODUCT DESIGN: Human being as applicator of forces, Anthropometry, the design of controls, the design of displays, Man/Machine information exchange, Workplace layout from ergonomic considerations.

VALUE ENGINEERING: Value, Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, value analysis job plan, creativity, steps to problem solving and value analysis, value analysis tests, value engineering idea generation check list, Cost reduction through value engineering-case study, materials and process selection in value engineering.

UNIT-IV

MODERN APPROACHES TO PRODUCT DESIGN: Concurrent design, Quality function deployment (QFD), Rapid prototyping, 3D printing, Introduction to 4D printing.

PRODUCT DEVELOPMENT: A modern product development process, reverse engineering and redesign product development process, product life cycle, product development teams, Product development planning, Manufacturing & economic aspects of product development.

RECOMMENDED BOOKS:

1. Kail T Ulrich and Steven D Eppinger, "Product Design and Development, TMH.
2. AK Chitale and Gupta, "Product Design and Engineering, PHI.
3. Niebel & Draper, "Product Design and Process Engineering", McGraw-Hill.
4. Kevin Otto & Kristin Wood, "Product Design-Techniques in reverse engineering and new product development" Pearson.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1stSem.)
(MANUFACTURING SYTEMS)

MTIP-113A	SIMULATION OF INDUSTRIAL SYSTEMS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of industrial systems and its simulation.						
Course Outcomes							
CO1	To explain the concept of industrial simulation systems and its models of simulation.						
CO2	To understand the simulation of discrete and queueing systems.						
CO3	To understand the simulation if inventory systems and design of simulation experiments.						
CO4	To simulate the industrial problems like reliability problems,computertimesharingproblem and understand the simulation languages.						

UNIT-I

Introduction and overview: concept of system, system environment, elements of system, system modeling, types of models, Monte Carlo method, system simulation, simulation - a management laboratory, advantages & limitations of system simulation, continuous and discrete systems.

Simulation of continuous systems: characteristics of a continuous system, comparison of numerical integration with continuous simulation system. Simulation of an integration formula.

UNIT-II

Simulation of discrete system: Time flow mechanisms, Discrete and continuous probability density functions. Generation of random numbers, testing of random numbers for randomness and for auto correlation, generation of random variates for discrete distribution, generation of random variates for continuous probability distributions-binomial, normal, exponential and beta distributions; combination of discrete event and continuous models.

Simulation of queuing systems: Concept of queuing theory, characteristic of queues, stationary and time dependent queues, queue discipline, time series analysis, measure of system performance.

Kendall's notation, auto covariance and auto correlation function, auto correlation effects in queuing systems, simulation of single server queues, multi-server queues, queues involving complex arrivals and service times with blanking and reneging.

UNIT-III

Simulation of inventory systems: Rudiments of inventory theory, MRP, in-process inventory. Necessity of simulation in inventory problems, forecasting and regression analysis, forecasting through simulation, generation of Poisson and Erlang variates, simulation of complex inventory situations.

Design of Simulation experiments: Length of run, elimination of initial bias, Variance, Variance reduction techniques, stratified sampling, antipathetic sampling, common random numbers, time series analysis, spectral analysis, model validation, optimization procedures, search methods, single variable deterministic case search, single variable non-deterministic case search, and regenerative technique.

UNIT-IV

Simulation of PERT: Simulation of - maintenance and replacement problems, capacity planning, production systems, reliability problems, computer time sharing problem, the elevator system.

Simulation Languages: Continuous and discrete simulation languages, block structured continuous languages, special purpose simulation languages, SIMSCRIPT, GPSS SIMULA importance and limitations of special purpose languages.

RECOMMENDED BOOKS:

1. Loffick, Simulation and Modelling - Tata McGraw Hill
2. Deo Narsingh, System Simulation with Digital Computer - Prentice Hall
3. Hira, D.S., System Simulation-S. Chand & Co.
4. Meelamkavil, Computer Simulation and Modelling - John Willey
5. Gorden, System Simulation - Prentice hall
6. Jerry Banks and John, S. Carson II, 'Discrete – Event System Simulation', Prentice Hall Inc., NewJersey, 1984.

7. Geoffrey Gordon, 'System simulation', Prentice Hall, NJ, 1978.
8. Law, A.M. and W.D. Keltor, 'Simulation modelling analysis', McGraw Hill, 1982.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTIP–115A	SUPPLY CHAIN MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of Supply chain and different aspects of supply chain management.						
Course Outcomes							
CO1	To impart knowledge about basics of Supply chain management and Supply chain						
CO2	To acquaint students with the different aspects involved in sourcing and procurement in supply chain management.						
CO3	To impart knowledge to students about Evaluating performance of Supply chain and decision making about Transportation, Storage and warehousing.						
CO4	To let student understand Quantitative tools for SCM, Information Technology in a Supply Chain:						

UNIT-I

Overview of supply chain management: Introduction, Definition, The Objective of a Supply Chain, The Importance of Supply Chain Decisions, Decision Phases in a Supply Chain, Process Views of a Supply Chain, Examples of Supply Chains.

Supply chain dynamics: Introduction, Coping with Dynamics in Supply chain. Bullwhip effect, Analysis of Bullwhip Effect, Impact of Lead time, Inventory management and Supply chain dynamics, offshoring and outsourcing Effect on SC dynamics and cost.

UNIT-II

Outsourcing and Make or Buy Decisions: Strategic Decisions and Core competencies, Tactical Decisions, Factors influencing make or buy decisions, Control of Production or Quality, Unreliable Suppliers, Suppliers Specialized knowledge and research, Small Volume Requirements, Limited Facilities, Workforce Stability, Multiple Sourcing Policy, Managerial and Procurement considerations, the Volatile nature of Make/Buy situation, Administration: Procedures and Personal.

Sourcing of Supply: Importance of Source Selection, Responsibilities for Source Selection, Evaluating a potential supplier, The criticality of Qualifying Sources, Competitive Bidding and Negotiation, Prerequisite for competitive bidding, Two step Bidding/Negotiation, Benefits and Risks of International Sourcing, Identifying and Qualifying an International Source.

UNIT-III

Supply Chain Performance: Achieving Strategic fit And Scope: Competitive and Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope**,** Challenges to Achieving and Maintaining, Strategic Fit, Supply chain drivers and metrics, Financial Measures of Performance, Drivers of Supply Chain Performance, Framework for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing.

Transportation, storage and warehousing: Introduction, Transportation mode choice, Transport operator decisions, Trucking sectors in India, Rail transport, Air Transport, Water transport, Transport network, Storage and warehousing, types of warehousing, risk pooling, IT Integration: Supply chain information system, Role of IT in SCM process, Business process Re-engineering, Internet and its applications in SCM.

UNIT-IV

Quantitative tools for SCM: Introduction, Forecasting, Demand forecast, Forecasting strategy & technique, Management of Inventories in SC, Linear programming, Routing models, pricing decisions, Introduction to MCDM approach.

Information Technology in a Supply Chain: The Role of IT in a Supply Chain, The Supply Chain IT Framework Customer Relationship Management, Internal Supply Chain Management, Supplier Relationship Management, The Transaction Management Foundation, The Future of IT in the Supply Chain, Risk Management in IT, Supply Chain IT in practice.

RECOMMENDED BOOKS:

1Chopra, S., and Meindl, P., Supply chain Management: Strategy, Planning and Operations. Second Edition, Pearson Education (Singapore) Pte. Ltd, 2004.

2Rangaraj, Supply Chain Management for Competitive Advantage, TMH.

3. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw-Hill Edition, 2003.
4. Doebler, D.W. and Burt, D.N., Purchasing and Supply Chain Management: Text and Cases, McGraw-Hill Publishing Company Limited, New Delhi, 1996.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTRM-111A	RESEARCH METHODOLOGY AND IPR						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	2	60	40	100	3

Objective	The objective of this course is to make the students capable of formulating the research problems/ proposals and get aware about the intellectual property and patent laws.
Course Outcomes	
CO 1	Student will be able to understand research problem formulation.
CO 2	Student will be able to analyze research related information and follow research ethics.
CO 3	Student will be able to understand the Patents, Designs, Trade and Copyright and able to apply the knowledge for patent.
CO 4	Student will be able to understand the concept of Patent Rights, Licensing and transfer of technology and able to apply the knowledge in new developments in IPR.

Unit-I

Meaning of research problem, Sources of research problem, Criteria, characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit-II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit-III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit-IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and Institutions.

RECOMMENDED BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: An introduction for science & engineering students" Kenwyn, South Africa : Juta & Co. Ltd., 1996
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Juta Academic; 2nd edition (April 28, 2004)
3. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners" SAGE Publications Ltd; Fourth edition (14 January 2014)
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers; Revised edition (July 25, 2007)
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks.

Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTMS-105	TRIBOLOGY LAB.							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	To make students understand about the Tribological properties of specimen.							
Course Outcomes								
CO1	To understand the concept of sliding and abrasive wear using wear and friction monitoring apparatus And dry abrasion tester.							
CO2	Students will be able to determine different type of lubricants their grades , test standards and different Properties of lubricants.							
CO3	To measure extreme pressure properties of a lubricant using four ball tester.							
CO4	Students should be able to use different types of tribo test equipments.							

List of Experiments

1. To study the pressure distribution of a journal bearing using journal bearing apparatus.
2. To determine abrasion index of a material with the help of dry abrasion tester.
3. To determine the rate of Wear of metal and plot displacement v/s time curves by friction & wear monitor apparatus.
4. To evaluate the load wear index & weld point with the help of four ball stream pressure tester.
5. Analysis of various properties of Lubricant oil using lubricant oil analyzer.
6. Compare and analyze the wear characteristics of different materials.
7. To study different types of bearings used in industries.
8. To study the effect of axial and circumferential grooves in case of oil bearing.
9. To study the surface characterization of wear components.
10. To determine the erosive wear rate of different materials using Air Jet Erosion Tester under different conditions.

Note: Atleast nine experiments need to be performed by the students from the above mentioned list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTMS-107	ADVANCED MANUFACTURING LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	To make the students understand the different type of machines and manufacturing techniques in production industries.							
Course Outcomes								
CO1	To practice on milling machine and profile projector.							
CO2	To study working of CNC machines.							
CO3	To study moulding sand and various testing on equipments.							
CO4	To know about various grinding wheels and surface grinding machines.							

List of Experiments

1. Introduction to Gear Hobbing Machine and cut the Spur gear on Gear Hobbing Machine
2. Introduction of Horizontal Milling Machine and. to cut the Gear on Milling Machine using Indexing Head
3. To study the working Principal of Profile Projector and Practice on Profile Projector using small jobs.
4. To study the constructional details and working of CNC lathe trainer.
5. To generate a CNC codes program for a given drawing involving turning, facing and step turning and simulate the program and perform the job on CNC lathe.
6. To generate a CNC code program for a given drawing involving taper turning, grooving, threading, drilling etc. and simulate the program and perform the job on CNC lathe.
7. To study the CNC milling machine and generate the CNC codes for the given drawing and simulate the programs.
8. Introduction of Molding sand, Mould test Equipments, Sand and performance of various testing on Equipments.
9. Introduction of various Grinding wheels and Demonstration of Surface Grinding Machine and cylindrical grinder.
10. Introduction of Tool and Cutter Grinding machine.

Note: At Least nine experiments need to be performed by the students from the above mentioned list.

w.e.f. 2018-19

Audit Course-I

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTAD-101A	ENGLISH FOR RESEARCH PAPER WRITING						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to impart the knowledge of English for research paper writing.						
Course Outcomes							
CO1	To understand that how to improve writing skills and level of readability.						
CO2	To Learn about what to write in each section.						
CO3	To understand the skills needed when writing a title.						
CO4	To learn the skills required in writing the results, discussion and conclusions.						

Unit-I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit-II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit-III

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. Key skills needed when writing a Title, key skills needed when writing an abstract, key skills needed when writing an Introduction, skills needed when writing a Review of the Literature.

Unit-IV

Skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions, Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

RECOMMENDED BOOKS:

1. Goldbort R, "Writing for Science", Yale University Press (available on Google Books)
2. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press
3. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM. Highman's book.
4. Adrian Wallwork, "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTAD-103A	DISASTER MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to impart the knowledge of disasters management.						
Course Outcomes							
CO1	To demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.						
CO2	To critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.						
CO3	To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.						
CO4	To critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.						

Unit-I

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit-II

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Unit-III

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

Unit-IV

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

RECOMMENDED BOOKS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies '"New Royal book Company.
2. Sahni, Pardeep (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTAD- 105A	SANSKRIT FOR TECHNICAL KNOWLEDGE						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to understand basic Sanskrit Language and Ancient Sanskrit literature related to science & technology.						
Course Outcomes							
CO1	Students will get a working knowledge in illustrious Sanskrit, the scientific language of the world.						
CO2	Learning of Sanskrit to improve brain functioning.						
CO3	Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.						
CO4	The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.						

Unit-I

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Unit-II

Order, Introduction of roots, Technical information about Sanskrit Literature

Unit-III

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

RECOMMENDED BOOKS:

1. Dr.Vishwas, "Abhyaspustakam" Samskrita-Bharti Publication, New Delhi
2. Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam "Teach Yourself Sanskrit" Prathama Deeksha-, New Delhi Publication
3. Suresh Soni, "India's Glorious Scientific Tradition" Ocean books (P) Ltd., New Delhi.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING SYSTEMS)

MTAD-107A	VALUE EDUCATION						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The objective of this course is to understand value education, self-development, Imbibe good values in students and Let them know about the importance of character building.						
Course Outcomes							
CO1	To get knowledge of self-development.						
CO2	To learn the importance of Human values.						
CO3	To develop the overall personality.						
CO4	To know about the importance of character.						

Unit-I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

Unit-II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

Unit-III

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

Unit-IV

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively

RECOMMENDED BOOKS:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Second Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTIP-102A	MECHATRONICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to acquaint the knowledge of electronic devices and electromechanical systems, hydraulic and pneumatic systems, CNC, Robotics and PLC's.						
Course Outcomes							
CO1	To understand the concepts of Mechatronics, fundamental of electronics and digital circuits and electrical actuating circuits.						
CO2	To acquaint the knowledge of hydraulic system with its practical applications.						
CO3	To acquaint the knowledge of pneumatic system with its practical applications.						
CO4	To study the fundamentals of CNC, Robotics and programmable logic controllers (PLC's) and their use.						

UNIT-I

Introduction: The Mechatronics approach: A methodology for integrated design of Mechanical, Electronics and Electrical Control, Computer and Instrumentation.

Fundamentals of Electronics and digital circuits: Number systems: Binary, Octal, Hexadecimal, Conversion from Binary to Decimal, Octal and Hexadecimal and vice–versa, Binary arithmetic: Addition, subtraction, Multiplication and division, Boolean Algebra: Laws, De-Morgan's laws, Logic Gates, Truth tables, Karnaugh maps and logic circuits. Generation of Boolean function from truth tables and simplification, **Electrical actuating system:** Basic principle of electrical switching, Solenoids, Electrical relays, Representation of output devices, Electrical motors: A.C. motors, Stepper motors, Induction motor speed control.

UNIT-II

HYDRAULIC SYSTEMS:

Direction Control Valves: Poppet Valve, Spool Valve, Sliding Spool type DCV, Check Valve, Pilot operated check valve, Restriction check valve, 2 Way vale, 3 way valve, 4 way valve, Manually actuated valve, Mechanically actuated valve, Pilot operated DCV, Solenoid Actuated valve, Rotary Valve, Centre flow path configurations for three position four way valve, Shuttle valve

Pressure Control Valve: Simple and compound pressure Relief Valve, Pressure Reducing Valve, Unloading valve, sequence valve, counterbalance valve, Brake Valve

Flow Control Valves: Fixed and non-adjustable valve, adjustable, throttling, non-pressure compensated pressure control valve, Pressure/temperature compensated flow control valve, Shuttle and Fast exhaust valve, Time delay valve, Flow Control Valves, Fluid Conditioners, Hydraulic Symbols (ANSI),Hydraulic Circuit design: Control of Single and double acting cylinders, double pump Hydraulic System

UNIT-III

PNEUMATIC SYSTEM:

Air Generation and distribution: Air compressors, Air Receiver, Filters, intercoolers, After-coolers, Relief Valve, Air dryers, Primary and secondary lines, Piping layouts, Air Filters, Air Regulators, Air Lubricator, Actuators and output devices, Direction control valves, Flow control valves, junction elements, Pneumatic circuits, Control of Single and double acting cylinders.

UNIT-IV

INTRODUCTION TO CNC MACHINES AND ROBOTICS:

CNC Machines: NC machines, CNC machines, DNC machines, Machine structure, Slidways, Guideways, Slide Drives, Spindle, Robotics:Components of robots, Classification of robots, Robots application

PROGRAMMABLE LOGIC CONTROLLERS

Introduction - Principles of operation - PLC Architecture and specifications - PLC hardware Components, Analog & digital I/O modules, CPU & memory module - Programming devices - PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram. PLC programming Simple instructions - Manually operated switches - Mechanically operated Proximity switches - Latching relays, Applications of PLC.

RECOMMENDED BOOKS:

1. W. Bolton,Mechatronics, Pearson Education.
2. Majumdar,Pneumatic system, TMH.
3. Andrew Parr, Hydraulic and Pneumatic systems,TMH.
4. M.P. Groover,Automation, Production systems and computer integrated manufacturing, TMH.
5. Shetty and Kolk,Mechatronics system design, Thomson learning.
6. Mahalik,Mechatronics, TMH.
7. Anthony Esposito,Fluid power with application,Pearson Education.
8. K.P Ramachandran, M.S Balasundaram,Mechatronics, Wiley India.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks.* The student will attempt a total of *FIVE questions,* each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining/our questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTMS-102	OPTIMIZATION TECHNIQUES						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The objective of this course is to impart knowledge about programming and optimization**.**						
Course Outcomes							
CO 1	Students should know about the concept of linear programming and its applications.						
CO 2	Students should know about the concept of integers and quadratic programming and its problem solving technique.						
CO 3	Students should know about the concept of Queuing Models and Optimization.						
CO 4	Students should be able to apply concept of PERST/CPM and schedule optimization.						

UNIT-I

Linear Programming: Variables, Constraints and Analysis of Objective Functions, Formulation, Graphical solution, standard and matrix forms of linear programming problems, Simplex method and its flow chart, Two phase Simplex method, Degeneracy, Duality: Definition, General Rule for converting any primar into its Dual, Dual Simplex method and its flow chart.

UNIT-II

Integer and Quadratic Programming: Importance and Applications, Gomorg's all integer programming problem technique, Branch and Bound Method. Limitations and application, Importance and Applications of Quadratic programming, problem solving technique.

UNIT-III

Queuing Models and Optimization States: Introduction, Applications, Characteristic, single and multiple serving stations problems, design of optimum serving stations Waiting and Ideal time costs, Transient and Steady states for Optimization, M/M/1, M/M/C, M/Ek/1 and Deterministic Models.

UNIT-IV

PERT, CPM and Schedule Optimization: Basic steps in PERT and CPM, Forward and Backward computation, Representation in Tabular form, Slack and Critical path, Difference between CPM and PERT, Float, Crashing of activities for optimization, Probabilistic approach to activity duration. Economical order size for resource planning in certainty and uncertainty situations.

RECOMMENDED BOOKS:

1. Operation Research, **P.KGupta., D.SHira.**, Sultan Chand & Sons, New Delhi, 1994.
2. Operation Research, **Kanti Swarup, P.KGupta. & Man Mohan**, Sultan Chand & sons, New Delhi, 1990.
3. Optimization Methods in Operations Research and System Analysis, **K.V Mittal**, New Age International (P) Ltd., New Delhi, 1992.
4. Optimization Theory and Applications, **S.S.Rao**, Wiley Eastern Ltd. New Delhi, 1991.
5. Operations Research, **Sharma, S.D**., Kedar Nath and Ram Nath, Meerut, 1996.
6. Operation Research - An Introduction, H.A.Taha, McMillan Publishing Co, New York, 1986.
7. Operation Research & Networking, **Bazara**,Wiley.
8. Optimization Techniques, **Avieral**,

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-III

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTIP-106A	ADVANCED WELDING PROCESSES						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of Welding metallurgy and welding processes.						
Course Outcomes							
CO1	To impart knowledge about various Weld metallurgy and Weld arc characteristics.						
CO2	To acquaint students with the various welding power sources and their applications.						
CO3	To impart knowledge to students about Electrode coatings and Metal transfer phenomenon in weld metal transfer.						
CO4	To let student understand the basics of Solid state welding processes and some of the latest welding techniques.						

UNIT-I

WELDING METALLURGY: Introduction, Weld Metal Zone, Theory of solidification of metals and alloys, Homogeneous Nucleation, Heterogeneous Nucleation, Freezing of alloys, Epitaxial Solidification; Effect of Welding speed on Grain structure, Fusion boundary zone, Heat affected zone, Under bead zone, Grain Refined Zone, Partial transformed zone, Properties of HAZ

WELDING ARC: Definition of Arc, Structure and characteristics, Arc efficiency, arc blow, Electrical Characteristics of arc, Types of Welding Arcs, mechanism of arc initiation and maintenance, role of electrode polarity on arc behaviour and arc stability, analysis of the arc. Arc length regulation in mechanized welding processes.

UNIT-II

WELDING POWER SOURCES: Requirement of an Arc welding power sources, basic characteristics of power sources for various arc welding processes, duty cycles, Selection of a static Volt-Ampere characteristic for a welding process, AC/DC welding power source, DC rectifiers, thyristor controlled rectifiers, transistorized units, inverter systems, Mathematical Problems on Static volt ampere characteristics

UNIT-III

COATED ELECTRODES: Electrode coatings, classification of coatings of electrodes for SMAW, SAW fluxes, role of flux ingredients and shielding gases, classification of solid and flux code wires.

METAL TRANSFER & MELTING RATE: Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal transfer and melting rate.

UNIT-IV

SOLID STATE WELDING: Theory and mechanism of solid state welding, techniques and scope of friction welding, diffusion welding, cold pressure welding and ultrasonic welding, high energy rate welding, analysis of the Process.

WELDING TECHNIQUES: Technique, scope and application of the electron beam and laser welding processes, under water welding - process & problem.

RECOMMENDED BOOKS:

1. Raymond Sacks, —Welding: Principles & Practicesll McGraw-Hill
2 R.S.Parmar, —Welding processes & Technologyll, Khanna Publishers
3 R.S.Parmar, —Welding Engineering & Technologyll, Khanna Publishers
4 S.V. Nandkarni, —Modern Arc Welding Technology, Oxford & IBH publishing Co.
5 L.M.Gourd, —Principles of Welding Technologyll, ELBS/ Edward Arnold.
6 Richard L. Little —Welding & Welding Technologyll, Mc-Graw Hill.
7 Cary, Howard —Modern Welding Technology', prentice Hall, 1998.
8 Rossi —Welding Technologyll, Mc-Graw Hill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTIP–108A	ADVANCED METAL CUTTING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of advanced cutting tools, tools geometry, mechanisms and analysis.						
Course Outcomes							
CO1	To impart knowledge about various functional related to tools geometry.						
CO2	To acquaint with the analysis of fundamental factors affecting tool forces						
CO3	To impart knowledge about cutting tool life and mathematical modelling for wear.						
CO4	To let student understand abrasive machining and its process simulation.						

UNIT-I

Introduction system of Tool nomenclature, Tool Geometry, Mechanism of Chip formation and forces in orthogonal cutting, Merchant's force diagram.

Oblique Cutting: Normal chip reduction coefficient under oblique cutting, true shear angle, effective rake, influx region consideration for deformation, direction of maximum elongation, effect of cutting variables on chip reduction co-efficient, forces system in oblique cutting, effect of wear land on force system, force system in milling, effect of helix angle.

UNIT-II

Fundamentals of Dynamometry, Theoretical determination of forces, angle relations, heat and temperature during metal cutting; distribution, measurement, analysis, theoretical estimation of work piece temperature, hot machining

Fundamental factors, which effect tool forces: Correlation of standard mechanized test. (Abuladze –relation), nature of contact and stagnant phenomenon, rates of strains, shear strain and normal strain distributions, cutting variables on cutting forces.

UNIT-III

Cutting Tools: Tools materials analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, wear of cutting tools, criterion, flank and crater wear analysis, optimum tool life, tool life equations, (Taylor's woxen etc) Tool life test, machining optimization, predominant types of wear; abrasive, adhesive, diffusion wear models, wear measurements and techniques, Major Test of tool wear oxidative mathematical modelling for wear, test of machinability and influence of metallurgy on machinability. Economics of metal machining

UNIT-IV

Abrasive Machining: Mechanics of grinding, cutting action of grit, maximum grit chip thickness, energy and grit force temperature during grinding, wheel wear, grinding, process simulation, testing of grinding wheels, mechanics of lapping and honing, free body abrasion.

RECOMMENDED BOOKS:

1. Sen & Bhattacharya,Principles of Machine tools, New Central Book Agency.
2. Brown,Machining of Metals, Prentice Hall.
3. Shaw,Principles of Metal cutting, Oxford I.B.H.
4. Arshimov & Alekree,Metal cutting theory & Cutting tool design, MIR Publications.
5. Machining Science & Application by Knowenberg Longman Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTIP-110A	Metrology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs.**
Objective	The main objective of the course is to deal with the basic principles of dimensional measuring instruments and precision measurement techniquesin achieving quality and reliability in the service of any product in dimensional control.						
Course Outcomes							
CO1	To understand the studentsabout the requirement of metrology and the concepts of limit, fits and gauges.						
CO2	To study the linear and angular measurements and the optical measurement tools and techniques.						
CO3	To understand how to use surface roughness and thread measuring instruments.						
CO4	To study the comparators, measurement through comparators and the advanced metrology concepts.						

UNIT-I

Introduction to metrology: Definition, types, need of inspection, terminologies, methods of measurement, selection of instruments, measurement errors, units, Measurement standards, calibration, statistical concepts in metrology.

Systems of Limits and Fits: Introduction, nominal size, tolerance limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard Institution system – British standard system, International standard system for plain and screwed work.

Limit Gauges: Taylor's principle – Design of limit gauges, computer aided tolerancing.

UNIT-II

Linear Measurement: Length standard, line and end standards, slip gauges – calibration of the slip gauges, dial indicator, micrometres. Measurement of angles and tapers: Different methods – bevel protractor – angle slip gauges – spirit levels– sine bar – sine plate, rollers and spheres.

Flat Surface Measurement: Measurement of flat surfaces – instruments used – straight edges– surface plates – optical flat and auto collimator.

Optical Measuring Instruments: Tool maker's microscope and its uses, collimators, optical projector, optical flats and their uses, interferometer.

UNIT-III

Surface Roughness Measurement: Introduction, terminology, specifying roughness on drawings, surface roughness parameters, factors affecting surface roughness, ideal surface roughness, roughness measurement methods, precautions in measurement, surface microscopy, surface finish softwares.

Screw Thread Measurement: Elements of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch, profile thread gauges.

Measurement through Comparators: Comparator: Features of comparators, classification of comparators, different comparators, advanced comparators, thread comparators.

UNIT-IV

Metrology of machine tools: Alignment and practical tests.

Gear Measurement: Gear measuring instruments, gear tooth profile measurement, measurement of diameter, pitch, pressure angle and tooth thickness.

Advanced Metrology: Advanced measuring machines, CNC systems, Laser vision, In-process gauging, 3D metrology, metrology softwares, Nano technology instrumentation, stage position metrology, testing and certification services, optical system design, lens design, coating design, precision lens assembly techniques, complex opto mechanical assemblies, contact bonding and other joining technologies.

RECOMMENDED BOOKS:

1. K.J. Hume,Engineering Metrology, Macdonald and Co. (publisher) London.
2. Czichos, The Springer handbook of metrology and Testing, 2011.
3. Jay. L. Bucher, The Metrology Hand book, American Society for Quality, 2004.
4. Smith GT,Industrial Metrology, Spinger.
5. John W. Greve, Frank W. Wilson,Hand book of industrial metrology, PHI – New Delhi.
6. D.M. Anthony, Engineering Metrology, Pergamon Press.
7. Khare MK,Dimensional Metrology, OXFORD-IBH Publishers.
8. I C Gupta, "Engineering Metrology", 5th Edition, Danapath Rai & Co, 2008.
9. R.K. Jain, "Engineering Metrology". 20th Edition, Khanna Publishers, 2007.
10. M. Mahajan, "Engineering Metrology", Dhanapati Rai publications, 2007.
11. BIS standards on Limits & Fits (IS 919), Surface Finish (IS 2073), Machine Tool Alignment, 1993.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-IV

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTIP–112A	SEQUENCING AND SCHEDULING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of different production and machine models of sequencing and scheduling.						
Course Outcomes							
CO1	To understand the concept of sequencing and scheduling.						
CO2	To study and practice for the extension of basic models and parallel machine models.						
CO3	To understand the concepts of the flow shop scheduling and practice for the flow shop scheduling models.						
CO4	To understand the job shop problems and simulation models for dynamic job shop problem.						

UNIT-I

Single-Machine Sequencing: Introduction, Preliminaries, Problems without Due Dates, Problems with Due Dates
Optimization Methods for the Single-Machine Problem: Introduction, Adjacent Pairwise Interchange Methods, A Dynamic Programming Approach, Dominance Properties, A Branch and Bound Approach.
Earliness and Tardiness Costs: Introduction, Minimizing Deviations from a Common Due Date, The Restricted Version, Asymmetric Earliness and Tardiness Costs, Quadratic Costs, Job-Dependent Costs, Distinct Due Dates,Sequencing for Stochastic Scheduling.

UNIT-II

Extensions of the Basic Model: Introduction, Non-simultaneous Arrivals, Related Jobs, Sequence-Dependent Setup Times, Stochastic Models with Sequence-Dependent Setup Times.
Parallel machine models: Introduction, Minimizing the Makespan, Minimizing Total Flow time, Stochastic Models.

UNIT-III

Flow Shop Scheduling: Introduction, Permutation Schedules, The Two-Machine Problem, Special Cases of The Three-Machine Problem, Minimizing the Makespan, Variations of the *m*-Machine Model, Stochastic flow shop scheduling.

UNIT-IV

The Job Shop Problem: Introduction, Types of Schedules, Schedule Generation, The Shifting Bottleneck Procedure, Neighborhood Search Heuristics.
Simulation Models for the Dynamic Job Shop: Introduction, Model Elements, Types of Dispatching Rules, Reducing Mean Flowtime, Meeting Due Dates.

RECOMMENDED BOOKS:

1. Michael Pinedoo, Scheduling: theory, algorithms and systems, Prentice Hall, New Delhi, 1995.
2. King, J.R. Production planning and control, Pergamon International Library, 1975.
3. Kenneth R. Baker, Introduction to sequencing and scheduling, John Wiley and Sons, 1974.
4. Kenneth R. Baker and Dan Trietsch, Principles of sequencing and scheduling, John Wiley and Sons, 2009.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTIP–114A	QUALITY ENGINEERING AND MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of quality tools and engineering for the improvement of product quality.						
Course Outcomes							
CO1	To understand the statistical concepts of quality and quality statistics.						
CO2	To study the quality control chartsin production process and practice for its use in problem solving.						
CO3	To understand the quality improvement tools.						
CO4	To study the ISO systems, failure analysis and testing.						

Unit-I

Introduction to Quality: An Historical Overview: Defining Quality, The Total Quality System, Total Quality Management, Economics of Quality, Quality, Productivity, and Competitive Position, Quality Costs, Success Stories.

Statistics for Quality: Variability in Populations, Some Definitions, Quality vs. Variability, Section I: Empirical Methods for Describing Populations, Section II: Mathematical Models for Describing Populations, Section III: Inference of Population Quality from a Sample.

Unit-II

Quality in Design: Planning for Quality, Product Planning, Product Design, Process Design.

Quality in Production-Process Control I: Process Control, The Control Charts, Measurement Control Charts, Attribute Control Charts, Summary on Control Charts, Process Capability, Measurement System Analysis,

Quality in Production-Process Control II: Derivation of Limits, Operating Characteristics of Control Charts, Measurement Control Charts for Special Situations.

Unit-III

Quality in Procurement: Importance of Quality in Supplies, Establishing a Good Supplier Relationship, Choosing and Certifying Suppliers, Specifying the Supplies Completely, Auditing the Supplier, Supply Chain Optimization Using Statistical Sampling for Acceptance,

Continuous Improvement of Quality: The Need for Continuous Improvement, The Problem-Solving Methodology, Quality Improvement Tools, Lean Manufacturing.

Unit-IV

A System for Quality: The Systems Approach, Dr. Deming's System, Dr. Juran's System, Dr. Feigenbaum's System, Baldrige Award Criteria, ISO 9000 Quality Management Systems, ISO 9001:2008 Requirements, The Six Sigma System.

RECOMMENDED BOOKS:

1. Grant & Leaveworth, Statistical Quality Control, McGraw Hill
2. Duncan,Quality Control & Industrial Statistics, Irwin Press
3. Juran,Quality Control Handbook, McGraw Hill.
4. Hansen,Quality Control, Prentice Hall
5. Thomason,An Introduction to reliability & control, Machinery Publishing.
6. A.V. Taylor, Total Quality Control, McGraw-Hill
7. K.S.Krishnamoorthi, V. Ram Krishnamoorthi,A First Course in Quality Engineering: Integrating Statistical and Management Methods of Quality, Second Edition, CRC Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weight of 12 marks*.
The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTIP–116A	RELIABILITY ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of reliability analysis in industrial system. Students can get acquainted with different reliability calculation models.						
Course Outcomes							
CO1	To understand the concepts of reliability in industrial systems.						
CO2	To study the reliability determination methods and advanced evaluation techniques.						
CO3	To understand various reliability prediction and evolution methods.						
CO4	To acquaint the fundamentals of reliability management and risk assessment.						

UNIT-I

Reliability Engineering: Reliability function, failure rate, Mean time between failures (MTBF), Mean time to failure (MTTF), mortality curve, useful life availability, maintainability, system effectiveness. Introduction to probability distributions.

Time to failure distributions: Exponential, normal, Gamma, Weibull; ranking of data, probability plotting techniques, Hazard plotting Concept of Bathtub Hazard Rate curve, Reliability evaluation of two-state device networks-series, parallel, k-out-of-m systems; Standby redundant systems, Reliability evaluation of three-state device networks-series and parallel.

UNIT-II

Reliability Determination and Prediction: Reliability Determination Methods: Network reduction technique, Path tracing technique, Decomposition technique, Delta-Star method.

Advanced Reliability Evaluation Concepts: Supplementary variables technique, Interference theory, Human reliability, Common cause failures, Fault trees, Failure mode and effect analysis

UNIT-III

Reliability Prediction Models: Series and parallel systems - RBD approach - Standby systems - m/n configuration - Application of Baye's theorem - cut and tie set method - Markov analysis - FTA - Limitations.

UNIT-IV

Reliability testing: Time acceleration factor, influence of acceleration factor in test planning, application to acceleration test, high temperature operating life acceleration model, temperature humidity bias acceleration model, temperature cycle acceleration model, vibration accelerator model, failure free accelerated test planning. Accelerated reliability growth.

Risk Assessment: Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.

RECOMMENDED BOOKS:

1. Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", TMH, 2000.
2. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2007.
3. Sharma S C, Inspection Quality Control and Reliability, Khanna Publishers.
4. Connor P.D.T.O. Practical Reliability Engineering", John Wiley.
5. Naikan V N A Reliability Engineering and Life Testing", PHI Learning Private Limited.
6. Prabhakar Murthy D N and Marvin R, "Product Reliability", Springer-Verlag.
7. Dana Crowe and Alec Feinberg, Design for Reliability, CRC Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weight of 12 marks*.

The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTIP–118A	MECHATRONICS LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	To practice on electrical circuits, hydraulic and pneumatic systems and PLC's for their practical implications.							
Course Outcomes								
CO1	To understand the PLC using PLC simulators.							
CO2	To demonstrate and actuate the positioning using sensors, actuators and programming.							
CO3	To study the pneumatic and electro-pneumatic training system with simulation software.							
CO4	To design and test on hydraulic and pneumatic circuits.							

List of Experiments

1. To study and conduct exercises on PLC Simulator.
2. Control of conveyor manually and through programming, also programming using sensors and conveyor.
3. To study and conduct exercise on CNC lathe.
4. To study and conduct exercises on Robotic simulation software.
5. To study and conduct exercises on Pneumatic & Electro-Pneumatic Training System.
6. To study the stepper motor interface with PLC.
7. **Design and testing of hydraulic circuits such as**
   i) Pressure control
   ii) Flow control
   iii) Direction control
   iv) Design of circuit with programmed logic sequence, using an optional PLC in hydraulic.
   Electro hydraulic Trainer.
8. **Design and testing of pneumatic circuits such as**
   i. Pressure control
   ii. Flow control
   iii. Direction control
   iv. Circuits with logic controls
   v. Circuits with timers
   vi. Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.
9. To perform exercises on process control trainer.

Note: At least eight experiments should be performed from the above list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTMS–104	OPTIMINZATION TECHNIQUES LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	The lab empowers students to know about the programming for solution of different mathematical problems.							
Course Outcomes								
CO1	Students know how to program linear equations putting exponential curve and newtons interpolation Formula.							
CO2	The students to know how to program for Qualitative data.							
CO3	To know about analysis of variance of data.							
CO4	Students will aware about prediction of trend values of future years.							

List of Experiments

1. Program for fitting Linear Equation by using Least Square Method.
2. Program for fitting Exponential Curve.
3. Program to implement Lagrange's Interpolation Formula.
4. Program to implement Newton's Backward and Forward Interpolation Formula using Switch Statement.
5. Program to test the goodness of fit for Qualitative data [Chi-Square Test].
6. Program to test the difference between Mean of two Independent Sample using T- test.
7. Program to make an analysis of Variance of data [One-way ANOVA]
8. Program to make an analysis of Variance of data [Two-way ANOVA]
9. Program for computation of trend value using Semi-Average Method.
10. Program for Computation of trend value using Moving – Average Method.
11. Program for prediction of Trend Value for Future Years.

Note: At least nine experiments should be performed from the above list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTMS-106	MINI PROJECT							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**4**	**2**	**-**	**-**	**100**	**100**	**3**
Objective	In case of mini project, they will solve a live problem using software/analytical/computational tools or fabricate an experimental setup.							
Course Outcomes								
CO 1	Students will learn to write technical reports.							
CO 2	Students will develop skills to present and defend their work in front of technically qualified audience							

Students can take up small problems in the field of Manufacturing and Industrial Systems or relevant field as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Students will be required to submit a brief synopsis of 3-4 pages related to the topic by the first week of September.

w.e.f. 2018-19

Audit Course-II

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTAD- 102A	CONSTITUTION OF INDIA						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**

Objective	The main objective of the course is to impart the students with the knowledge of informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
Course Outcomes	
CO1	To discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO2	To discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3	To discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO4	To discuss the passage of the Hindu Code Bill of 1956.

Unit-I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)
Philosophy of the Indian Constitution: Preamble, Salient Features

Unit-II

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality, Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit-III

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit-IV

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

RECOMMENDED BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "framing of Indian Constitution", 1st Edition, 2015.
3. M. P. Jain, "Indian Constitution Law", 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTAD-104A	PEDAGOGY STUDIES						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The main objective of the course is to review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers and Identify critical evidence gaps to guide the development.						
Course Outcomes							
CO1	Understand the pedagogical practices being used by teachers in formal and informal classrooms in developing countries.						
CO2	Become aware of the evidence on the effectiveness of these pedagogical practices, in different conditions and with different population of learners.						
CO3	Understand the significance of teacher education (curriculum and practicum) and the school curriculum and guidance materials for effective pedagogy.						

Unit-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions. Overview of methodology and Searching.

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

Unit-II

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit-III

Professional development: alignment with classroom practices and follow-up support, Peer support

Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Unit-IV

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education

Curriculum and assessment, Dissemination and research impact.

RECOMMENDED BOOKS:

1. Ackers J, Hardman F, "Classroom interaction in Kenyan primary schools", Compare, 31 (2): 245-261.
2. Agrawal M, "Curricular reform in schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K, "Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?" International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ, "Culture and pedagogy: International comparisons in primary education". Oxford and Boston: Blackwell.
6. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign"

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTAD-106A	STRESS MANAGEMENT BY YOGA						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The main objective of the course is to achieve overall health of body and mind and to overcome stress						
Course Outcomes							
CO1	Develop healthy mind in a healthy body thus improving social health.						
CO2	Improve efficiency						
CO3	Learn the Yogasan						
CO4	Learn the Pranayam						

Unit-I

Definitions of Eight parts of yog. (Ashtanga)

Unit-II

Yam and Niyam. Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit-III

Asan and Pranayam

i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam

RECOMMENDED BOOKS:

1. Janardan Swami Yogabhyasi Mandal, "Yogic Asanas for Group Tarining-Part-I" : Nagpur
2. Swami Vivekananda, "Rajayoga or conquering the Internal Nature" Advaita Ashrama (Publication Department), Kolkata

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING SYSTEMS)

MTAD-108A	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	To learn to achieve the highest goal happily. To become a person with stable mind, pleasing personality and determination. To awaken wisdom in students.						
Course Outcomes							
CO1	Students become aware about leadership.						
CO2	Students will learn how to improve communication skills						
CO3	Understand the team building and conflict						
CO4	Student will learn how to manage the time.						

Neetisatakam-Holistic development of personality

i) Verses- 19,20,21,22 (wisdom)
ii) Verses- 29,31,32 (pride & heroism)
iii) Verses- 26,28,63,65 (virtue)
iv) Verses- 52,53,59 (dont's)
v) Verses- 71,73,75,78 (do's)

Approach to day to day work and duties.

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47, 48,
Chapter 3-Verses 13, 21, 27, 35,
Chapter 6-Verses 5, 13, 17, 23, 35,
Chapter 18-Verses 45, 46, 48.

Statements of basic knowledge.

Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16, 17, 18

Personality of Role model. Shrimad Bhagwad Geeta:

Chapter 2-Verses 17,

Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

RECOMMENDED BOOKS:

1. Swami Swarupananda, "Srimad Bhagavad Gita" Advaita Ashram (PublicationDepartment), Kolkata
2. P.Gopinath, "Bhartrihari's Three Satakam (Niti-sringar-vairagya) by, Rashtriya Sanskrit Sansthanam, New Delhi.

Third Semester
(Programme Elective-V)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SYSTEMS

MTIP-201A	ENTERPRISE RESOURCE PLANNING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3
Objective	The main objective of the course is to impart the students with the knowledge of integrated applications to manage the business and automate many back office functions related to technology, services and human resources.						
Course Outcomes							
CO1	To study the basic principles and models of an enterprise.						
CO2	To understand the concepts of technology and architecture in ERP.						
CO3	To study ERP system packages.						
CO4	To study the ERP procurement issues.						

UNIT I

ENTERPRISE RESOURCE PLANNING:
Introduction, Evolution of ERP, Principle of ERP, Enabling Technologies, ERP Characteristics, Features of ERP, The advantages of ERP, Reasons for the Failure of ERP Implementation, Risk and governance issues in an ERP, ERP Framework, Business Blueprint, Business Engineering Vs. Business Process Re-Engineering, ERP Tools and Software, Demand Chain, Value Chain, and Supply Chain.

UNIT-II

ERP ARCHITECTURE: Need to Study ERP Architecture**,** Layered Architecture, Types of ERP Architecture, Two-tier Implementations, Three-tier Client/Server Implementations, Web-based architecture, Service-Oriented Architectures, Logical Architecture of an ERP System, Physical Architecture of an ERP System, and Evaluation Framework for ERP Acquisition.

UNIT III

ERP PACKAGE INTEGRATION AND IMPLEMENTATION: ERP market, SAP, People soft, BAAN company, ORACLE corporation, A comparative assessment and selection of ERP packages and modules, Sales Force Automation, Integration of ERP, Integration of ERP and the Internet, ERP implementation strategies, Comparison of Big Bang vs. Phased Approach, Implementation Strategy in Small and Medium Enterprise, Post Implementation Issues.

UNIT IV

OVERVIEW OF ARCHITECTURE OF DIFFERENT ERP SOFTWARES: Oracle overview, Architecture, A.I.M. and applications, SAP Software architecture overview, ERP before and after Y2K, Impact of Y2K on ERP Development, Risk and Governance Issues in an ERP

ERP MODULES: Finance module, Sales & Distribution module, Human Resources module, Plant Maintenance module, Quality Management module, Material management module, manufacturing management module.

RECOMMENDED BOOKS:

1. Sadagopan. S, ERP-A Managerial Perspective, Tata Mcgraw Hill,1999.
2. Jose Antonio Fernandez, the SAP R/3 Handbook, Tata Mcgraw Hill,1998.
3. Vinod Kumar Crag and N.K. Venkitakrishnan, Enterprise Resource Planning- Concepts and Practice, Prentice Hall of India,1998.
4. Garg & Venkitakrishnan,ERPWARE, ERP Implementation Framework, Prentice Hall,1999.
5. Thomas E Vollmann and Bery Whybark, Manufacturing and Control Systems, Galgothia Publications,1998.
6. Alexis Leon,Enterprise resource planning, Tata Mcgraw-Hill

Note: The paper will have a total of *NINE questions.* QuestionNo.1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all FourUnits).
All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SYSTEMS

MTIP-203A	DESIGN OF EXPERIMENTS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 hrs
Objective	To understand the various design of experiments techniques for optimization of problems.						
Course Outcomes							
CO1	To understand the concepts of Design of Experiment and statistical Methods.						
CO2	To understand the ANOVA and factorial design and fitting response curves and surfaces.						
CO3	To study the application of Taguchi Method and testing of hypothesis						
CO4	To study and implement the Response Surface Methodology.						

UNIT-I

Introduction to Designed Experiments:
Introduction,Strategyofexperimentation,Sometypicalapplicationsofexperimentaldesign, Basic principles, Guidelines for designing experiments, Using statistical design in experimentation, A Checklist for Planning experiments, *Introduction to Minitab, Interface of Minitab, Customizing Minitab, Entering Data, Graphing Data, Printing Data and Graphs, Saving and Retrieving information.*
Basic Statistical Methods: Introduction, Basic statistical concepts, Types of Data, Graphical Presentation of Data.
Descriptive Statistics: Measure of Location, Measure of Variation, The Normal Distribution, Counting, Minitab Commands to Calculate Descriptive Statistics.
Inferential Statistics: The Distribution of Sample Means (R Known), Confidence Interval for the Population Mean (σ Known), Hypothesis testing for one sample mean (σ Known), Hypothesis test for two sample means, Testing for Normality, *Hypothesis test and Confidence Intervals with Minitab.*

UNIT-II

Analysis of Variance: Introduction to Analysis of Variance, ANOVA assumptions and Validation, ANOVA Table, The sum of square approach to ANOVA calculations, Analysis of the fixed Effect model, Decomposition of the Total sum of squares. Statistical analysis, Estimation of the Model Parameters, Unbalanced Data, Model Accuracy Check, Practical interpretation of results. *ANOVA with Minitab*
Factorial Experiments: Basic definition and principles, Advantages of factorials, Two level factorial design, The 2^1 Factorial Experiment, The 2^2 Factorial Experiment, The 2^3 Factorial Design, Addition of Centre Cells to 2^k Designs. General Procedure for Analysis of 2^k designs. 2^k Factorial Designs in Minitab.

UNIT-III

Introduction to Taguchi Method: Introduction, Taguchi Quality loss function, Orthogonal Array, Properties of Orthogonal Array, Minimum number of experiments to be conducted, Static Problems, Dynamic Problems, Assumptions of the Taguchi method, Steps in Taguchi Method, Assessment of Factors and Interactions, Selection and Application of Orthogonal arrays, Data Analysis from Taguchi Experiments, Variable Data with main factors only, Variable Data with Interactions, Attribute Data Analysis, Confirmation Experiment, Confidence Intervals, Robust Design Approach. *Applications of Taguchi Method using Minitab.*

UNIT-IV

Introduction to Response Surface Methodology: Introduction, Terms in Quadratic Models, The method of steepest ascent, Analysis of Second order response surfaces, Experimental design for fitting response surfaces, 2k Designs with Centers, 3^k Factorial Designs, Box- Behnken Designs, Central Composite Designs, Analysis of Data from RSM Designs, Design Considerations for Response Surface Experiments. *Response Surface Designs in Minitab.*

RECOMMENDED BOOKS:

1. Douglas C Montgomery,Design and Analysis of Experiments, John Wiley
2. Paul G. Mathews,Design of Experiments with MINITAB, New Age International Publishers.
3. K. Krishnaiah, P. Shahabudeen,Applied Design of Experiments and Taguchi Methods,PHI.
4. Angela Dean and Daniel Voss,Design and Analysis of Experiments, Springer.
5. John P.W.M., Statistical Design and Analysis of Experiments, John Wiley
6. Montgomery D.C., Runger G. C., Introduction to Linear Regression Analysis, John Wiley
7. Myres R.H. and Montgomery D.C.,Response Surface Methodology Process and Product Optimization Using Designed Experiments, Wiley
8. G UNIPUB, White Plains,Introduction to Quality Engineering Taguchi, New York.
9. https://www.ee.iitb.ac.in/~apte/CV_PRA_TAGUCHI_INTRO.htm
10. www.ecs.umass.edu/mie/labs/mda/fea/sankar/chap2.html

Note: The paper will have a total of *NINE questions.*QuestionNo.1, which is compulsory, shall be Objective Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SYSTEMS

MTIP–205A	STRATEGIC ENTREPRENEURSHIP						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To provide knowledge to the students about entrepreneurship concepts and various development programme and policies.						
Course Outcomes							
CO1	To know about the small scale industries, scopes and the causes of their sickness.						
CO2	To know about the EDP and different government policies.						
CO3	To learn about business incubations and its future perspectives.						
CO4	To learn E-business marketing and developments.						

UNIT-I

Small Scale Industries: Definition and types of SSI's; Role, scope and performance in national economy; Problems of small scale industries.

Industrial Sickness: Definition; Causes of sickness; Indian scenario, Government help; Management strategies; Need for trained entrepreneurs

UNIT-II

Entrepreneurship Development Programme: Introduction, Origin of EDP's , Organizations involved in EDP's, Objectives of EDPs, Implementation of EDP's, Short comings of EDP's, Role in entrepreneurship development.

Step: Introduction, Origin, Status in India, Success and failure factors, Govt. polices and incentives, future prospects in India.

UNIT-III

Business Incubation: Introduction, Origin and development of business incubators in India and other countries, types of incubators, success parameters for a business incubator, Benefits to industries, institutes, government and society, future prospects, A few case studies (at least 2).

Project Management: Concept, Characteristics and Significance of Project Management, Components of Project Management, Project Life Cycle, Project Identification and Selection, Project Formulation and Appraisal.

UNIT-IV

Special Aspects of Entrepreneurship: Entrepreneurship, Social entrepreneurship, International entrepreneurship, Rural entrepreneurship, Community Development, Women entrepreneurship.

Network Marketing: Introduction, E-business, E-commerce, E-auction, A basic internet e-business architecture, A multi-tier e-business architecture.

RECOMMENDED BOOKS:

1. P.K. Gupta,Strategic Entrepreneurship, Everest Publishing House.
2. David Cleland,Project Management –Strategic Design and Implementation, McGraw Hill.
3. David H Holl,Entrepreneurship-New Venture Creation, Prentice Hall of India.
4. Steed & Steed,Sustainable Strategic Management, Prentice Hall of India.
5. Kotler,Marketing Management by Prentice Hall of India.
6. Tarek Khalil,Management of Technology, McGraw Hill.
7. Henry Steiner,Engineering Economic Principles, McGraw Hill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Open Elective

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SYSTEMS

MTOE-201A	BUSINESS ANALYTICS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes							
CO1	Able to have knowledge of various business analysis techniques.						
CO2	Learn the requirement specification and transforming the requirement into different models.						
CO3	Learn the requirement representation and managing requirement assets.						
CO4	Learn the Recent Trends in Embedded and collaborative business						

Unit-I

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.
Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit-II

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.
Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit-III

Finalizing Requirements, Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements, Managing Requirements Assets: Change Control, Requirements Tools

Unit-IV

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

RECOMMENDED BOOKS:

1. James Cadle, "Business Analysis", BCS, The Chartered Institute for IT.
2. Erik Larson and, Clifford Gray, "Project Management: The Managerial Process", McGraw-Hill Education.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SYSTEMS

MTOE-203A	INDUSTRIAL SAFETY						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to aware students about the industrial safety maintenance and fault findings.						
Course Outcomes							
CO1	Understand the industrial safety.						
CO2	Analyze fundamentals of maintenance engineering.						
CO3	Understand the wear and corrosion and fault tracing.						
CO4	Understanding when to do periodic inceptions and apply the preventing maintenance.						

Unit-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-II

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion, Types of corrosion, Corrosion prevention methods.

Unit-III

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-IV

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

RECOMMENDED BOOKS:

1. Higgins & Morrow, "Maintenance Engineering Handbook", Da Information Services.
2. H. P. Garg, "Maintenance Engineering", S. Chand and Company.
3. Audels, "Pump-hydraulic Compressors", Mcgraw Hill Publication.
4. Winterkorn, Hans, "Foundation Engineering Handbook", Chapman & Hall London.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SYSTEMS

MTOE-205A	OPERATIONS RESEARCH						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to aware students about the dynamic programming to solve problems of discrete and continuous variables and model the real world problem and simulate it.						
Course Outcomes							
CO1	Students should be able to apply the dynamic programming to solve problems of discreet and continuous variables.						
CO2	Students should be able to apply the concept of non-linear programming						
CO3	Students should be able to carry out sensitivity analysis						
CO4	Student should be able to model the real world problem and simulate it.						

Unit-I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit-II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit-III

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit-IV

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

RECOMMENDED BOOKS:

1. H.A. Taha, "Operations Research, An Introduction", PHI, 2008
2. H.M. Wagner, "Principles of Operations Research", PHI, Delhi, 1982.
3. J.C. Pant, "Introduction to Optimisation: Operations Research", Jain Brothers, Delhi, 2008
4. Hitler Libermann, "Operations Research", McGraw Hill Pub. 2009
5. Pannerselvam, "Operations Research", Prentice Hall of India 2010
6. Harvey M Wagner, "Principles of Operations Research", Prentice Hall of India 2010

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SYSTEMS

MTOE-207A	COST MANAGEMENT OF ENGINEERING PROJECTS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the students with the knowledge of cost management for the engineering project and apply cost models to the real world projects.						
Course Outcomes							
CO1	Students should be able to learn the strategic cost management process.						
CO2	Students should be able to understand types of project and project team types						
CO3	Students should be able to carry out Cost Behavior and Profit Planning analysis.						
CO4	Student should be able to learn the quantitative techniques for cost management.						

Unit-I

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making, relevant cost, Differential cost, Incremental cost and Opportunity cost, Objectives of a Costing System, Inventory valuation, Creation of a Database for operational control, Provision of data for Decision-Making.

Unit-II

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning, Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents Project team, Role of each member, Importance Project site, Data required with significance, Project contracts, Types and contents, Project execution Project cost control, Bar charts and Network diagram, Project commissioning, mechanical and process.

Unit-III

Cost Behavior and Profit Planning Marginal Costing, Distinction between Marginal Costing and Absorption Costing, Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Standard Costing and Variance Analysis, Pricing strategies, Pareto Analysis, Target costing, Life Cycle Costing, Costing of service sector, Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control, Flexible Budgets, Performance budgets, Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-IV

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

RECOMMENDED BOOKS:

1. Charles Thomas Horngren, "Cost Accounting a Managerial Emphasis", Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, "Advanced Management Accounting"
3. Robert S Kaplan Anthony A. Alkinson, "Management & Cost Accounting"
4. Ashish K. Bhattacharya, "Principles & Practices of Cost Accounting", A. H. Wheeler publisher
5. N.D. Vohra, "Quantitative Techniques in Management", Tata McGraw Hill Book Co. Ltd.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SYSTEMS

MTOE-209A	COMPOSITE MATERIALS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the students with the knowledge of composites, its materials, analysis, fabrication, and performance analysis.						
Course Outcomes							
CO1	Students should be able to learn the classification and characteristics of composite materials.						
CO2	Students should be able to understand about different fabrication techniques related to metal matrix composites.						
CO3	Students should be able to understand about different fabrication techniques related to polymer matrix composites.						
CO4	Student should be able to do the analyses of the composite materials under different loading conditions.						

UNIT–I

INTRODUCTION: Definition – Classification and characteristics of Composite materials, Advantages and application of composites, Functional requirements of reinforcement and matrix, Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures, Iso-strain and Iso-stress conditions.

UNIT – II

Manufacturing of Metal Matrix Composites: Casting, Solid State diffusion technique, Cladding, Hot iso static pressing, Properties and applications.

Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration, Liquid phase sintering, Manufacturing of Carbon, Carbon composites, Knitting, Braiding, Weaving. Properties and applications.

UNIT–III

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs, hand layup method, Autoclave method, Filament winding method, Compression moulding, Reaction injection moulding, Properties and applications.

UNIT – IV

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

RECOMMENDED BOOKS:

1. R.W.Cahn, "Material Science and Technology" VCH, West Germany.
2. WD Callister, Jr, "Materials Science and Engineering, An introduction"
3. Balasubramaniam, "John Wiley & Sons", NY, Indian edition, 2007.
4. Lubin, "Hand Book of Composite Materials"
5. K.K.Chawla, "Composite Materials"
6. Deborah D.L. Chung, "Composite Materials Science and Applications"
7. Danial Gay, Suong V. Hoa, and Stephen W. Tasi, "Composite Materials Design and Applications"

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SYSTEMS

MTOE-211A	WASTE TO ENERGY						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the students with the knowledge of generation of energy from the waste.						
Course Outcomes							
CO1	Students should be able to learn the classification of waste as a fuel and biomass pyrolysis.						
CO2	Students should be able to learn gasification process and different types of gasifiers.						
CO3	Students should be able to learn different combustors for biomass.						
CO4	Student should be able to learn the Biogas plant technology different biomass conversions processes for different applications.						

Unit-I

Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW, Conversion devices, Incinerators, gasifiers, digestors.

Biomass Pyrolysis: Pyrolysis, Types, slow fast, Manufacture of charcoal, Methods, Yields and application, Manufacture of pyrolytic oils and gases, yields and applications.

Unit-II

Biomass Gasification: Gasifiers, Fixed bed system, Downdraft and updraft gasifies, Fluidized bed gasifiers, Design, construction and operation, Gasifier burner arrangement for thermal heating, Gasifier engine arrangement and electrical power, Equilibrium and kinetic consideration in gasifier operation.

Unit-III

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-IV

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

RECOMMENDED BOOKS:

1. Desai, Ashok V, "Non-Conventional Energy", Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. and Mahdi, S. S., "Biogas Technology - A Practical Hand Book - Vol. I & II", Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Challal, D. S, "Food, Feed and Fuel from Biomass", IBH Publishing Co. Pvt. Ltd., 1991.
4. C. Y. WereKo-Brobby and E. B. Hagan, "Biomass Conversion and Technology", John Wiley & Sons, 1996.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SYSTEMS

MTMS-201	DISSERTATION PHASE – I							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical Marks	Total	Time (Hrs.)
0	0	20	10	-	100	-	100	-
Objective	The main objective of this course is to plan a research work (which includes the problem formulation/literature review, proposed objectives, proposed methodologies and references) in the field of Industrial and Manufacturing Engineering or interrelated fields of applications.							
Course Outcomes								
CO 1	Students will be exposed to various self-learning topics.							
CO 2	Students will be exposed to an exhaustive survey of the literature such as books, national/international refereed journals, resource persons and industrial surveys for the selection/ identification of engineering/research problem.							
CO 3	Students will be able to set the research objectives of the identified engineering/research problem.							
CO 4	Students will learn modern tools/techniques related to the identified engineering/research problem for the solution and able to learn technical report writing skills.							
CO 5	Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.							

The students will start their research work in third semester with a research problem having research potential involving scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.

The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his/her supervisor and the topic of dissertation must be mutually decided by the supervisor and student.

The students will be required to submit a progress report related to their dissertation work by the end of September. The progress report will cover the following:

- The goal set for the period.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.

The progress report must be at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The students will be required to appear for comprehensive Seminar & Viva-voce and submit a synopsis report based on their progress related to the dissertation as per the presentation date mentioned in the academic calendar for the session. The synopsis report will be submitted in the same format as that of the thesis and will contain the following:

1. Introduction
2. Literature Survey
3. Gaps in Literature
4. Objectives of the Proposed Work
5. Methodology
6. References

*** Student will choose his/her guide in the end of second semester.**

Fourth Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (4th semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING SYSTEMS

MTMS-202	DISSERTATION PHASE –II							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical	Total	Time (Hrs.)
0	0	32	16	-	100	200	300	-
Objective	The main objective of the course is to make the students able to do some good research in the field of their interests related to Industrial and Manufacturing Engineering or interrelated fields of applications.							
Course Outcomes								
CO 1	Students will be able to design solutions for engineering problems that meet the specified needs with appropriate considerations.							
CO 2	Students will be able to conduct investigations of engineering problems using research-based knowledge and experimental/research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.							
CO 3	Students will be able to apply resources and modern engineering tools and techniques with an understanding of the limitations.							
CO 4	Students will be able to either work in a research environment or in an industrial environment.							
CO 5	Students will be conversant with technical report writing, professional ethics, responsibilities and norms of the engineering practice.							
CO 6	Students will be able to present and convince their topic of study to the engineering community.							

The students are required to continue Analytical/Experimental/Computational/Industrial Problems or Case studies investigations in the field of Industrial and Production Engineering or other related fields which have been finalized in the third semester. They would be working under the supervision of a faculty member.

The students will be required to submit a progress report duly signed by their respective supervisors to the department, related to their dissertation work in the last week of March. The progress report will cover the following:

- The goal set for the period.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.
- References

The progress report must be of at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The candidate has to prepare a detailed dissertation report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up/numerical details/industrial case study etc. as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study.

The final dissertation will be submitted in the end of semester as per academic calendar for the session, which will be evaluated by internal as well as external examiners based upon his/her research work. At least one publication is expected before final submission of the dissertation from every student in peer reviewed referred journals or reputed conference from the work done by them in their dissertation. The dissertation should be presented in standard format as provided by the department.

The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a supervisor, co-supervisor etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his supervisor.

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SPECIALIZATION: MANUFACTURING TECHNOLOGY
SEMESTER-1

S. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTMT-101	Advanced Tribology	3	0	0	3	3	60	40	-	100	3
2	MTIP-103A	Computer Aided Design and Manufacturing	3	0	0	3	3	60	40	-	100	3
3		*Programme Elective-I	3	0	0	3	3	60	40	-	100	3
4		**Programme Elective-II	3	0	0	3	3	60	40	-	100	3
5	MTRM-111A	Research Methodology and IPR	2	0	0	2	2	60	40	-	100	3
6	MTMT-103	Advanced Tribology Lab	0	0	4	4	2	-	40	60	100	3
7	MTIP-119A	Computer Aided Design and Manufacturing Lab	0	0	4	4	2	-	40	60	100	3
8		***Audit Course-I	2	0	0	2	-	-	100	-	100	3
Total						**24**	**18**	**300**	**280**	**120**	**700**	

***PROGRAMME ELECTIVE- I for(MTMT) 1st Semester**		
1.	MTIP-105A	Tool Engineering
2.	MTIP-107A	Advanced Engineering Materials
3.	MTIP-109A	Non-Conventional Machining

****PROGRAMME ELECTIVE- II for (MTMT) 1st Semester**		
1.	MTIP-111A	Product Design and Development
2.	MTIP-113A	Simulation of Industrial Systems
3.	MTIP-115A	Supply Chain Management

*****AUDIT COURSE – I for 1st Semester (MTMT)**		
1.	MTAD-101A	English for Research Paper Writing
2.	MTAD-103A	Disaster Management
3.	MTAD-105A	Sanskrit for Technical Knowledge
4.	MTAD-107A	Value Education

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2.*** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

3. The programme Elective I & II and Audit Course-I are common with M.TECH. (I&P).The course starts with MTIP code is common with M.TECH. (I&P).

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SPECIALIZATION: MANUFACTURING TECHNOLOGY
SEMESTER-II

S. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTIP-102A	Mechatronics	3	0	0	3	3	60	40	-	100	3
2	MTMT-102	Automation and Computer- Integrated Manufacturing	3	0	0	3	3	60	40	-	100	3
3		*Programme Elective-III	3	0	0	3	3	60	40	-	100	3
4		**Programme Elective-IV	3	0	0	3	3	60	40	-	100	3
5	MTIP-118A	Mechatronics Lab	0	0	4	4	2	-	40	60	100	3
6	MTMT- 104	Advanced Welding Technology Lab	0	0	4	4	2	-	40	60	100	3
7	MTMT-106	Mini Project	0	0	4	4	2	-	-	100	100	3
8		***Audit Course-II	2	0	0	2	-	-	100	-	100	3
Total						**26**	**18**	**240**	**240**	**220**	**700**	

***PROGRAMME ELECTIVE-III for (MTMT) 2nd Semester**		
1.	MTIP-106A	Advanced Welding Processes
2.	MTIP-108A	Advanced Metal Cutting
3.	MTIP-110A	Metrology

***PROGRAMME ELECTIVE-IV for(MTMT) 2nd Semester**		
1.	MTIP-112A	Sequencing and Scheduling
2.	MTIP-114A	Quality Engineering and Management
3.	MTIP-116A	Reliability Engineering

*****AUDIT COURSE–II for (MTMT)2nd Semester**		
1.	MTAD-102A	Constitution of India
2.	MTAD-104A	Pedagogy Studies
3.	MTAD-106A	Stress Management by Yoga
4.	MTAD-108A	Personality Development through Life Enlightenment Skills

Note: 1. ***Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

2. The programme Elective III& IV and Audit Course-II are common with M.TECH. (I&P).The course starts with MTIP code is common with M.TECH. (I&P).

KURUKSHETRA UNIVERSITY, KURUKSHETRA
Established by state Legislature Act XII of 1956
(A+ Grade, NAAC Accredited)
MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MANUFACTURING TECHNOLOGY
SEMESTER-III

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1		*Programme Elective-V	3	0	0	3	3	60	40	-	100	3
2		**Open Elective	3	0	0	3	3	60	40	-	100	3
3	MTMT-201	Dissertation Phase-I	0	0	20	20	10	-	100	-	100	--
Total						**26**	**16**	**120**	**180**		**300**	

***PROGRAMME ELECTIVE-V for (MTMT) 3rd Semester**		
1.	MTIP-201A	Enterprise Resource Planning
2.	MTIP-203A	Design of Experiments
3.	MTIP-205A	Strategic Entrepreneurship

****OPEN ELECTIVE for(MTMT) 3rd Semester**		
1.	MTOE-201A	Business Analytics
2.	MTOE-203A	Industrial Safety
3.	MTOE-205A	Operations Research
4.	MTOE-207A	Cost Management of Engineering Projects
5.	MTOE-209A	Composite Materials
6.	MTOE-211A	Waste to Energy

Note:1. The programme Elective-V and Open Elective are common with M.TECH. (I&P).

SEMESTER-IV

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTMT-202	Dissertation Phase-II	0	0	32	32	16	-	100	200	300	--
Total						**32**	**16**		**100**	**200**	**300**	

Total credits = 68

INSTRUCTIONS FOR PAPER SETTER

- The question paper is to be attempted in **THREE Hours**.
- Maximum Marks for the paper are **60.**
- The syllabus for the course is divided into **FOUR units.**
- The paper will have a total of **NINE questions.**
- **Question No. 1,** which is compulsory, shall be OBJECTIVE Type **and have content from the entire syllabus (all Four Units).**

  Q. No. 2 & 3 from Unit I

  Q. No. 4 & 5 from Unit II

  Q. No. 6 & 7 from Unit III

  Q. No. 8 & 9 from Unit IV

- All questions will have equal **weightage of 12 marks.**
- The candidate will attempt a total of **FIVE questions**, each of 12 marks. Q. No. 1 is compulsory. The candidate shall attempt remaining **four** questions by selecting **only one question from each unit.**
- A question may have any number of sections labeled as 1(a), 1(b), 1(c), 1(d), ---- 2(a), 2(b), --.A section may further have any number of subsections labeled as (i), (ii), (iii),.
- **SPECIAL INSRUCTIONS FOR Q. No. 1 ONLY**

  Question No. 1, which is compulsory, shall be OBJECTIVE/ short answer type **and have content from the entire syllabus (all Four Units).**

  Emphasis is to be given on the basic concepts, analytical reasoning and understanding of the various topics in the subject. This question may have a number of parts and/or subparts. The short questions could be combination of following types:

  - Multiple Choice
  - Yes/ No choice
  - Fill in Blanks type
  - Short numerical computations
  - Short Definitions
  - Matching of Tables

  The above mentioned question types is **only a Guideline**. Examiner could set the question as per the nature of the subject.

First Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1ST Sem.)
(MANUFACTURING TECHNOLOGY)

MTMT- 101	ADVANCED TRIBOLOGY						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	To develop a solution oriented approach by in depth knowledge of Industrial Tribology and address the underlying concepts, methods and application of Industrial Tribology.						
Course Outcomes							
CO 1	Students will be able to understand the fundamentals of tribology, friction and wear processes in contacts between different materials.						
CO 2	Students will be able to understand the material requirements for tribological applications and different surface treatment techniques.						
CO 3	Students will be able to study different types of lubricants and testing techniques.						
CO 4	Students will be able to study the maintenance and conservation techniques, testing specifications and standards.						

Unit I

Introduction to Tribological Systems: Industrial interface & significance of tribology, Economic Importance of Tribology, variouscondition Monitoring Techniques for tribological systems, surface energy and flash temperature theory. Analysis of surface roughness and its measurement, Analysis of real area contacts and its measurement. Material properties influencing friction, Measurement of friction.

Unit II

Wear: Wear and wear types. Mechanisms of wear - Adhesive, abrasive, corrosive, erosion, fatigue, fretting, etcIndustrial application of wear, Measurement of wear in dry atmosphere and differentenvironments. Quantitative expression for adhesive and abrasive wear. Study of abrasion in grinding, lapping and Honing, wear resisting materials, Methods of Controlling Wear, Wear in various mechanical components.

Unit III

Lubrication: Mechanism of lubrication, Functions of lubricants, properties of lubricants,Characteristics of lubricants and greases, Boundary, squeeze film hydrodynamic and hydrostatic lubrications, Reynold's equation in two and three dimensional flow. Pressure equation and its distribution, load carrying capacity, frictional energy in oil film and coefficient of friction in journal bearing.

Unit IV

Bearings: Requirements of bearings, Design of bearing: clearance in journal bearing, pressureequation of journal bearing, Bearing materials, Minimum oil film thickness, summer field number, oil grooves and flow of oil in axial and circumferential grooves, cavitation and turbulence in oil bearings. Design of air bearing and other gas bearings, journal bearings with specialized applications.

Suggested Books:

1. Friction & wear by Robinwlcz by John Wiliey and sons.
2. Basic Lubrication theory by longman
3. Industrial Tribology, Tribology failure and their analysis by Dr. B.S. Prahbu
4. E.P. Bowden and Tabor. D., "Friction and Lubrication ", Heinemann Educational Books Ltd.
5. A. Cameron, "Basic Lubrication theory ", Longman, U.K.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP–103A	COMPUTER AIDED DESIGN AND MANUFACTURING						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to understand about the technology of computers for the design, process planning and manufacturing the products.						
Course Outcomes							
CO1	To understand the fundamentals and applications of computers in the field of designing and manufacturing and the transformation of geometricmodels.						
CO2	To understand the concepts of G.T. and FMS.						
CO3	To know the use of computers in process planning and shop floor control.						
CO4	To learn the basics of AGV and coding systems for CNC.						

UNIT I

Fundamentals of CAD: Introduction to CAD/CAM, Historical Development, Industrial Look at CAD/CAM, Application of computers in design, creating manufacturing database, Benefits of CAD. Computer Hardware, Graphic input devices, display devices, Graphics output devices, Central processing unit (CPU).

Geometric transformations: 2D and 3D; transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous representations, concatenated representation; Orthographic projections, Numerical Problems

UNIT II

Group Technology and Cellular Manufacturing

Part families, parts classifications and coding, Production flow Analysis, cellular Manufacturing-composite part concept, machine cell design, applications of group technology, Grouping parts and machines by Rank order clustering technique, Arranging machines in a G.T. cell.

Flexible Manufacturing

Introduction, FMS components, Flexibility in Manufacturing – machine, Product, Routing, Operation, types of FMS, FMS layouts, FMS planning and control issues, deadlock in FMS, FMS benefits and applications.

UNIT III

Process Planning

Introduction, Manual process planning, Computer aided process planning – variant, generative, Decision logic- decision tables, decision trees, Introduction to Artificial intelligence.

Shop Floor Control

Introduction, Shop floor control features, Major displays, Major reports, Phases of SFC Order Release, Order Scheduling, Order Progress, Manufacturing control, Methodology, Applications, Shop floor data collections, Types of data collection system, Data input techniques, Automatic data, Collection system.

UNIT IV

CNC Basics and Part Programming

Introduction, Historical Background, Basic Components of an NC, Steps in NC, Verifications of Numerical control machine tool programs, Classification of NC Machine tool, Basics of motion control and feedback for NC M/C, NC part programming, Part programming methods, Modern Machining system, Automatically programmed tools, DNC, Adaptive control

Automated Guided Vehicle

Introduction, History, Features, Functions of AGV, Types of AGV, Safety consideration for AGV, Design of AGV.

RECOMMENDED BOOKS:

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
3. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
6. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
7. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
8. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall
9. Chang, Wang & Wysk Computer Aided Manufacturing. Prentice Hall
10. Kundra &Rao, Numerical Control and Computer Aided Manufacturing by, Rao and Tiwari, Tata Mc-Graw Hill.
11. Mattson, CNC programming Principles and applications, Cengage Learning India Pvt. Ltd. Delhi

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks.* The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-I

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP–105A	TOOL ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs.**
Objective	The objective of the course is to impart the students with the knowledge of various aspects of design of different types of Tools and fixtures used in Industries.						
Course Outcomes							
CO1	To impart knowledge of materials for cutting tool and design of cutting tools.						
CO2	To acquaint students with various kinds of Gages and Work holding devices.						
CO3	To impart knowledge to students about Drill jigs and Fixtures.						
CO4	To let student understand the tool design process for NC Machine tools						

UNIT-I

Cutting Tool Materials: Introduction and desirable properties, Carbon and Medium-Alloy Steels, High-Speed Steels, Cast-Cobalt Alloys, Carbides, Coated Tools, Alumina-Based Ceramics, Cubic Boron Nitride, Silicon-Nitride Based Ceramics, Diamond, Reinforced Tool Materials, Cutting-Tool Reconditioning.

Design of Cutting Tools Basic Requirements, Mechanics and Geometry of Chip Formation, General Considerations for Metal Cutting, Design of single point Cutting Tools, Design of Milling Cutters, Design of Drills and Drilling, Design of Reamers, Design of Taps, Chip Breakers.

UNIT-II

Gages and Gage Design: Limits fits and tolerances, Geometrical tolerances-specification and measurement, Types of gages, Gage design, gage tolerances, Material for Gages.

Work Holding Devices: Basic requirements of work holding devices, Location: Principles, methods and devices, Clamping: Principles, methods and devices.

UNIT-III

Drill Jigs: Definition and types of Drill Jigs, Chip Formation in Drilling, General Considerations in the Design of Drill Jigs, Drill Bushings, Drill Jigs, and Modern Manufacturing

Design of Fixtures: Fixtures and Economics , Types of Fixtures , Milling Fixtures , Boring Fixtures, Broaching Fixtures, Lathe Fixtures, Grinding

UNIT-IV

Tool Design for Numerically Controlled Machine Tools: Fixture Design for Numerically Controlled Machine Tools, Cutting Tools for Numerical Control, Tool-holding Methods for Numerical Control.

RECOMMENDED BOOKS:

1. ASTME, "Fundamentals of Tool Design", Prentice Hall of India, 1983.
2. Donaldson, "Tool Design", Tata-McGraw Hill, 3rd Edition, 2000.
3. Joshi P.H., "Jigs and Fixtures", Tata-McGraw Hill, 2010.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem)

(MANUFACTURING TECHNOLOGY)

MTIP–107A	ADVANCED ENGINEERING MATERIALS						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs.**
Objective	The objective of the course is to impart the students with the knowledge of various advanced and smart materials.						
Course Outcomes							
CO1	To impart knowledge of Piezoelectric and shape memory alloys.						
CO2	To acquaint students with deep know how about Electro-rheological and composite materials						
CO3	ToimpartknowledgetostudentsaboutMEMSsystemsandHightemperature applicationmaterials.						
CO4	To let student understand the processing and characteristics of powder metallurgy processes and structural materials.						

UNIT-I

Introduction to advanced Engineering materials: Classes of Materials and their usage, Historical Perspective, Intelligent Materials, Structural Materials, Functional Materials, Primitive Functions of Intelligent Materials, Intelligence inherent in Materials, Materials Intelligently Harmonizing with humanity, Biomimetic.

Smart Materials and Structural Systems: Introduction, Actuator Materials, Sensing Technologies, Micro-sensors, Intelligent systems, Hybrid Smart Materials, Passive Sensory Smart Structures, Reactive Actuator based smart structures, Active Sensing and Reactive smart structures, smart skins, Aero-elastic tailoring of airfoils, Synthesis of future smart systems.

UNIT-II

Electrocaloric Effect: An Introduction, History of Electrocaloric Cooling,Mechanism of working ofElectrocaloric Cooling, Electrocaloric Materials, Performance of Electrocaloric Materials.

Heat Resistant Steels: Conventional Heat-Resistant Steels, Silicon-Bearing High Chromium Heat-Resistant Steels,Nitride-Strengthened Reduced Activation Heat-Resistant Steels, China Low Activation Martensitic SteelNitride-Strengthened Steels,Microstructural Stability

UNIT-III

Smart Micro-systems: Silicon Capacitive Accelerometer, Piezo-resistive Pressure sensor, Conductometric Gas sensor, An Electrostatic Comb-drive, Magnetic Micro-relay, Portable Blood Analyser, Piezoelectric Inkjet Print Head.

Bucky balls to robotics: Bucky ball, Nano Structure of Fullerene, Carbon Nanotubes, Nano Diamond, Boron nitride nanotubes, Single electron transistors, Molecular machine, Nano Biometrics, Nano Robots,

UNIT-IV

Nano-Alloys: Introduction, Chemical Synthesis: General Concepts, Reduction of Metallic Salts, The Organometallic Route: Thermal Decomposition Method, Other Chemical Methods for synthesis of Nano-alloys,Physical Routes for synthesis of Nano-Alloys;Experimental Techniques and Examples.

Shape memory alloys (SMA): Shape memory effect and the metallurgical phenomenon of SMA, Types of SMA, One way and two way Shape memory effect. Temperature assisted shape memory effect, Applications.

RECOMMENDED BOOKS:

- Gandhi, M.V. and Thompson, B.S., Smart materials and Structures, Chapman & Hall,1992.
- Ananthasuresh G.K., Vinoy K.J., Micro and Smart Systems, Wiley India.

- Wei Yan, Wei Wang, 9-12 Cr Heat Resistant Steels, Engineering Material series, Springer International.
- Damien Alloyeau, Christine Mottet, Nanoalloys Synthesis, Structure and Properties, Springer International.
- Tatiana Correia, Qi Zhang, Electrocaloric Materials: New Generation of Coolers
- Otsuka, K. and Wayman, C. M., Shape memory materials, C.U.P,1998
- Taylor, W., Pizoelectricity, George Gorden and Breach Sc. Pub.,1985
- Mallick, P.K., Fiber Reinforced Composites Materials, Manufacturing andDesign. Marcel Dekker Inc, New York,1993.
- Rama Rao, P. (ed.), Advances in Materials and their applications, Wiley EasternLtd.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP–109A	NON-CONVENTIONAL MACHINING						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs.**
Objective	To acquaint the students with the advanced technologies and processes in various streams of Non-conventional machining.						
Course Outcomes							
CO1	To impart knowledge of Various Non-conventional Mechanical Working Processes, technology, process parameters and analysis for metal removal for these processes.						
CO2	To acquaint students with deep knowhow about chemical and electrochemical machining processes,						
CO3	To impart knowledge to students about various kinds of Electric discharge machining processes, process parameters associated with these processes and various process characteristics.						
CO4	To let student understand the working and technology associated with Laser Beam machining and Electron beam machining processes.						

UNIT-I

Introduction, Need of Non-conventional machining processes, Characteristics of conventional and Non-conventional Machining processes. **Mechanical Working Processes**: **Abrasive Jet Machining:** Machining setup, Abrasives, Process Parameters, Machining Characteristics, Material removal models in AJM, Process capability, Advantages, limitations, Applications

Water Jet Machining: Basic mechanism of Water jet machining setup, Process parameters, Catcher, Process capabilities, Advantages, limitations, Applications **Abrasive Water Jet Machining process:** Working Principle, AWJM Machine, Process Variables, Mechanism of Metal Removal, Cutting Parameters, Process capabilities, Applications, Environmental issues.

Ultrasonic Machining: Fundamental principles, Equipment, Magnetostriction, Elements of process, Mechanics of cutting, Analysis of Process Parameters, Process capabilities, Economic considerations. Applications, Limitations

UNIT-II

Chemical Machining: Introduction, Fundamental Principles, Process Parameters; Maskants and Etchants, Advantages, Limitations, Applications.

Electrochemical Machining Processes: Introduction, Classification of ECM Processes, Fundamentals Principles of ECM, Elements of ECM, ECM Machine Tool Process, Determination of Metal Removal Rate, Evaluation of Metal Removal of an alloy, Electrochemistry of ECM, Cathode and Anode reaction, Dynamics of ECM, Self-Regulating feature of ECM, Process Parameters, Process capabilities, Electrochemical Deburring. **Electrochemical Grinding:** Schematics, Electrochemistry, Process Parameters, Process capabilities, Applications, Advantages, Limitations.

UNIT-III

EDM: Introduction, Basic Principles & Schematics, Process Parameters, Characteristics of EDM, Dielectric, Electrode Material, Modelling of Material Removal, Spark Erosion Generators, Analysis and Metal Removal Rate in RC circuit, Selection of Tool Material and Tool Design, Di-Electric system, Process Variables, Dielectric Pollution and its effects, Process Characteristics, Applications, Electric Discharge Grinding and Electric Discharge Diamond Grinding; **Wire EDM**: Working Principle, Wire EDM Machine, Advances in Wire-cut EDM Process Variables, Process Characteristics, Applications.

UNIT-IV

Laser Beam Machining Back Ground, Production of Laser, Working Principle of LBM, Types of LASERS, Process Characteristics, and Metallurgical effects, Advantages and Limitations, Applications.

Electron Beam Machining:

Electron Beam Action, Generation and control of Electron beam, Theory of Electron Beam Machining, Process Parameters, Process capabilities, Applications.

High Energy Rate Forming, Elctro-Hydraulic Forming, Explosive Forming, Hot Machining Analysis of the Process.

RECOMMENDED BOOKS:

1V.K. Jain, Advanced Machining Processes, Allied Publishers Pvt Ltd
2P.C. Pandey and H.S. Shan,Modern Machining Processes, Tata McGraw- Hill
3M. K. Singh, Unconventional Manufacturing Process, New Age Publishers
4J. A. Mcgeough, Advanced Methods of Machining,Springer.
5 Benedict, Non-Traditional Manufacturing Process, CRC pub.
6P. K. Mishra, Nonconventional manufacturing, Narosa Publishers

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-II

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP-111A	PRODUCT DESIGN AND DEVELOPMENT						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs.**
Objective	The objective of the course is to understand about the product design and developments with inputs from aesthetics, ergonomics, design for manufacturing ease and cost effectiveness apart from reliability and durability and other considerations.						
Course Outcomes							
CO1	To understand the concept of product design, design considerations, design practiced by the industry, production and marketing, and aesthetics.						
CO2	To provide a detailed fundamental approach to several primary processes and design guidelines for manufacturing, assembly and environment.						
CO3	To discuss the human factor engineering and the concept of value engineering.						
CO4	To study the modern approaches to product design, concept of product development and its manufacturing and economic aspects.						

UNIT-I

INTRODUCTION: Introduction to product design, Design by evolution and innovation, Essential factors of product design, Production consumption cycle, Flow and value addition in production consumption cycle, Morphology of design.

PRODUCT DESIGN PRACTICE AND INDUSTRY: Product strategies, Time to market, Analysis of the product, Basic design considerations, Role of aesthetics in product design.

UNIT-II

DESIGN FOR MANUFACTURE AND ASSEMBLY: Overview and motivation, Basic method: Design guidelines: Design for assembly, Design for piece part production, Advanced method: Manufacturing cost analysis, cost driver modeling, Critique for design for assembly method.

DESIGN FOR THE ENVIRONMENT: Environmental objectives, Basic DFE methods, Design guidelines, Life cycle assessment, Techniques to reduce environmental impact.

UNIT-III

HUMAN ENGINEERING CONSIDERATIONS IN PRODUCT DESIGN: Human being as applicator of forces, Anthropometry, the design of controls, the design of displays, Man/Machine information exchange, Workplace layout from ergonomic considerations.

VALUE ENGINEERING: Value, Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, value analysis job plan, creativity, steps to problem solving and value analysis, value analysis tests, value engineering idea generation check list, Cost reduction through value engineering-case study, materials and process selection in value engineering.

UNIT-IV

MODERN APPROACHES TO PRODUCT DESIGN: Concurrent design, Quality function deployment (QFD), Rapid prototyping, 3D printing, Introduction to 4D printing.

PRODUCT DEVELOPMENT: A modern product development process, reverse engineering and redesign product development process, product life cycle, product development teams, Product development planning, Manufacturing & economic aspects of product development.

RECOMMENDED BOOKS:

1. Kail T Ulrich and Steven D Eppinger, "Product Design and Development, TMH.

2. AK Chitale and Gupta, “Product Design and Engineering, PHI.
3. Niebel & Draper, “Product Design and Process Engineering”, McGraw-Hill.
4. Kevin Otto & Kristin Wood, “Product Design-Techniques in reverse engineering and new product development”Pearson.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP–113A	SIMULATION OF INDUSTRIAL SYSTEMS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of industrial systems and its simulation.						
Course Outcomes							
CO1	To explain the concept of industrial simulation systems and its models of simulation.						
CO2	To understand the simulation of discrete and queueing systems.						
CO3	To understand the simulation if inventory systems and design of simulation experiments.						
CO4	To simulate the industrial problems like reliability problems,computertimesharingproblem and understand the simulation languages.						

UNIT-I

Introduction and overview: concept of system, system environment, elements of system, system modeling, types of models, Monte Carlo method, system simulation, simulation - a management laboratory, advantages & limitations of system simulation, continuous and discrete systems.

Simulation of continuous systems: characteristics of a continuous system, comparison of numerical integration with continuous simulation system. Simulation of an integration formula.

UNIT-II

Simulation of discrete system: Time flow mechanisms, Discrete and continuous probability density functions. Generation of random numbers, testing of random numbers for randomness and for auto correlation, generation of random variates for discrete distribution, generation of random variates for continuous probability distributions-binomial, normal, exponential and beta distributions; combination of discrete event and continuous models.

Simulation of queuing systems: Concept of queuing theory, characteristic of queues, stationary and time dependent queues, queue discipline, time series analysis, measure of system performance.

Kendall's notation, auto covariance and auto correlation function, auto correlation effects in queuing systems, simulation of single server queues, multi-server queues, queues involving complex arrivals and service times with blanking and reneging.

UNIT-III

Simulation of inventory systems: Rudiments of inventory theory, MRP, in-process inventory. Necessity of simulation in inventory problems, forecasting and regression analysis, forecasting through simulation, generation of Poisson and Erlang variates, simulation of complex inventory situations.

Design of Simulation experiments: Length of run, elimination of initial bias, Variance, Variance reduction techniques, stratified sampling, antipathetic sampling, common random numbers,

time series analysis, spectral analysis, model validation, optimization procedures, search methods, single variable deterministic case search, single variable non-deterministic case search, and regenerative technique.

UNIT-IV

Simulation of PERT: Simulation of - maintenance and replacement problems, capacity planning, production systems, reliability problems, computer time sharing problem, the elevator system.

Simulation Languages: Continuous and discrete simulation languages, block structured continuous languages, special purpose simulation languages, SIMSCRIPT, GPSS SIMULA importance and limitations of special purpose languages.

RECOMMENDED BOOKS:

1. Loffick, Simulation and Modelling - Tata McGraw Hill
2. Deo Narsingh, System Simulation with Digital Computer - Prentice Hall
3. Hira, D.S., System Simulation-S. Chand & Co.
4. Meelamkavil, Computer Simulation and Modelling - John Willey
5. Gorden, System Simulation - Prentice hall
6. Jerry Banks and John, S. Carson II, 'Discrete – Event System Simulation', Prentice Hall Inc., NewJersey, 1984.
7. Geoffrey Gordon, 'System simulation', Prentice Hall, NJ, 1978.
8. Law, A.M. and W.D. Keltor, 'Simulation modelling analysis', McGraw Hill, 1982.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP–115A	**SUPPLY CHAIN MANAGEMENT**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of the course is to impart the students with the knowledge of Supply chain and different aspects of supply chain management.						
Course Outcomes							
CO1	To impart knowledge about basics of Supply chain management and Supply						
CO2	To acquaint students with the different aspects involved in sourcing and procurement in supply chain management.						
CO3	To impart knowledge to students about Evaluating performance of Supply chain and decision making about Transportation, Storage and warehousing.						
CO4	To let student understand Quantitative tools for SCM, Information Technology in a Supply Chain:						

UNIT-I

Overview of supply chain management: Introduction, Definition, The Objective of a Supply Chain, The Importance of Supply Chain Decisions, Decision Phases in a Supply Chain, Process Views of a Supply Chain, Examples of Supply Chains.

Supply chain dynamics: Introduction, Coping with Dynamics in Supply chain. Bullwhip effect, Analysis of Bullwhip Effect, Impact of Lead time, Inventory management and Supply chain dynamics, offshoring and outsourcing Effect on SC dynamics and cost.

UNIT-II

Outsourcing and Make or Buy Decisions: Strategic Decisions and Core competencies, Tactical Decisions, Factors influencing make or buy decisions, Control of Production or Quality, Unreliable Suppliers, Suppliers Specialized knowledge and research, Small Volume Requirements, Limited Facilities, Workforce Stability, Multiple Sourcing Policy, Managerial and Procurement considerations, the Volatile nature of Make/Buy situation, Administration: Procedures and Personal.

Sourcing of Supply: Importance of Source Selection, Responsibilities for Source Selection, Evaluating a potential supplier, the criticality of Qualifying Sources, Competitive Bidding and Negotiation, Prerequisite for competitive bidding, two step Bidding/Negotiation, Benefits and Risks of International Sourcing, Identifying and Qualifying an International Source.

UNIT-III

Supply Chain Performance: Achieving Strategic fit And Scope: Competitive and Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope**,** Challenges to Achieving and Maintaining, Strategic Fit, Supply chain drivers and metrics, Financial Measures of Performance, Drivers of Supply Chain Performance, Framework for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing.

Transportation, storage and warehousing: Introduction, Transportation mode choice, Transport operator decisions, Trucking sectors in India, Rail transport, Air Transport, Water transport, Transport network, Storage and warehousing, types of warehousing, risk pooling, IT Integration: Supply chain information system, Role of IT in SCM process, Business process Re-engineering, Internet and its applications in SCM.

UNIT-IV

Quantitative tools for SCM: Introduction, Forecasting, Demand forecast, Forecasting strategy & technique, Management of Inventories in SC, Linear programming, Routing models, pricing decisions, Introduction to MCDM approach.

Information Technology in a Supply Chain: The Role of IT in a Supply Chain, The Supply Chain IT Framework Customer Relationship Management, Internal Supply Chain Management, Supplier Relationship Management, The Transaction Management Foundation, The Future of IT in the Supply Chain, Risk Management in IT, Supply Chain IT in practice.

RECOMMENDED BOOKS:

1. Chopra, S., and Meindl, P., Supply chain Management: Strategy, Planning and Operations. Second Edition, Pearson Education (Singapore) Pte. Ltd, 2004.
2. Rangaraj, Supply Chain Management for Competitive Advantage, TMH.
3. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw-Hill Edition, 2003.
4. Doebler, D.W. and Burt, D.N., Purchasing and Supply Chain Management: Text and Cases, McGraw-Hill Publishing Company Limited, New Delhi, 1996.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit..*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTRM-111A	RESEARCH METHODOLOGY AND IPR						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**2**	**60**	**40**	**100**	**3**

Objective	The objective of this course is to make the students capable of formulating the research problems/ proposals and get aware about the intellectual property and patent laws.
Course Outcomes	
CO 1	Student will be able to understand research problem formulation.
CO 2	Student will be able to analyze research related information and follow research ethics.
CO 3	Student will be able to understand the Patents, Designs, Trade and Copyright and able to apply the knowledge for patent.
CO 4	Student will be able to understand the concept of Patent Rights, Licensing and transfer of technology and able to apply the knowledge in new developments in IPR.

Unit-I

Meaning of research problem, Sources of research problem, Criteria, characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit-II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit-III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit-IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and Institutions.

RECOMMENDED BOOKS:

- Stuart Melville and Wayne Goddard, "Research methodology: An introduction for science & engineering students" Kenwyn, South Africa : Juta & Co. Ltd., 1996
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Juta Academic; 2nd edition (April 28, 2004)
- Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners" SAGE Publications Ltd; Fourth edition (14 January 2014)
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
- Mayall, "Industrial Design", McGraw Hill, 1992.

- Niebel, "Product Design", McGraw Hill, 1974.
- Asimov, "Introduction to Design", Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers; Revised edition (July 25, 2007)
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTMT-103	ADVANCED TRIBOLOGY LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	To study friction, wear mechanism of materials and performance of lubricants under various test conditions using concepts, methods and application of Industrial Tribology.							
Course Outcomes								
CO1	Students will be able to understand the friction phenomena and different wear processes in contacts between metallic, ceramic and polymeric surfaces.							
CO2	Students will be able to know different types of lubricants, their grades, test standards and different properties of lubricants.							
CO3	Students will be able to understand the causes of tribological failures and surface characterization.							
CO4	Students will be able to use different types of tribo-test equipments and design of wear and friction test.							

List of Experiments

1. To study the friction and wear properties of a specimen (metallic/polymeric/ceramic surfaces) using wear and friction monitoring apparatus under dry sliding conditions.
2. To study the friction and wear properties of a specimen (metallic/polymeric/ceramic surfaces) using wear and friction monitoring apparatus under wet sliding conditions.
3. To study the effect of temperature on the friction and wear performance of composite materials using high temperature pin/ball on disc tester.
4. To study the variation of viscosity of lubricants with temperature.
5. To evaluate the wear and extreme pressure properties of a lubricating oil/ grease using four ball tester.
6. To study the surface characterization of wear components.
7. To study different types of industrial abrasives materials, properties and applications.
8. To determine abrasion index of a material with the help of dry abrasion test rig.
9. To access the adhesion and scratch resistance of surface coatings (hard or soft) using Scratch Tester.
10. To determine the erosive wear rate of different materials using Air Jet Erosion Tester under different conditions.
11. To demonstrate the pressure distribution of a lubricant in a journal bearing.

Note: At least eight experiments should be performed from the above list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP-119 A	COMPUTER AIDED DESIGN AND MANUFACTURING LAB							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical	Total	Time
0	0	4	2	-	40	60	100	3hrs.
Objective	To acquaint the students with 2-D and 3-D modeling using design softwares.							
Course Outcomes								
CO1	To understand the basic solid modeling and applied features of the softwares.							
CO2	To learn and practice of surface techniques and surface creations using software.							
CO3	To learn and practice of assembly and detailed drafting.							
CO4	To let student understand how to prepare MMCs using Stir Casting process.							

List of Experiments:

The students will be required to carry out the following exercises or their equivalent tasks using a 3-D modeling software package (e.g. Solid-works/ Creo/ Ideas/ Solid Edge/UG/CATIA/ etc.). Practical must be performed on licensed version (Preferably the latest version) of any one of above mentioned software.

1 BASIC SOLID MODELING

Introduction & sketcher tools

a) CAD Tools and Applications: CAD - CAM - CAE
b) Parametric Feature Based Modelling and Parent-Child Relation
c) Design Intent and Associativity between 3 Modes
d) Modelling Software - Getting Started & Graphical User Interface
e) Sketch Entities and Tools
f) Dimensioning and Adding Relations to define the Sketch

Sketched Features (Boss / Base and Cut)

a) Base Features
b) Extrude & Revolve
c) Reference Geometry, Curves & 3D Sketch
d) Sweep & Loft

Editing & Refining Model

a) Editing Sketch, Sketch Plane and Editing Feature
b) Suppress / Un-Suppress Feature and Reordering Feature

2 ADVANCE FEATURES APPLIED FEATURES

a) Patterns & Mirror
b) Fillet/Round & Chamfer
c) Hole & Hole Wizard
d) Draft, Shell, Rib and Scale
e) Dome, Flex and Wrap

Multi Body

a) Indent Tool
b) Combine Bodies – Boolean Operations
c) Split, Move/Copy and Delete Bodies

Other Tools & Options

a) Design Table and Configurations
b) Adding Equations and Link Values
c) Tools - Measure and Mass Properties

d) Appearance - Edit Material, Colour and Texture
e) Options - System and Document Properties

3 SURFACING TECHNIQUES BASIC SURFACE CREATIONS
a) Extrude & Revolve
b) Sweep & Loft
c) Boundary Surface
d) Planar Surface
Other Derived Techniques
a) Offset Surface
b) Radiate Surface
c) Ruled Surface
d) Fill Surface
e) Mid Surface
Modify / Edit Surfaces
a) Fillet/Round
b) Extend
c) Trim & Untrim
d) Knit Surfaces
e) Delete and Patch
Surfaces for Hybrid Modelling
a) Thicken – Boss / Base and Cut
b) Replace face
c) End condition for Sketched feature - Up to Surface or Offset from Surface.
d) Solid body from closed surfaces

4 ASSEMBLY & MECHANISMS BOTTOM UP ASSEMBLY APPROACH
a) Inserting Components/Sub-Assemblies
b) Adding Mates - Standard & Advance
c) Editing Mates, Part and Replacing Components
Top down Approach & Mechanisms
a) Inserting New Part to Existing Assembly
b) Use of Layout Sketching
c) External References - In-context and Out-of-context, Locked and Broken
Assembly Features
a) Component Patterns & Mirrors
b) Cuts & Holes
c) Belt/Chain and Weld Bead
Representations of Assembly Components
a) Light Weight, Suppressed and Resolved
b) Hide, Transparency and Isolate
c) Exploded View
Assembly Check
a) Interference Detection,
b) Collision Detection and Physical Dynamics
Motion Study
c) Assembly Motion & Physical Simulation
d) Animation Wizard & Save as AVI file
e) Mechanism Analysis – Plot Displacement, Velocity and Acceleration Diagram

5 DETAILED DRAFTING
Introduction to Engineering Drawings
a) General Procedure for Drafting & Detailing

b) Inserting Drawing Views, Dimensioning and Adding Annotations
c) Drawing Templates & Sheet Format
d) Setting Options

Drawing Views

a) Model View & Standard 3 View
b) Projected View & Auxiliary View
c) Section & Aligned Section View
d) Detail View, Broken-out Section and Crop View.

Dimensioning

a) Standards, Rules and Guidelines
b) Dimension Insertion/Creation - Insert Model Items & Dimension tool

Annotations

a) Notes & Holes Callout
b) Datum & Geometric Tolerances
c) Surface Finish & Weld Symbols, Centre Mark & Centre line, BOM Balloon & Bill of Material

Audit Course-I

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTAD-101 A	ENGLISH FOR RESEARCH PAPER WRITING						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to impart the knowledge of English for research paper writing.						
Course Outcomes							
CO1	To understand that how to improve writing skills and level of readability.						
CO2	To Learn about what to write in each section.						
CO3	To understand the skills needed when writing a title.						
CO4	To learn the skills required in writing the results, discussion and conclusions.						

Unit-I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit-II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit-III

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. Key skills needed when writing a Title, key skills needed when writing an abstract, key skills needed when writing an Introduction, skills needed when writing a Review of the Literature.

Unit-IV

Skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions, Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

RECOMMENDED BOOKS:

- Goldbort R, "Writing for Science", Yale University Press (available on Google Books)
- Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press
- Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM. Highman's book.
- Adrian Wallwork, "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTAD-103 A	DISASTER MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to impart the knowledge of disasters management.						
Course Outcomes							
CO1	To demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.						
CO2	To critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.						
CO3	To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.						
CO4	To critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.						

Unit-I

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit-II

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Unit-III

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

Unit-IV

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

RECOMMENDED BOOKS:

- R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
- Sahni, Pardeep (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
- Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTAD- 105 A	SANSKRIT FOR TECHNICAL KNOWLEDGE						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to understand basic Sanskrit Language and Ancient Sanskrit literature related to science & technology.						
Course Outcomes							
CO1	Students will get a working knowledge in illustrious Sanskrit, the scientific language of the world.						
CO2	Learning of Sanskrit to improve brain functioning.						
CO3	Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.						
CO4	The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.						

Unit-I

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Unit-II

Order, Introduction of roots, Technical information about Sanskrit Literature

Unit-III

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

RECOMMENDED BOOKS:

- Dr.Vishwas, "Abhyaspustakam" Samskrita-Bharti Publication, New Delhi
- Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam "Teach Yourself Sanskrit" Prathama Deeksha-, New Delhi Publication
- Suresh Soni, "India's Glorious Scientific Tradition" Ocean books (P) Ltd., New Delhi.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(MANUFACTURING TECHNOLOGY)

MTAD-107 A	VALUE EDUCATION						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to understand value education, self-development, and Imbibe good values in students and Let them know about the importance of character building.						
Course Outcomes							
CO1	To get knowledge of self-development.						
CO2	To learn the importance of Human values.						
CO3	To develop the overall personality.						
CO4	To know about the importance of character.						

Unit-I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

Unit-II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

Unit-III

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

Unit-IV

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively

RECOMMENDED BOOKS:

- Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Second Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP-102 A	MECHATRONICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to acquaint the knowledge of electronic devices and electromechanical systems, hydraulic and pneumatic systems, CNC, Robotics and PLC's.						
Course Outcomes							
CO1	To understand the concepts of Mechatronics, fundamental of electronics and digital circuits and electrical actuating circuits.						
CO2	To acquaint the knowledge of hydraulic system with its practical applications.						
CO3	To acquaint the knowledge of pneumatic system with its practical applications.						
CO4	To study the fundamentals of CNC, Robotics and programmable logic controllers (PLC's) and their use.						

UNIT-I

Introduction: The Mechatronics approach: A methodology for integrated design of Mechanical, Electronics and Electrical Control, Computer and Instrumentation.

Fundamentals of Electronics and digital circuits: Number systems: Binary, Octal, Hexadecimal, Conversion from Binary to Decimal, Octal and Hexadecimal and vice–versa, Binary arithmetic: Addition, subtraction, Multiplication and division, Boolean Algebra: Laws, De-Morgan's laws, Logic Gates, Truth tables, Karnaugh maps and logic circuits. Generation of Boolean function from truth tables and simplification, **Electrical actuating system:** Basic principle of electrical switching, Solenoids, Electrical relays, Representation of output devices, Electrical motors: A.C. motors, Stepper motors, Induction motor speed control.

UNIT-II

HYDRAULIC SYSTEMS:

Direction Control Valves: Poppet Valve, Spool Valve, Sliding Spool type DCV, Check Valve, Pilot operated check valve, Restriction check valve, 2 Way vale, 3 way valve, 4 way valve, Manually actuated valve, Mechanically actuated valve, Pilot operated DCV, Solenoid Actuated valve, Rotary Valve, Centre flow path configurations for three position four way valve, Shuttle valve

Pressure Control Valve: Simple and compound pressure Relief Valve, Pressure Reducing Valve, Unloading valve, sequence valve, counterbalance valve, Brake Valve

Flow Control Valves: Fixed and non-adjustable valve, adjustable, throttling, non-pressure compensated pressure control valve, Pressure/temperature compensated flow control valve, Shuttle and Fast exhaust valve, Time delay valve, Flow Control Valves, Fluid Conditioners, Hydraulic Symbols (ANSI), Hydraulic Circuit design: Control of Single and double acting cylinders, double pump Hydraulic System

UNIT-III

PNEUMATIC SYSTEM:

Air Generation and distribution: Air compressors, Air Receiver, Filters, intercoolers, After-coolers, Relief Valve, Air dryers, Primary and secondary lines, Piping layouts, Air Filters, Air Regulators, Air Lubricator, Actuators and output devices, Direction control valves, Flow control valves, junction elements, Pneumatic circuits, Control of Single and double acting cylinders.

UNIT-IV

INTRODUCTION TO CNC MACHINES AND ROBOTICS:

CNC Machines: NC machines, CNC machines, DNC machines, Machine structure, Slide-ways, Guideways, Slide Drives, Spindle, Robotics:Components of robots, Classification of robots, Robots application

PROGRAMMABLE LOGIC CONTROLLERS

Introduction - Principles of operation - PLC Architecture and specifications - PLC hardware Components, Analog & digital I/O modules, CPU & memory module - Programming devices - PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram. PLC programming Simple instructions - Manually operated switches - Mechanically operated Proximity switches - Latching relays, Applications of PLC.

RECOMMENDED BOOKS:

1. W. Bolton, Mechatronics, Pearson Education.
2. Majumdar, Pneumatic system, TMH.
3. Andrew Parr, Hydraulic and Pneumatic systems,TMH.
4. M.P. Groover, Automation, Production systems and computer integrated manufacturing, TMH.
5. Shetty and Kolk, Mechatronics system design, Thomson learning.
6. Mahalik, Mechatronics, TMH.
7. Anthony Esposito, Fluid power with application, Pearson Education.
8. K.P Ramachandran, M.S Balasundaram, Mechatronics, Wiley India.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks.* The student will attempt a total of *FIVE questions,* each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining/our questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2ND Sem.)
(MANUFACTRING TECHNOLOGY)

MTMT -102	AUTOMATION AND COMPUTER-INTEGRATED MANUFACTURING						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of automation with manufacturing concern.						
Course Outcomes							
CO1	To impart knowledge about various functional requirements of automation in Manufacturing and material conveyor system.						
CO2	To acquaint students with the FMS, part program and their functional significance and GT.						
CO3	To impart knowledge to students about CAD/CAM/CIM and CAPP						
CO4	To let student understand basics of NC/CNC/DNC						

Unit-I

Introduction: Automation in Production System, Principles and Strategies of Automation,Basic Elements of an Automated System, Advanced Automation Functions, Level of Automation

Material Handling: Material Handling Systems, AG vehicles, conveyer system, features of industrial robots, AutomatedStorage/Retrieval Systems, Work holding system

Unit-II

Automated Manufacturing Systems: Components,Classification and Overview ofManufacturing Systems, GT and Cellular Manufacturing, Part families, Part Classification and coding,Product flow analysis, Group technology machine cells, benefits of GT.

FMS, Introduction to FMS - concepts, FMS components, application and benefits, FMS planning and implementation issues,Distributed data processing in FMS –DBMS and their applications in CAD/CAM

Unit-III

Product design: Product design and CAD, CAD system hardware, CAM, CAD/CAM and Computer Integrated Manufacturing, Quality function deployment.

Process Planning- Introduction, Computer-aided process planning, Material requirementplanning, Capacity planning, shop floor control, advanced manufacturing planning.

Unit-IV

Numeric Control: Fundamentals of NC technology, Computer numeric control, distributed numeric control,Applications of Numeric control.

Industrial Robotics: Robot anatomy and related attributes, Robot control system, End effectors, Sensors in Robotics, Industrial Robot applications.

Suggested books:

1 Automation, Production systems and CIM by MIKELL P. Grover, PHI.
2 Computer Integrated Manufacturing by Kant Vajpayee.
3. David J.Parrish, "Flexible Manufacturing" Butterworth-Heinemann, 1990.

Programme Elective-III

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP-106 A	ADVANCED WELDING PROCESSES						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of Welding metallurgy and welding processes.						
Course Outcomes							
CO1	To impart knowledge about various Weld metallurgy and Weld arc characteristics.						
CO2	To acquaint students with the various welding power sources and their applications.						
CO3	To impart knowledge to students about Electrode coatings and Metal transfer phenomenon in weld metal transfer.						
CO4	To let student understand the basics of Solid state welding processes and some of the latest welding techniques.						

UNIT-I

WELDING METALLURGY: Introduction, Weld Metal Zone, Theory of solidification of metals and alloys, Homogeneous Nucleation, Heterogeneous Nucleation, Freezing of alloys, Epitaxial Solidification; Effect of Welding speed on Grain structure, Fusion boundary zone, Heat affected zone, Under bead zone, Grain Refined Zone, Partial transformed zone, Properties of HAZ

WELDING ARC: Definition of Arc, Structure and characteristics, Arc efficiency, arc blow, Electrical Characteristics of arc, Types of Welding Arcs, mechanism of arc initiation and maintenance, role of electrode polarity on arc behaviour and arc stability, analysis of the arc. Arc length regulation in mechanized welding processes.

UNIT-II

WELDING POWER SOURCES: Requirement of an Arc welding power sources, basic characteristics of power sources for various arc welding processes, duty cycles, Selection of a static Volt-Ampere characteristic for a welding process, AC/DC welding power source, DC rectifiers, thyristor controlled rectifiers, transistorized units, inverter systems, Mathematical Problems on Static volt ampere characteristics

UNIT-III

COATED ELECTRODES: Electrode coatings, classification of coatings of electrodes for SMAW, SAW fluxes, role of flux ingredients and shielding gases, classification of solid and flux code wires.

METAL TRANSFER & MELTING RATE: Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal transfer and melting rate.

UNIT-IV

SOLID STATE WELDING: Theory and mechanism of solid state welding,techniques and scope of friction welding, diffusion welding, cold pressure welding and ultrasonic welding, high energy rate welding,analysis of the Process.

WELDING TECHNIQUES: Technique, scope and application of the electron beam and laser welding processes,under water welding - process & problem.

RECOMMENDED BOOKS:

1Raymond Sacks, —Welding: Principles & Practices|| McGraw-Hill
2R.S.Parmar, —Welding processes & Technology||, Khanna Publishers
3R.S.Parmar, —Welding Engineering & Technology||, Khanna Publishers
4S.V. Nandkarni, —Modern Arc Welding Technology, Oxford & IBH publishing Co.
5L.M.Gourd, —Principles of Welding Technology||, ELBS/ Edward Arnold.
6Richard L. Little —Welding & Welding Technology||, Mc-Graw Hill.
7Cary, Howard —Modern Welding Technology', prentice Hall, 1998.
8Rossi —Welding Technology||, Mc-Graw Hill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).
All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP–108 A	ADVANCED METAL CUTTING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of advanced cutting tools, tools geometry, mechanisms and analysis.						
Course Outcomes							
CO1	To impart knowledge about various functional related to tools geometry.						
CO2	To acquaint with the analysis of fundamental factors affecting tool forces						
CO3	To impart knowledge about cutting tool life and mathematical modelling for wear.						
CO4	To let student understand abrasive machining and its process simulation.						

UNIT-I

Introduction system of Tool nomenclature, Tool Geometry, Mechanism of Chip formation and forces in orthogonal cutting, Merchant's force diagram.

Oblique Cutting: Normal chip reduction coefficient under oblique cutting, true shear angle, effective rake, influx region consideration for deformation, direction of maximum elongation, effect of cutting variables on chip reduction co-efficient, forces system in oblique cutting, effect of wear land on force system, force system in milling, effect of helix angle.

UNIT-II

Fundamentals of Dynamometry, Theoretical determination of forces, angle relations, heat and temperature during metal cutting; distribution, measurement, analysis, theoretical estimation of work piece temperature, hot machining

Fundamental factors, which effect tool forces: Correlation of standard mechanized test. (Abuladze – relation), nature of contact and stagnant phenomenon, rates of strains, shear strain and normal strain distributions, cutting variables on cutting forces.

UNIT-III

Cutting Tools: Tools materials analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, wear of cutting tools, criterion, flank and crater wear analysis, optimum tool life, tool life equations, (Taylor's woxen etc) Tool life test, machining optimization, predominant types of wear; abrasive, adhesive, diffusion wear models, wear measurements and techniques, Major Test of tool wear oxidative mathematical modelling for wear, test of machinability and influence of metallurgy on machinability. Economics of metal machining

UNIT-IV

Abrasive Machining: Mechanics of grinding, cutting action of grit, maximum grit chip thickness, energy and grit force temperature during grinding, wheel wear, grinding, process simulation, testing of grinding wheels, mechanics of lapping and honing, free body abrasion.

RECOMMENDED BOOKS:

1. Sen & Bhattacharya,Principles of Machine tools, New Central Book Agency.
2. Brown,Machining of Metals, Prentice Hall.
3. Shaw,Principles of Metal cutting, Oxford I.B.H.
4. Arshimov & Alekree,Metal cutting theory & Cutting tool design, MIR Publications.
5. Machining Science & Application by Knowenberg Longman Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP-110 A	METROLOGY						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs.**
Objective	The main objective of the course is to deal with the basic principles of dimensional measuring instruments and precision measurement techniquesin achieving quality and reliability in the service of any product in dimensional control.						
Course Outcomes							
CO1	To understand the studentsabout the requirement of metrology and the concepts of limit, fits and gauges.						
CO2	To study the linear and angular measurements and the optical measurement tools and techniques.						
CO3	To understand how to use surface roughness and thread measuring instruments.						
CO4	To study the comparators, measurement through comparators and the advanced metrology concepts.						

UNIT-I

Introduction to metrology: Definition, types, need of inspection, terminologies, methods of measurement, selection of instruments, measurement errors, units, Measurement standards, calibration, statistical concepts in metrology.

Systems of Limits and Fits: Introduction, nominal size, tolerance limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard Institution system – British standard system, International standard system for plain and screwed work.

Limit Gauges: Taylor's principle – Design of limit gauges, computer aided tolerancing.

UNIT-II

Linear Measurement: Length standard, line and end standards, slip gauges – calibration of the slip gauges, dial indicator, micro-meter. Measurement of angles and tapers: Different methods – bevel protractor – angle slip gauges – spirit levels– sine bar – sine plate, rollers and spheres.

Flat Surface Measurement: Measurement of flat surfaces – instruments used – straight edges– surface plates – optical flat and auto collimator.

Optical Measuring Instruments: Tool maker's microscope and its uses, collimators, optical projector, optical flats and their uses, interferometer.

UNIT-III

Surface Roughness Measurement: Introduction, terminology, specifying roughness on drawings, surface roughness parameters, factors affecting surface roughness, ideal surface roughness, roughness measurement methods, precautions in measurement, surface microscopy, surface finish softwares.

Screw Thread Measurement: Elements of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch, profile thread gauges.

Measurement through Comparators: Comparator: Features of comparators, classification of comparators, different comparators, advanced comparators, thread comparators.

UNIT-IV

Metrology of machine tools: Alignment and practical tests.

Gear Measurement: Gear measuring instruments, gear tooth profile measurement, measurement of diameter, pitch, pressure angle and tooth thickness.

Advanced Metrology: Advanced measuring machines, CNC systems, Laser vision, In-process gauging, 3D metrology, metrology softwares, Nano technology instrumentation, stage position metrology, testing and certification services, optical system design, lens design, coating design, precision lens assembly techniques, complex opto mechanical assemblies, contact bonding and other joining technologies.

RECOMMENDED BOOKS:

1. K.J. Hume,Engineering Metrology, Macdonald and Co. (publisher) London.
2. Czichos, The Springer handbook of metrology and Testing, 2011.
3. Jay. L. Bucher, The Metrology Hand book, American Society for Quality, 2004.
4. Smith GT,Industrial Metrology, Spinger.
5. John W. Greve, Frank W. Wilson,Hand book of industrial metrology, PHI – New Delhi.
6. D.M. Anthony, Engineering Metrology, Pergamon Press.
7. Khare MK,Dimensional Metrology, OXFORD-IBH Publishers.
8. I C Gupta, "Engineering Metrology", 5th Edition, Danapath Rai & Co, 2008.
9. R.K. Jain, "Engineering Metrology". 20th Edition, Khanna Publishers, 2007.
10. M. Mahajan, "Engineering Metrology", Dhanapati Rai publications, 2007.
11. BIS standards on Limits & Fits (IS 919), Surface Finish (IS 2073), Machine Tool Alignment, 1993.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-IV

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP–112 A	**SEQUENCING AND SCHEDULING**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of different production and machine models of sequencing and scheduling.						
Course Outcomes							
CO1	To understand the concept of sequencing and scheduling.						
CO2	To study and practice for the extension of basic models and parallel machine models.						
CO3	To understand the concepts of the flow shop scheduling and practice for the flow shop scheduling models.						
CO4	To understand the job shop problems and simulation models for dynamic job shop problem.						

UNIT-I

Single-Machine Sequencing: Introduction, Preliminaries, Problems without Due Dates, Problems with Due Dates

Optimization Methods for the Single-Machine Problem: Introduction, Adjacent Pairwise Interchange Methods, A Dynamic Programming Approach, Dominance Properties, A Branch and Bound Approach.

Earliness and Tardiness Costs: Introduction, Minimizing Deviations from a Common Due Date, The Restricted Version, Asymmetric Earliness and Tardiness Costs, Quadratic Costs, Job-Dependent Costs, Distinct Due Dates,Sequencing for Stochastic Scheduling.

UNIT-II

Extensions of the Basic Model: Introduction, Non-simultaneous Arrivals, Related Jobs, Sequence-Dependent Setup Times, Stochastic Models with Sequence-Dependent Setup Times.

Parallel machine models: Introduction, Minimizing the Makespan, Minimizing Total Flow time, Stochastic Models.

UNIT-III

Flow Shop Scheduling: Introduction, Permutation Schedules, The Two-Machine Problem, Special Cases of The Three-Machine Problem, Minimizing the Makespan, Variations of the *m*-Machine Model, Stochastic flow shop scheduling.

UNIT-IV

The Job Shop Problem: Introduction, Types of Schedules, Schedule Generation, the Shifting Bottleneck Procedure, Neighborhood Search Heuristics.

Simulation Models for the Dynamic Job Shop: Introduction, Model Elements, Types of Dispatching Rules, Reducing Mean Flowtime, and Meeting Due Dates.

RECOMMENDED BOOKS:

1. Michael Pinedoo, Scheduling: theory, algorithms and systems, Prentice Hall, New Delhi, 1995.
2. King, J.R. Production planning and control, Pergamon International Library, 1975.
3. Kenneth R. Baker, Introduction to sequencing and scheduling, John Wiley and Sons, 1974.
4. Kenneth R. Baker and Dan Trietsch, Principles of sequencing and scheduling, John Wiley and Sons, 2009.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP–114A	QUALITY ENGINEERING AND MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of quality tools and engineering for the improvement of product quality.						
Course Outcomes							
CO1	To understand the statistical concepts of quality and quality statistics.						
CO2	To study the quality control chartsin production process and practice for its use in problem solving.						
CO3	To understand the quality improvement tools.						
CO4	To study the ISO systems, failure analysis and testing.						

Unit-I

Introduction to Quality: An Historical Overview: Defining Quality, The Total Quality System, Total Quality Management, Economics of Quality, Quality, Productivity, and Competitive Position, Quality Costs, Success Stories.

Statistics for Quality: Variability in Populations, Some Definitions, Quality vs. Variability, Section I: Empirical Methods for Describing Populations, Section II: Mathematical Models for Describing Populations, Section III: Inference of Population Quality from a Sample.

Unit-II

Quality in Design: Planning for Quality, Product Planning, Product Design, Process Design.

Quality in Production-Process Control I: Process Control, the Control Charts, Measurement Control Charts, Attribute Control Charts, Summary on Control Charts, Process Capability, Measurement System Analysis,

Quality in Production-Process Control II: Derivation of Limits, Operating Characteristics of Control Charts, Measurement Control Charts for Special Situations.

Unit-III

Quality in Procurement: Importance of Quality in Supplies, Establishing a Good Supplier Relationship, Choosing and Certifying Suppliers, Specifying the Supplies Completely, Auditing the Supplier, Supply Chain Optimization Using Statistical Sampling for Acceptance,

Continuous Improvement of Quality: The Need for Continuous Improvement, The Problem-Solving Methodology, Quality Improvement Tools, Lean Manufacturing.

Unit-IV

A System for Quality: The Systems Approach, Dr. Deming's System, Dr. Juran's System, Dr. Feigenbaum's System, Baldrige Award Criteria, ISO 9000 Quality Management Systems, ISO 9001:2008 Requirements, The Six Sigma System.

RECOMMENDED BOOKS:

1. Grant & Leaveworth, Statistical Quality Control, McGraw Hill
2. Duncan,Quality Control & Industrial Statistics, Irwin Press
3. Juran,Quality Control Handbook, McGraw Hill.
4. Hansen,Quality Control, Prentice Hall
5. Thomason,An Introduction to reliability & control, Machinery Publishing.
6. A.V. Taylor, Total Quality Control, McGraw-Hill

7. K.S.Krishnamoorthi, V. Ram Krishnamoorthi,A First Course in Quality Engineering: Integrating Statistical and Management Methods of Quality, Second Edition, CRC Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weight of 12 marks*.

The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP–116 A	RELIABILITY ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of reliability analysis in industrial system. Students can get acquainted with different reliability calculation models.						
Course Outcomes							
CO1	To understand the concepts of reliability in industrial systems.						
CO2	To study the reliability determination methods and advanced evaluation techniques.						
CO3	To understand variousreliability prediction and evolution methods.						
CO4	To acquaint the fundamentals of reliability management and risk assessment.						

UNIT-I

Reliability Engineering: Reliability function,failure rate, Mean time between failures (MTBF), Mean time to failure (MTTF), mortality curve, useful life availability, maintainability, system effectiveness. Introduction to probability distributions.

Time to failure distributions: Exponential, normal, Gamma, Weibull; ranking of data, probability plotting techniques, Hazard plotting Concept of Bathtub Hazard Rate curve, Reliability evaluation of two-state device networks-series, parallel, k-out-of-m systems; Standby redundant systems, Reliability evaluation of three-state device networks-series and parallel.

UNIT-II

Reliability Determination and Prediction: Reliability Determination Methods: Network reduction technique, Path tracing technique, Decomposition technique, Delta-Star method.

Advanced Reliability Evaluation Concepts: Supplementary variables technique, Interference theory, Human reliability, Common cause failures, Fault trees, Failure mode and effect analysis

UNIT-III

Reliability Prediction Models: Series and parallel systems - RBD approach - Standby systems - m/n configuration - Application of Baye's theorem - cut and tie set method - Markov analysis - FTA - Limitations.

UNIT-IV

Reliability testing: Time acceleration factor, influence of acceleration factor in test planning, application to acceleration test, high temperature operating life acceleration model, temperature humidity bias acceleration model, temperature cycle acceleration model, vibration accelerator model, failure free accelerated test planning. Accelerated reliability growth.

Risk Assessment: Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.

RECOMMENDED BOOKS:

1. Charles E. Ebeling, “An introduction to Reliability and Maintainability engineering”, TMH, 2000.
2. Roy Billington and Ronald N. Allan, “Reliability Evaluation of Engineering Systems”, Springer, 2007.
3. Sharma S C, Inspection Quality Control and Reliability, Khanna Publishers.
4. Connor P.D.T.O. Practical Reliability Engineering”, John Wiley.
5. Naikan V N A Reliability Engineering and Life Testing”, PHI Learning Private Limited.
6. Prabhakar Murthy D N and Marvin R, “Product Reliability”, Springer-Verlag.

7. Dana Crowe and Alec Feinberg, Design for Reliability, CRC Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weight of 12 marks*.

The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP–118 A	**MECHATRONICS LAB**							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major**	**Minor**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3**
Objective	To practice on electrical circuits, hydraulic and pneumatic systems and PLC's for their practical implications.							
Course Outcomes								
CO1	To understand the PLC using PLC simulators.							
CO2	To demonstrate and actuate the positioning using sensors, actuators and programming.							
CO3	To study the pneumatic and electro-pneumatic training system with simulation software.							
CO4	To design and test on hydraulic and pneumatic circuits.							

List of Experiments

1. To study and conduct exercises on PLC Simulator.
2. Control of conveyor manually and through programming, also programming using sensors and conveyor.
3. To study and conduct exercise on CNC lathe.
4. To study and conduct exercises on Robotic simulation software.
5. To study and conduct exercises on Pneumatic & Electro-Pneumatic Training System.
6. To study the stepper motor interface with PLC.
7. **Design and testing of hydraulic circuits such as**
   i) Pressure control
   ii) Flow control
   iii) Direction control
   iv)Design of circuit with programmed logic sequence, using an optional PLC in hydraulic. Electro hydraulic Trainer.
8. **Design and testing of pneumatic circuits such as**
   i. Pressure control
   ii. Flow control
   iii. Direction control
   iv. Circuits with logic controls
   v. Circuits with timers
   vi. Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.
9. To perform exercises on process control trainer.

Note: At least eight experiments should be performed from the above list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTMT-104	ADVANCED WELDING TECHNOLOGY LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	To practice on electrical circuits, hydraulic and pneumatic systems and PLC's for their practical implications.							
Course Outcomes								
CO1	To understand the PLC using PLC simulators.							
CO2	To demonstrate and actuate the positioning using sensors, actuators and programming.							
CO3	To study the pneumatic and electro-pneumatic training system with simulation software.							
CO4	To design and test on hydraulic and pneumatic circuits.							

List of Experiments

- To understand the basic concepts of welding by carrying out simple exercises relevant to its principles
- Detailed study on different types of Welding Processes practised in industry.
- To study Advanced Welding Techniques and welding of Non-Ferrous Metals & Cast Iron
- To join the given two work piece as per the required type of joint by gas welding
- To join two given metal plates by a single 'V' butt joint in arc welding
- To join two given metal plates by a tee fillet joint in arc welding
- To know weld defects & their causes and weld distortions & their remedies
- To make butt welding using TIG welding equipment
- To study and observe the welding process through demonstration and practice. (Electric Arc Welding)
- To study Metal Inert Gas (MIG) Shielded Arc Welding
- Experimental Study of Welding Parameters On Tig Welding Of Aluminium Alloy

Note: At least eight experiments should be performed from the above list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTMT-106		MINI PROJECT						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**4**	**2**	**-**	**-**	**100**	**100**	**3**
Objective		In case of mini project, they will solve a live problem using software/analytical/computational tools or fabricate an experimental setup.						
		Course Outcomes						
CO 1		Students will learn to write technical reports.						
CO 2		Students will develop skills to present and defend their work in front of technically qualified audience.						

Students can take up small problems in the field of Industrial and Production engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Students will be required to submit a brief synopsis of 3-4 pages related to the topic by the first week of September.

Audit

Course-II

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTAD- 102A	CONSTITUTION OF INDIA						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3

Objective	The main objective of the course is to impart the students with the knowledge of informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
Course Outcomes	
CO1	To discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO2	To discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3	To discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO4	To discuss the passage of the Hindu Code Bill of 1956.

Unit-I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features

Unit-II

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality, Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit-III

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit-IV

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

RECOMMENDED BOOKS:

- The Constitution of India, 1950 (Bare Act), Government Publication.
- Dr. S. N. Busi, Dr. B. R. Ambedkar, "framing of Indian Constitution", 1st Edition, 2015.
- M. P. Jain, "Indian Constitution Law", 7th Edn., Lexis Nexis, 2014.
- D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTAD-104A	PEDAGOGY STUDIES						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The main objective of the course is to review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers and Identify critical evidence gaps to guide the development.						
Course Outcomes							
CO1	Understand the pedagogical practices being used by teachers in formal and informal classrooms in developing countries.						
CO2	Become aware of the evidence on the effectiveness of these pedagogical practices, in different conditions and with different population of learners.						
CO3	Understand the significance of teacher education (curriculum and practicum) and the school curriculum and guidance materials for effective pedagogy.						

Unit-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions. Overview of methodology and Searching.

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

Unit-II

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit-III

Professional development: alignment with classroom practices and follow-up support, Peer support

Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Unit-IV

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

RECOMMENDED BOOKS:

- Ackers J, Hardman F, "Classroom interaction in Kenyan primary schools", Compare, 31 (2): 245-261.
- Agrawal M, "Curricular reform in schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361- 379.
- Akyeampong K, "Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

- Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?" International Journal Educational Development, 33 (3): 272–282.
- Alexander RJ, "Culture and pedagogy: International comparisons in primary education". Oxford and Boston: Blackwell.
- Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign"

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTAD-106 A	STRESS MANAGEMENT BY YOGA						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The main objective of the course is to achieve overall health of body and mind and to overcome stress						
Course Outcomes							
CO1	Develop healthy mind in a healthy body thus improving social health.						
CO2	Improve efficiency						
CO3	Learn the Yogasan						
CO4	Learn the Pranayam						

Unit-I

Definitions of Eight parts of yog. (Ashtanga)

Unit-II

Yam and Niyam. Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit-III

Asan and Pranayam

i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam

RECOMMENDED BOOKS:

- Janardan Swami Yogabhyasi Mandal, "Yogic Asanas for Group Tarining-Part-I" : Nagpur
- Swami Vivekananda, "Rajayoga or conquering the Internal Nature" Advaita Ashrama (Publication Department), Kolkata

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(MANUFACTURING TECHNOLOGY)

MTAD-108 A	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	To learn how to achieve the highest goal happily. To become a person with stable mind, pleasing personality and termination. To awaken wisdom in students.						
Course Outcomes							
CO1	Students become aware about leadership.						
CO2	Students will learn how to improve communication skills						
CO3	Understand the team building and conflict						
CO4	Student will learn how to manage the time.						

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

Approach to day to day work and duties.

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47, 48,

Chapter 3-Verses 13, 21, 27, 35,

Chapter 6-Verses 5, 13, 17, 23, 35,

Chapter 18-Verses 45, 46, 48.

Statements of basic knowledge.

Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16, 17, 18

Personality of Role model. Shrimad Bhagwad Geeta:

Chapter 2-Verses 17,

Chapter 3-Verses 36, 37, 42,

Chapter 4-Verses 18, 38, 39

Chapter18 – Verses 37, 38, 63

RECOMMENDED BOOKS:

- Swami Swarupananda, "Srimad Bhagavad Gita" Advaita Ashram (Publication Department), Kolkata
- P.Gopinath, "Bhartrihari's Three Satakam (Niti-sringar-vairagya) by, Rashtriya Sanskrit Sansthanam, New Delhi.

Third Semester (Programme Elective-V)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd.Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP–201 A	ENTERPRISE RESOURCE PLANNING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of the course is to impart the students with the knowledge of integrated applications to manage the business and automate many back office functions related to technology, services and human resources.						
Course Outcomes							
CO1	To study the basic principles and models of an enterprise.						
CO2	To understand the concepts of technology and architecture in ERP.						
CO3	To study ERP system packages.						
CO4	To study the ERP procurement issues.						

UNIT I

ENTERPRISE RESOURCE PLANNING:
Introduction, Evolution of ERP, Principle of ERP, Enabling Technologies, ERP Characteristics, Features of ERP, The advantages of ERP, Reasons for the Failure of ERP Implementation, Risk and governance issues in an ERP, ERP Framework, Business Blueprint, Business Engineering Vs. Business Process Re-Engineering, ERP Tools and Software, Demand Chain, Value Chain, and Supply Chain.

UNIT-II

ERP ARCHITECTURE: Need to Study ERP Architecture**,** Layered Architecture,Types of ERP Architecture:Two-tier Implementations,Three-tier Client/Server Implementations, Web-based architecture, Service-Oriented Architectures,Logical Architecture of an ERP System,Physical Architecture of an ERP System, Evaluation Framework for ERP Acquisition.

UNIT III

ERP PACKAGE INTEGRATION AND IMPLEMENTATION: ERP market, SAP, Peoplesoft, BAAN company, ORACLE corporation, A comparative assessment and selection of ERP packages and modules, Sales Force Automation, Integration of ERP, Integration of ERP and the Internet, ERP implementation strategies,Comparison of Big Bang vs. Phased Approach,Implementation Strategy in Small and Medium Enterprise, Post Implementation Issues.

UNIT IV

OVERVIEW OF ARCHITECTURE OF DIFFERENT ERP SOFTWARES:
Oracle overview, Architecture, A.I.M. and applications, SAP Software architecture overview, ERP before and after Y2K, Impact of Y2K on ERP Development, Risk and Governance Issues in an ERP
ERP MODULES: *Finance module, Sales & Distribution module, Human Resources module, Plant Maintenance module, Quality Management module, Material management module, manufacturing management module.*

RECOMMENDED BOOKS:

1. Sadagopan. S, ERP-A Managerial Perspective, Tata Mcgraw Hill,1999.
2. Jose Antonio Fernandez, the SAP R/3 Handbook, Tata Mcgraw Hill,1998.
3. Vinod Kumar Crag and N.K. Venkitakrishnan, Enterprise Resource Planning- Concepts and Practice, Prentice Hall of India,1998.
4. Garg & Venkitakrishnan,ERPWARE, ERP Implementation Framework, Prentice Hall,1999.
5. Thomas E Vollmann and Bery Whybark, Manufacturing and Control Systems, Galgothia Publications,1998.

6. Alexis Leon, Enterprise resource planning, Tata Mcgraw-Hill

Note: The paper will have a total of *NINE questions*. Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd Sem.)
(MANUFACTURING TECHNOLOGY)

MTIP-203	DESIGN OF EXPERIMENTS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To understand the various design of experiments techniques for optimization of problems.						
Course Outcomes							
CO1	To understand the concepts of Design of Experiment and statistical Methods.						
CO2	To understand the ANOVA and factorial design and fitting response curves and						
CO3	To study the application of Taguchi Method and testing of hypothesis						
CO4	To study and implement the Response Surface Methodology.						

UNIT-I

Introduction to DesignedExperiments:
Introduction:Strategyofexperimentation,sometypicalapplicationsofexperimentaldesign, Basic principles, Guidelines for designing experiments, using statistical design in experimentation, A Checklist for Planning experiments,*Introduction to Minitab, Interface of Minitab, Customizing Minitab, Entering Data, Graphing Data, Printing Data and Graphs, Saving and Retrieving information.*

Basic Statistical Methods: Introduction, Basic statistical concepts, Types of Data, Graphical Presentation of Data.
Descriptive Statistics: Measure of Location, Measure of Variation, The Normal Distribution, Counting, Minitab Commands to Calculate Descriptive Statistics.

Inferential Statistics: The Distribution of Sample Means (R Known), Confidence Interval for the Population Mean (σ Known), Hypothesis testing for one sample mean (σ Known), Hypothesis test for two sample means, Testing for Normality, *Hypothesis test and Confidence Intervals with Minitab.*

UNIT-II

Analysis of Variance: Introduction to Analysis of Variance, ANOVA assumptions and Validation, ANOVA Table, The sum of square approach to ANOVA calculations, Analysis of the fixed Effect model, Decomposition of the Total sum of squares. Statistical analysis, Estimation of the Model Parameters, Unbalanced Data, Model Accuracy Check, Practical interpretation of results. *ANOVA with Minitab*

Factorial Experiments: Basic definition and principles, Advantages of factorials, two level factorial design, The 2^1 Factorial Experiment, The 2^2 Factorial Experiment, The 2^3 Factorial Design, Addition of Centre Cells to 2^k Designs. General Procedure for Analysis of 2^k designs. 2^k Factorial Designs in Minitab.

UNIT-III

Introduction to Taguchi Method: Introduction, Taguchi Quality loss function, Orthogonal Array, Properties of Orthogonal Array, Minimum number of experiments to be conducted, Static Problems, Dynamic Problems,Assumptions of the Taguchi method, Steps in Taguchi Method, Assessment of Factors and Interactions, Selection and Application of Orthogonal arrays, Data Analysis from Taguchi Experiments, Variable Data with main factors only, Variable Data with Interactions, Attribute Data Analysis, Confirmation Experiment, Confidence Intervals, Robust Design Approach. *Applications of Taguchi Method using Minitab*.

UNIT-IV

Introduction to Response Surface Methodology: Introduction, Terms in Quadratic Models, The method of steepest ascent, Analysis of Second order response surfaces, Experimental design for fitting response surfaces, 2k Designs with Centers, 3^k Factorial Designs, Box-Behnken Designs, Central Composite Designs, Analysis of Data from RSM Designs, Design Considerations for Response Surface Experiments. *Response Surface Designs in Minitab.*

RECOMMENDED BOOKS:

1. Douglas C Montgomery,Design and Analysis of Experiments, John Wiley
2. Paul G. Mathews,Design of Experiments with MINITAB, New Age International Publishers.
3. K. Krishnaiah, P. Shahabudeen,Applied Design of Experiments and Taguchi Methods,PHI.
4. Angela Dean and Daniel Voss,Design and Analysis of Experiments, Springer.
5. John P.W.M., Statistical Design and Analysis of Experiments, John Wiley
6. Montgomery D.C., Runger G. C., Introduction to Linear Regression Analysis, John Wiley
7. Myres R.H. and Montgomery D.C.,Response Surface Methodology Process and Product Optimization Using Designed Experiments, Wiley
8. G UNIPUB, White Plains,Introduction to Quality Engineering Taguchi, New York.
9. https://www.ee.iitb.ac.in/~apte/CV_PRA_TAGUCHI_INTRO.htm
10. www.ecs.umass.edu/mie/labs/mda/fea/sankar/chap2.html

Note: Thepaperwillhaveatotalof*NINEquestions.*QuestionNo.1,whichiscompulsory, shall be Objective Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from eachunit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(MANUFACTURING TECHNOLOGY)

MTIP–205 A	STRATEGIC ENTREPRENEURSHIP						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To provide knowledge to the students about entrepreneurship concepts and various development programmes and policies.						
Course Outcomes							
CO1	To know about the small scale industries, scopes and the causes of their sickness.						
CO2	To know about the EDP and different government policies.						
CO3	To learn about business incubations and its future perspectives.						
CO4	To learn E-business marketing and developments.						

UNIT-I

Small Scale Industries: Definition and types of SSI's; Role, scope and performance in national economy; Problems of small scale industries.

Industrial Sickness: Definition; Causes of sickness; Indian scenario, Government help; Management strategies; Need for trained entrepreneurs

UNIT-II

Entrepreneurship Development Programmes: Introduction, Origin of EDP's , Organizations involved in EDP's, Objectives of EDPs, Implementation of EDP's, Short comings of EDP's, Role in entrepreneurship development.

Step: Introduction, Origin, Status in India, Success and failure factors, Govt. polices and incentives, future prospects in India.

UNIT-III

Business Incubation: Introduction, Origin and development of business incubators in India and other countries, types of incubators, success parameters for a business incubator, Benefits to industries, institutes, government and society; future prospects. A few case studies (at least 2).

Project Management: Concept, Characteristics and Significance of Project Management. Components of Project Management. Project Life Cycle. Project Identification and Selection. Project Formulation and Appraisal.

UNIT-IV

Special Aspects of Entrepreneurship: Entrepreneurship, Social entrepreneurship, International entrepreneurship, Rural entrepreneurship, Community Development, Women entrepreneurship.

Network Marketing: Introduction, E-business, E-commerce, E-auction, A basic internet e-business architecture, A multi-tier e-business architecture.

RECOMMENDED BOOKS:

1. P.K. Gupta,Strategic Entrepreneurship, Everest Publishing House.
2. David Cleland,Project Management –Strategic Design and Implementation, McGraw Hill.
3. David H Holl,Entrepreneurship-New Venture Creation, Prentice Hall of India.
4. Steed & Steed,Sustainable Strategic Management, Prentice Hall of India.
5. Kotler,Marketing Management by Prentice Hall of India.
6. Tarek Khalil,Management of Technology, McGraw Hill.
7. Henry Steiner,Engineering Economic Principles, McGraw Hill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Open Elective

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(MANUFACTURING TECHNOLOGY)

MTOE-201 A	BUSINESS ANALYTICS						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes							
CO1	Able to have knowledge of various business analysis techniques.						
CO2	Learn the requirement specification and transforming the requirement into different models.						
CO3	Learn the requirement representation and managing requirement assets.						
CO4	Learn the Recent Trends in Embedded and collaborative business						

Unit-I

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.

Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit-II

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.

Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit-III

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements.

Managing Requirements Assets: Change Control, Requirements Tools

Unit-IV

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

RECOMMENDED BOOKS:

1. James Cadle, "Business Analysis", BCS, The Chartered Institute for IT.
2. Erik Larson and, Clifford Gray, "Project Management: The Managerial Process", McGraw-Hill Education.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(MANUFACTURING TECHNOLOGY)

MTOE-203 A	INDUSTRIAL SAFETY						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is toaware students about the industrial safety maintenance and fault findings.						
Course Outcomes							
CO1	Understand the industrial safety.						
CO2	Analyze fundamentals of maintenance engineering.						
CO3	Understand the wear and corrosion and fault tracing.						
CO4	Understanding when to do periodic inceptions and apply the preventing maintenance.						

Unit-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-II

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-III

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-IV

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

RECOMMENDED BOOKS:

1. Higgins & Morrow, "Maintenance Engineering Handbook", Da Information Services.
2. H. P. Garg, "Maintenance Engineering", S. Chand and Company.
3. Audels, "Pump-hydraulic Compressors", Mcgraw Hill Publication.
4. Winterkorn, Hans, "Foundation Engineering Handbook", Chapman & Hall London.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(MANUFACTURING TECHNOLOGY)

MTOE-205 A	OPERATIONS RESEARCH						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to aware students about the dynamic programming to solve problems of discrete and continuous variables and model the real world problem and simulate it.						
Course Outcomes							
CO1	Students should be able to apply the dynamic programming to solve problems of discreet and continuous variables.						
CO2	Students should be able to apply the concept of non-linear programming						
CO3	Students should be able to carry out sensitivity analysis						
CO4	Student should be able to model the real world problem and simulate it.						

Unit-I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit-II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit-III

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit-IV

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

RECOMMENDED BOOKS:

1. H.A. Taha, "Operations Research, An Introduction", PHI, 2008
2. H.M. Wagner, "Principles of Operations Research", PHI, Delhi, 1982.
3. J.C. Pant, "Introduction to Optimisation: Operations Research", Jain Brothers, Delhi, 2008
4. Hitler Libermann, "Operations Research", McGraw Hill Pub. 2009
5. Pannerselvam, "Operations Research", Prentice Hall of India 2010
6. Harvey M Wagner, "Principles of Operations Research", Prentice Hall of India 2010

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks.* The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(MANUFACTURING TECHNOLOGY)

MTOE-207 A	COST MANAGEMENT OF ENGINEERING PROJECTS						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to impart the studentswith the knowledge of cost management for the engineering project and apply cost models to the real world projects.						
Course Outcomes							
CO1	Students should be able to learn the strategic cost management process.						
CO2	Students should be able to types of project and project team types						
CO3	Students should be able to carry out Cost Behavior and Profit Planning analysis.						
CO4	Student should be able to learn the quantitative techniques for cost management.						

Unit-I

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-II

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit-III

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-IV

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

RECOMMENDED BOOKS:

1. Charles Thomas Horngren, “Cost Accounting a Managerial Emphasis”, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, “Advanced Management Accounting”
3. Robert S Kaplan Anthony A. Alkinson, “Management & Cost Accounting”
4. Ashish K. Bhattacharya, “Principles & Practices of Cost Accounting”, A. H. Wheeler publisher
5. N.D. Vohra, “Quantitative Techniques in Management”, Tata McGraw Hill Book Co. Ltd.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(MANUFACTURING TECHNOLOGY)

MTOE-209 A	COMPOSITE MATERIALS						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to impart the studentswith the knowledge of composites, its materials, analysis, fabrication, and performance analysis.						
Course Outcomes							
CO1	Students should be able to learn the classification and characteristics of composite materials.						
CO2	Students should be able to understand about different fabrication techniques related to metal matrix composites.						
CO3	Students should be able to understand about different fabrication techniques related to polymer matrix composites.						
CO4	Student should be able to do the analyses of the composite materials under different loading conditions.						

UNIT–I

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures, Iso-strain and Iso-stress conditions.

UNIT – II

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. **Manufacturing of Ceramic Matrix Composites:** Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–III

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – IV

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

RECOMMENDED BOOKS:

1. R.W.Cahn, "Material Science and Technology" VCH, West Germany.
2. WD Callister, Jr, "Materials Science and Engineering, An introduction"
3. Balasubramaniam, "John Wiley & Sons", NY, Indian edition, 2007.
4. Lubin, "Hand Book of Composite Materials"
5. K.K.Chawla, "Composite Materials"
6. Deborah D.L. Chung, "Composite Materials Science and Applications"

7. Danial Gay, Suong V. Hoa, and Stephen W. Tasi, "Composite Materials Design and Applications"

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(MANUFACTURING TECHNOLOGY)

MTOE-211 A	WASTE TO ENERGY						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to impart the studentswith the knowledge of generation of energy from the waste.						
Course Outcomes							
CO1	Students should be able to learn the classification of waste as a fuel and biomass pyrolysis.						
CO2	Students should be able to learn gasification process and different types of gasifiers.						
CO3	Students should be able to learn different combustors for biomass.						
CO4	Student should be able to learn the Biogas plant technology different biomass conversions processes for different applications.						

Unit-I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-II

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-III

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-IV

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

RECOMMENDED BOOKS:

1. Desai, Ashok V, “Non-Conventional Energy”, Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. and Mahdi, S. S., “Biogas Technology - A Practical Hand Book - Vol. I & II”, Tata
McGraw Hill Publishing Co. Ltd., 1983.
3. Challal, D. S, “Food, Feed and Fuel from Biomass”, IBH Publishing Co. Pvt. Ltd., 1991.
4. C. Y. WereKo-Brobby and E. B. Hagan, “Biomass Conversion and Technology”, John Wiley & Sons, 1996.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks.* The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(MANUFACTURING TECHNOLOGY)

MTMT-201	DISSERTATION PHASE - I							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical Marks**	**Total**	**Time (Hrs.)**
0	**0**	**20**	**10**	**-**	**100**	**-**	**100**	**-**
Objective	The main objective of this course is to plan a research work (which includes the problem formulation/literature review, proposed objectives, proposed methodologies and references) in the field of Industrial and Production Engineering or interrelated fields of applications.							
Course Outcomes								
CO 1	Students will be exposed to various self-learning topics.							
CO 2	Students will be exposed toan exhaustive survey of the literature such as books, national/international refereed journals, resource persons andindustrialsurveysfor the selection/ identification of engineering/research problem.							
CO 3	Students will be able to set the research objectives of the identified engineering/research problem.							
CO 4	Students will learn modern tools/techniques related to the identified engineering/research problemfor the solution and able to learn technical report writing skills.							
CO 5	Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.							

The students will start their researchwork in third semester with a research problem having research potential involving scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.

The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his/her supervisor and the topic of dissertation must be mutually decided by the supervisor and student.

The students will be required to submit a progress report related to their dissertation work by the end of September. The progress report will cover the following:

- The goal set for the period.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.

The progress report must be at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The students will be required to appear for comprehensive Seminar & Viva-voce and submit a synopsis report based on their progress related to the dissertation as per the presentation date mentioned in

the academic calendar for the session. The synopsis report will be submitted in the same format as that of the thesis and will contain the following:

1. Introduction
2. Literature Survey
3. Gaps in Literature
4. Objectives of the Proposed Work
5. Methodology
6. References

*** Student will choose his/her guide in the end of second semester.**

Fourth Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (4thSem.)
(MANUFACTURING TECHNOLOGY)

MTMT-202	DISSERTATION PHASE -II							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**32**	**16**	**-**	**100**	**200**	**300**	**-**
Objective	The main objective of the course is to make the students able to do some good research in the field of their interests related to Industrial and Production Engineering or interrelated fields of applications.							
Course Outcomes								
CO 1	Students will be able to design solutions for engineering problems that meet the specified needs with appropriate considerations.							
CO 2	Students will be able to conduct investigations of engineering problems using research-basedknowledge and experimental/researchmethods including design of experiments,analysis and interpretation of data, and synthesisof the information to provide valid conclusions.							
CO 3	Students will be able to apply resources and modernengineering tools and techniques with an understanding of thelimitations.							
CO 4	Students will be able to either work in a research environment or in an industrial environment.							
CO 5	Students will be conversant with technical report writing, professional ethics, responsibilities and norms of the engineering practice.							
CO 6	Students will be able to present and convince their topic of study to the engineering community.							

The students are required to continue Analytical/Experimental/Computational/Industrial Problems or Case studies investigations in the field of Industrial and Production Engineering or other related fields which have been finalized in the third semester. They would be working under the supervision of a faculty member.

The students will be required to submit a progress report duly signed by their respective supervisors to the department, related to their dissertation work in the last week of March. The progress report will cover the following:

- The goal set for the period.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.
- References

The progress report must be of at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The candidate has to prepare a detailed dissertation report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up/numerical details/industrial case study etc. as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study.

The final dissertation will be submitted in the end of semester as per academic calendar for the session, which will be evaluated by internal as well as external examiners based upon his/her research work. At least one publication is expected before final submission of the dissertation from every student in peer reviewed referred journals or reputed conference from the work done by them in their dissertation. The dissertation should be presented in standard format as provided by the department.

The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a supervisor, co-supervisor etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his supervisor.

w.e.f. 2018-19

KURUKSHETRA UNIVERSITY, KURUKSHETRA
Established by the State Legislature Act XII of 1956
('A+' Grade, NAAC Accredited)
MASTER OF TECHNOLOGYINMECHANICAL ENGINEERING
(CREDIT BASED)(w. e. f. 2018-19)
SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING
SEMESTER-1

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTIP-101A	Advanced Metal Casting	3	0	0	3	3	60	40	-	100	3
2	MTIP-103A	Computer Aided Design and Manufacturing	3	0	0	3	3	60	40	-	100	3
3		*Programme Elective-I	3	0	0	3	3	60	40	-	100	3
4		**Programme Elective-II	3	0	0	3	3	60	40	-	100	3
5	MTRM-111A	Research Methodology and IPR	2	0	0	2	2	60	40	-	100	3
6	MTIP-117A	Advanced Metal Casting Lab	0	0	4	4	2	-	40	60	100	3
7	MTIP-119A	Computer Aided Design and Manufacturing Lab	0	0	4	4	2	-	40	60	100	3
8		***Audit Course-I	2	0	0	2	-	-	100	-	100	3
					Total	**24**	**18**	**300**	**280**	**120**	**700**	

***PROGRAMME ELECTIVE- I (I&P) for 1st Semester**		
1.	MTIP-105A	Tool Engineering
2.	MTIP-107A	Advanced Engineering Materials
3.	MTIP-109A	Non-Conventional Machining

****PROGRAMME ELECTIVE- II (I&P) for 1st Semester**		
1.	MTIP-111A	Product Design and Development
2.	MTIP-113A	Simulation of Industrial Systems
3.	MTIP-115A	Supply Chain Management

*****AUDIT COURSE – I for 1st Semester (I&P)**		
1.	MTAD-101A	English for Research Paper Writing
2.	MTAD-103A	Disaster Management
3.	MTAD-105A	Sanskrit for Technical Knowledge
4.	MTAD-107A	Value Education

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2. ***Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

w.e.f. 2018-19

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SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING
SEMESTER-II

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTIP-102A	Mechatronics	3	0	0	3	3	60	40	-	100	3
2	MTIP-104A	Industrial Tribology	3	0	0	3	3	60	40	-	100	3
3		*Programme Elective-III	3	0	0	3	3	60	40	-	100	3
4		**Programme Elective-IV	3	0	0	3	3	60	40	-	100	3
5	MTIP-118A	Mechatronics Lab	0	0	4	4	2	-	40	60	100	3
6	MTIP-120A	Industrial Tribology Lab	0	0	4	4	2	-	40	60	100	3
7	MTIP-122A	Mini Project	0	0	4	4	2	-	-	100	100	3
8		***Audit Course-II	2	0	0	2	-	-	100	-	100	3
					Total	**26**	**18**	**240**	**240**	**220**	**700**	

***PROGRAMME ELECTIVE-III (I&P) for 2nd Semester**		
1.	MTIP-106A	Advanced Welding Processes
2.	MTIP-108A	Advanced Metal Cutting
3.	MTIP-110A	Metrology

****PROGRAMME ELECTIVE - IV (I&P) for 2nd Semester**		
1.	MTIP-112A	Sequencing and Scheduling
2.	MTIP-114A	Quality Engineering and Management
3.	MTIP-116A	Reliability Engineering

*****AUDIT COURSE–II for 2nd Semester (I&P)**		
1.	MTAD-102A	Constitution of India
2.	MTAD-104A	Pedagogy Studies
3.	MTAD-106A	Stress Management by Yoga
4.	MTAD-108A	Personality Development through Life Enlightenment Skills

Note: 1. ***Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

w.e.f. 2018-19

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SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING

SEMESTER-III

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1		*Programme Elective-V	3	0	0	3	3	60	40	-	100	3
2		**Open Elective	3	0	0	3	3	60	40	-	100	3
3	MTIP-207A	Dissertation Phase-I	0	0	20	20	10	-	100	-	100	--
Total						**26**	**16**	**120**	**180**		**300**	

*PROGRAMME ELECTIVE-V (I&P) for 3rd Semester		
1.	MTIP-201A	Enterprise Resource Planning
2.	MTIP-203A	Design of Experiments
3.	MTIP-205A	Strategic Entrepreneurship

**OPEN ELECTIVE(I&P) for 3rd Semester		
1.	MTOE-201A	Business Analytics
2.	MTOE-203A	Industrial Safety
3.	MTOE-205A	Operations Research
4.	MTOE-207A	Cost Management of Engineering Projects
5.	MTOE-209A	Composite Materials
6.	MTOE-211A	Waste to Energy

SEMESTER-IV

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTIP-202A	Dissertation Phase-II	0	0	32	32	16	-	100	200	300	--
Total						**32**	**16**		**100**	**200**	**300**	

Total credits=68

INSTRUCTIONS FOR PAPER SETTER

1. The question paper is to be attempted in **THREE Hours**.
2. Maximum Marks for the paper are **60.**
3. The syllabus for the course is divided into **FOUR units.**
4. The paper will have a total of **NINE questions.**
5. **Question No. 1,** which is compulsory, shall be OBJECTIVE Type **and have content from the entire syllabus (all Four Units).**

   Q. No. 2 & 3 from Unit I

   Q. No. 4 & 5 from Unit II

   Q. No. 6 & 7 from Unit III

   Q. No. 8 & 9 from Unit IV

6. All questions will have equal **weightage of 12 marks.**
7. The candidate will attempt a total of **FIVE questions**, each of 12 marks. Q. No. 1 is compulsory. The candidate shall attempt remaining **four** questions by selecting **only one question from each unit.**
8. A question may have any number of sections labeled as 1(a), 1(b), 1(c), 1(d), ---- 2(a), 2(b), --.A section may further have any number of subsections labeled as (i), (ii), (iii),.
9. **SPECIAL INSRUCTIONS FOR Q. No. 1 ONLY**

   Question No. 1, which is compulsory, shall be OBJECTIVE/ short answer type **and have content from the entire syllabus (all Four Units).**

   Emphasis is to be given on the basic concepts, analytical reasoning and understanding of the various topics in the subject. This question may have a number of parts and/or subparts. The short questions could be combination of following types:

   i. Multiple Choice
   ii. Yes/ No choice
   iii. Fill in Blanks type
   iv. Short numerical computations
   v. Short Definitions
   vi. Matching of Tables

The above mentioned question types is **only a Guideline**. Examiner could set the question as per the nature of the subject.

w.e.f. 2018-19

First Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–101A	ADVANCED METAL CASTING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of moulding and casting.						
Course Outcomes							
CO1	To impart knowledge about various functional requirements of moulding materials and specifications and testing of moulding sand properties.						
CO2	To acquaint students with the phenomenon of solidification and analytics involved in solidification of Molten metal in various types of mould metal combintions.						
CO3	To impart knowledge to students about Gating system design and Riser design for getting an accurately designed defect free casting.						
CO4	To let student understand some special casting processes and testing of casting.						

UNIT-I

Functional Requirement of Moulding Materials: Principal ingredients of moulding Sands; Different Types of Sands; Clays, Different types of Clay structures, Moisture; Theories of Clay sand bonding, Sand system equipment, Flow of sand in a mechanized foundry, The Requirement of core sands,.

Specification and testing of Moulding Sands

Grain Size, Grain Shape, Clay content, Moisture Content, Bulk Density and Specific Surface Area, Acid Demand Value (ADV), Fines Content, Sintering Temperature, Mould hardness, Permeability, Strength, Deformation & toughness, Compactability, Mouldability, High Temperature Characteristics.

UNIT-II

Solidifications of Metals, Nucleation, free energy concept, critical radius of nucleus, Distribution coefficient and Constitutional Undercooling, Solidification in Pure Metals and Alloys, Directional Solidification, Casting Characteristics related to Solidification; Fluidity, Dendritic Growth, Dendrite coherency, Segregation, Inverse Segregation, Hot tearing, Hipping, Solidification under pressure.

Heat Transfer during casting process: Resistance to Heat Transfer, Centerline Feeding Resistance, Rate of solidification, Solidification of Large casting in an insulating mould, Solidification with predominant interface resistance, Solidification with constant casting surface temperature, Solidification with predominant resistance in mould and solidified Metal, Solidification Time and Chvorinov rule, Numerical Exercises.

UNIT-III

Gating System Design: Gating system defined, Types of Gating Systems, Types of Gates, Elements of Gating System, Gating System design, Factors involved in Gating design, Pouring time, Choke Area, Sprue design, Gating Ratio, Sprue runner gate ratio, Elimination of Slag and Dross, Filtration, Numerical exercises.

Riser Design: Need for riser, Basic requirements of an effective feeding system for a casting, Feeding Efficiency, Types of Risers, Effective feeding distances for simple and complex shapes. Use of chills, Directional solidification, Stresses in castings, Metal Mould reactions, Claine's Method, Modulus Method, Naval Research Laboratory (NRL) Method, Pouring rate and Temperature, Padding, Use of exothermic materials, Chills, Feeding Aids, Numerical exercises.

UNIT-IV

Special casting Processes: Shell Moulding, Investment Casting, Permanent Mould Casting, Diecasting, Centrifugal casting.

Inspection and testing of casting: Visual, Optical, Dimensional inspection, Laser Scanning, White light scanning, Radiographic Inspection, ultrasonic testing, Magnetic Particle Testing, dye penetration, Casting Defects; Classification, Causes and remedies.

RECOMMENDED BOOKS:

1. H.F. Taylor, "Foundry Engineering", John Wiley and Sons.
2. P.L. Jain, "Principles of Foundry Technology", Mc-Graw Hill.
3. MahiSahoo and SudhariSahu, "Principles of Metal Casting.
4. AmitabhaGhosh, " Manufacuring Science", Affliated East West Press.
5. P.N Rao, "Manufacturing Technology: Foundry, Forming and Welding" TMH.
6. K.P. Sinha,"Foundry Technology", Standard Publishers, Delhi.

7. Flinn, "Fundamentals of Metals Casting", Addison Wesley.
8. Heine Loper and Resenthal, "Principles of Metal Casting", Mc-Graw Hill.
9. Hielel and Draper, "Product Design & Process Engineering", Mc-Graw Hill.
10. Salman &Simans, "Foundry Practice", Issac Pitman.
11. ASME, "Metals Handbook- Metal Casting."
12. P.C. Mukharjee, Fundamentals of Metal casting Technology, Oxford, IBH.
13. P.R.Beeley, Foundry Technology , Butterworth Heinmann

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–103A	COMPUTER AIDED DESIGN AND MANUFACTURING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to understand about the technology of computers for the design, process planning and manufacturing the products.						
Course Outcomes							
CO1	To understand the fundamentals and applications of computers in the field of designing and manufacturing and the transformation of geometricmodels.						
CO2	To understand the concepts of G.T. and FMS.						
CO3	To know the use of computers in process planning and shop floor control.						
CO4	To learn the basics of AGV and coding systems for CNC.						

UNIT I

Fundamentals of CAD: Introduction to CAD/CAM, Historical Development, Industrial Look at CAD/CAM, Application of computers in design, Creating manufacturing database, Benefits of CAD. Computer Hardware, Graphic input devices, display devices, Graphics output devices, Central processing unit (CPU).

Geometric transformations: 2D and 3D; transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous representations, concatenated representation; Orthographic projections, Numerical Problems

UNIT II

Group Technology and Cellular Manufacturing

Part families, parts classifications and coding, Production flow Analysis, cellular Manufacturing- composite part concept, machine cell design, applications of group technology, Grouping parts and machines by Rank order clustering technique, Arranging machines in a G.T. cell.

Flexible Manufacturing

Introduction, FMS components, Flexibility in Manufacturing – machine, Product, Routing, Operation, types of FMS, FMS layouts, FMS planning and control issues, deadlock in FMS, FMS benefits and applications.

UNIT III

Process Planning

Introduction, Manual process planning, Computer aided process planning – variant, generative, Decision logic-decision tables, decision trees, Introduction to Artificial intelligence.

Shop Floor Control

Introduction, Shop floor control features, Major displays, Major reports, Phases of SFC Order Release, Order Scheduling, Order Progress, Manufacturing control, Methodology, Applications, Shop floor data collections, Types of data collection system, Data input techniques, Automatic data, Collection system.

UNIT IV

CNC Basics and Part Programming

Introduction, Historical Background, Basic Components of an NC, Steps in NC, Verifications of Numerical control machine tool programs, Classification of NC Machine tool, Basics of motion control and feedback for NC M/C, NC part programming, Part programming methods, Modern Machining system, Automatically programmed tools, DNC, Adaptive control

Automated Guided Vehicle

Introduction, History, Features, Functions of AGV, Types of AGV, Safety consideration for AGV, Design of AGV.

RECOMMENDED BOOKS:

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
3. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
6. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.

7. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
8. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall
9. Chang, Wang &Wysk Computer Aided Manufacturing. Prentice Hall
10. Kundra&Rao, Numerical Control and Computer Aided Manufacturing by, Rao andTiwari, Tata Mc-Graw Hill.
11. Mattson, CNC programming Principles and applications, Cengage Learning India Pvt. Ltd. Delhi

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-I

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–105A	TOOL ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to impart the students with the knowledge of various aspects of design of different types of Tools and fixtures used in Industries.						
Course Outcomes							
CO1	To impart knowledge of materials for cutting tool and design of cutting tools.						
CO2	To acquaint students with various kinds of Gages and Work holding devices.						
CO3	To impart knowledge to students about Drill jigs and Fixtures.						
CO4	To let student understand the tool design process for NC Machine tools						

UNIT-I

Cutting Tool Materials: Introduction and desirable properties, Carbon and Medium-Alloy Steels, High-Speed Steels, Cast-Cobalt Alloys, Carbides, Coated Tools, Alumina-Based Ceramics, Cubic Boron Nitride, Silicon-Nitride Based Ceramics, Diamond, Reinforced Tool Materials, Cutting-Tool Reconditioning.

Design of Cutting Tools Basic Requirements, Mechanics and Geometry of Chip Formation, General Considerations for Metal Cutting, Design of single point Cutting Tools, Design of Milling Cutters, Design of Drills and Drilling, Design of Reamers, Design of Taps, Chip Breakers.

UNIT-II

Gages and Gage Design: Limits fits and tolerances, Geometrical tolerances-specification and measurement, Types of gages, Gage design, gage tolerances, Material for Gages.

Work Holding Devices: Basic requirements of work holding devices, Location: Principles, methods and devices, Clamping: Principles, methods and devices.

UNIT-III

Drill Jigs: Definition and types of Drill Jigs, Chip Formation in Drilling, General Considerations in the Design of Drill Jigs, Drill Bushings, Drill Jigs, and Modern Manufacturing

Design of Fixtures: Fixtures and Economics , Types of Fixtures , Milling Fixtures , Boring Fixtures, Broaching Fixtures, Lathe Fixtures, Grinding

UNIT-IV

Tool Design for Numerically Controlled Machine Tools: Fixture Design for Numerically Controlled Machine Tools, Cutting Tools for Numerical Control, Tool-holding Methods for Numerical Control.

RECOMMENDED BOOKS:

1. ASTME, “Fundamentals of Tool Design”, Prentice Hall of India, 1983.
2. Donaldson, “Tool Design”, Tata-McGraw Hill, 3rd Edition, 2000.
3. Joshi P.H., “Jigs and Fixtures”, Tata-McGraw Hill, 2010.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–107A	ADVANCED ENGINEERING MATERIALS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 hrs
Objective	The objective of the course is to impart the students with the knowledge of various advanced and smart materials.						
Course Outcomes							
CO1	To impart knowledge of Piezoelectric and shape memory alloys.						
CO2	To acquaint students with deep know how about Electro-rheological and composite materials						
CO3	ToimpartknowledgetostudentsaboutMEMSsystemsandHightemperature applicationmaterials.						
CO4	To let student understand the processing and characteristics of powder metallurgy processes and structural materials.						

UNIT-I

Introduction to advanced Engineering materials: Classes of Materials and their usage, Historical Perspective, Intelligent Materials, Structural Materials, Functional Materials, Primitive Functions of Intelligent Materials, Intelligence inherent in Materials, Materials Intelligently Harmonizing with humanity, Biomimetic.

Smart Materials and Structural Systems: Introduction, Actuator Materials, Sensing Technologies, Micro-sensors, Intelligent systems, Hybrid Smart Materials, Passive Sensory Smart Structures, Reactive Actuator based smart structures, Active Sensing and Reactive smart structures, smart skins, Aero-elastic tailoring of airfoils, Synthesis of future smart systems.

UNIT-II

Electrocaloric Effect: An Introduction, History of Electrocaloric Cooling,Mechanism of working ofElectrocaloric Cooling, Electrocaloric Materials, Performance of Electrocaloric Materials.

Heat Resistant Steels: Conventional Heat-Resistant Steels, Silicon-Bearing High Chromium Heat-Resistant Steels,Nitride-Strengthened Reduced Activation Heat-Resistant Steels, China Low Activation Martensitic SteelNitride-Strengthened Steels,Microstructural Stability

UNIT-III

Smart Micro-systems: Silicon Capacitive Accelerometer, Piezo-resistive Pressure sensor, Conductometric Gas sensor, An Electrostatic Comb-drive, Magnetic Microrelay, Portable Blood Analyser, Piezoelectric Inkjet Print Head.

Buckyballs to robotics: Bucky ball, Nano Structure of Fullerene, Carbon Nanotubes, Nano Diamond, Boron nitride nanotubes, Single electron transistors, Molecular machine, Nano Biometrics, Nano Robots,

UNIT-IV

Nano-Alloys: Introduction, Chemical Synthesis: General Concepts, Reduction of Metallic Salts, The Organometallic Route: Thermal Decomposition Method, Other Chemical Methods for synthesis of Nano-alloys,Physical Routes for synthesis of Nano-Alloys;Experimental Techniques and Examples.

Shape memory alloys (SMA): Shape memory effect and the metallurgical phenomenon of SMA, Types of SMA, One way and Two way Shape memory effect. Temperature assisted shape memory effect, Applications.

RECOMMENDED BOOKS:

1. Gandhi, M.V. and Thompson, B.S., Smart materials and Structures, Chapman & Hall,1992.
2. Ananthasuresh G.K., Vinoy K.J., Micro and Smart Systems, Wiley India.
3. Wei Yan, Wei Wang, 9-12 Cr Heat Resistant Steels, Engineering Material series, Springer International.
4. Damien Alloyeau, Christine Mottet, Nanoalloys Synthesis, Structure and Properties, Springer International.
5. Tatiana Correia, Qi Zhang, Electrocaloric Materials: New Generation of Coolers
6. Otsuka, K. and Wayman, C. M., Shape memory materials, C.U.P,1998
7. Taylor, W., Pizoelectricity, George Gorden and Breach Sc. Pub.,1985
8. Mallick, P.K., Fiber Reinforced Composites Materials, Manufacturing andDesign. Marcel Dekker Inc, New York,1993.
9. Rama Rao, P. (ed.), Advances in Materials and their applications, Wiley EasternLtd.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–109A	NON-CONVENTIONAL MACHINING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To acquaint the students with the advanced technologies and processes in various streams of Non-conventional machining.						
Course Outcomes							
CO1	To impart knowledge of Various Non-conventional Mechanical Working Processes, technology, process parameters and analysis for metal removal for these processes.						
CO2	To acquaint students with deep knowhow about chemical and electrochemical machining processes,						
CO3	To impart knowledge to students about various kinds of Electric discharge machining processes, process parameters associated with these processes and various process characteristics.						
CO4	To let student understand the working and technology associated with Laser Beam machining and Electron beam machining processes.						

UNIT-I

Introduction, Need of Non-conventional machining processes, Characteristics of conventional and Non-conventional Machining processes. **Mechanical Working Processes**: **Abrasive Jet Machining:** Machining setup, Abrasives, Process Parameters, Machining Characteristics, Material removal models in AJM, Process capability, Advantages, limitations, Applications

Water Jet Machining: Basic mechanism of Water jet machining setup, Process parameters, Catcher, Process capabilities, Advantages, limitations, Applications **Abrasive Water Jet Machining process:** Working Principle, AWJM Machine, Process Variables, Mechanism of Metal Removal, Cutting Parameters, Process capabilities, Applications, Environmental issues.

Ultrasonic Machining: Fundamental principles, Equipment, Magnetostriction, Elements of process, Mechanics of cutting, Analysis of Process Parameters, Process capabilities, Economic considerations. Applications, Limitations

UNIT-II

Chemical Machining: Introduction, Fundamental Principles, Process Parameters; Maskants and Etchants, Advantages, Limitations, Applications.

Electrochemical Machining Processes: Introduction, Classification of ECM Processes, Fundamentals Principles of ECM, Elements of ECM, ECM Machine Tool Process, Determination of Metal Removal Rate, Evaluation of Metal Removal of an alloy, Electrochemistry of ECM, Cathode and Anode reaction, Dynamics of ECM, Self-Regulating feature of ECM, Process Parameters, Process capabilities, Electrochemical Deburring. **Electrochemical Grinding:** Schematics, Electrochemistry, Process Parameters, Process capabilities, Applications, Advantages, Limitations.

UNIT-III

EDM: Introduction, Basic Principles & Schematics, Process Parameters, Characteristics of EDM, Dielectric, Electrode Material, Modelling of Material Removal, Spark Erosion Generators, Analysis and Metal Removal Rate in RC circuit, Selection of Tool Material and Tool Design, Di-Electric system, Process Variables, Dielectric Pollution and its effects, Process Characteristics, Applications, Electric Discharge Grinding and Electric Discharge Diamond Grinding; **Wire EDM**: Working Principle, Wire EDM Machine, Advances in Wire-cut EDM Process Variables, Process Characteristics, Applications.

UNIT-IV

Laser Beam Machining Back Ground, Production of Laser, Working Principle of LBM, Types of LASERS, Process Characteristics, Metallurgical effects, Advantages and Limitations, Applications.

Electron Beam Machining:

Electron Beam Action, Generation and control of Electron beam, Theory of Electron Beam Machining, Process Parameters, Process capabilities, Applications.

High Energy Rate Forming, Elctro-Hydraulic Forming, Explosive Forming, Hot Machining Analysis of the Process.

RECOMMENDED BOOKS:

1. V.K. Jain, Advanced Machining Processes, Allied Publishers Pvt Ltd
2. P.C. Pandey and H.S. Shan,Modern Machining Processes, Tata McGraw- Hill
3. M. K. Singh, Unconventional Manufacturing Process, New Age Publishers

4. J. A. Mcgeough, Advanced Methods of Machining,Springer.
5. Benedict, Non-Traditional Manufacturing Process, CRC pub.
6. P. K. Mishra, Nonconventional manufacturing,Narosa Publishers

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).
All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-II

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP-111A	PRODUCT DESIGN AND DEVELOPMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to understand about the product design and developments with inputs from aesthetics, ergonomics, design for manufacturing ease and cost effectiveness apart from reliability and durability and other considerations.						
Course Outcomes							
CO1	To understand the concept of product design, design considerations, design practiced by the industry, production and marketing, and aesthetics.						
CO2	To provide a detailed fundamental approach to several primary processes and design guidelines for manufacturing, assembly and environment.						
CO3	To discuss the human factor engineering and the concept of value engineering.						
CO4	To study the modern approaches to product design, concept of product development and its manufacturing and economic aspects.						

UNIT-I

INTRODUCTION: Introduction to product design, Design by evolution and innovation, Essential factors of product design, Production consumption cycle, Flow and value addition in production consumption cycle, Morphology of design.

PRODUCT DESIGN PRACTICE AND INDUSTRY: Product strategies, Time to market, Analysis of the product, Basic design considerations, Role of aesthetics in product design.

UNIT-II

DESIGN FOR MANUFACTURE AND ASSEMBLY: Overview and motivation, Basic method: Design guidelines: Design for assembly, Design for piece part production, Advanced method: Manufacturing cost analysis, cost driver modeling, Critique for design for assembly method.

DESIGN FOR THE ENVIRONMENT: Environmental objectives, Basic DFE methods, Design guidelines, Life cycle assessment, Techniques to reduce environmental impact.

UNIT-III

HUMAN ENGINEERING CONSIDERATIONS IN PRODUCT DESIGN: Human being as applicator of forces, Anthropometry, the design of controls, the design of displays, Man/Machine information exchange, Workplace layout from ergonomic considerations.

VALUE ENGINEERING: Value, Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, value analysis job plan, creativity, steps to problem solving and value analysis, value analysis tests, value engineering idea generation check list, Cost reduction through value engineering-case study, materials and process selection in value engineering.

UNIT-IV

MODERN APPROACHES TO PRODUCT DESIGN: Concurrent design, Quality function deployment (QFD), Rapid prototyping, 3D printing, Introduction to 4D printing.

PRODUCT DEVELOPMENT: A modern product development process, reverse engineering and redesign product development process, product life cycle, product development teams, Product development planning, Manufacturing & economic aspects of product development.

RECOMMENDED BOOKS:

1. Kail T Ulrich and Steven D Eppinger, "Product Design and Development, TMH.
2. AK Chitale and Gupta, "Product Design and Engineering, PHI.
3. Niebel& Draper, "Product Design and Process Engineering", McGraw-Hill.
4. Kevin Otto & Kristin Wood, "Product Design-Techniques in reverse engineering and new product development"Pearson.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–113A	SIMULATION OF INDUSTRIAL SYSTEMS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of industrial systems and its simulation.						
Course Outcomes							
CO1	To explain the concept of industrial simulation systems and its models of simulation.						
CO2	To understand the simulation of discrete and queueing systems.						
CO3	To understand the simulation if inventory systems and design of simulation experiments.						
CO4	To simulate the industrial problems like reliability problems,computertimesharingproblem and understand the simulation languages.						

UNIT-I

Introduction and overview: concept of system, system environment, elements of system, system modeling, types of models, Monte Carlo method, system simulation, simulation - a management laboratory, advantages & limitations of system simulation, continuous and discrete systems.

Simulation of continuous systems: characteristics of a continuous system, comparison of numerical integration with continuous simulation system. Simulation of an integration formula.

UNIT-II

Simulation of discrete system: Time flow mechanisms, Discrete and continuous probability density functions. Generation of random numbers, testing of random numbers for randomness and for auto correlation, generation of random variates for discrete distribution, generation of random variates for continuous probability distributions-binomial, normal, exponential and beta distributions; combination of discrete event and continuous models.

Simulation of queuing systems: Concept of queuing theory, characteristic of queues, stationary and time dependent queues, queue discipline, time series analysis, measure of system performance.

Kendall's notation, auto covariance and auto correlation function, auto correlation effects in queuing systems, simulation of single server queues, multi-server queues, queues involving complex arrivals and service times with blanking and reneging.

UNIT-III

Simulation of inventory systems: Rudiments of inventory theory, MRP, in-process inventory. Necessity of simulation in inventory problems, forecasting and regression analysis, forecasting through simulation, generation of Poisson and Erlangvariates, simulation of complex inventory situations.

Design of Simulation experiments: Length of run, elimination of initial bias, Variance, Variance reduction techniques, stratified sampling, antipathetic sampling, common random numbers, time series analysis, spectral analysis, model validation, optimization procedures, search methods, single variable deterministic case search, single variable non-deterministic case search, and regenerative technique.

UNIT-IV

Simulation of PERT: Simulation of - maintenance and replacement problems, capacity planning, production systems, reliability problems, computer time sharing problem, the elevator system.

Simulation Languages: Continuous and discrete simulation languages, block structured continuous languages, special purpose simulation languages, SIMSCRIPT, GPSS SIMULA importance and limitations of special purpose languages.

RECOMMENDED BOOKS:

1. Loffick, Simulation and Modelling - Tata McGraw Hill
2. DeoNarsingh, System Simulation with Digital Computer - Prentice Hall
3. Hira, D.S., System Simulation-S. Chand & Co.
4. Meelamkavil, Computer Simulation and Modelling - John Willey
5. Gorden, System Simulation - Prentice hall
6. Jerry Banks and John, S. Carson II, 'Discrete – Event System Simulation', Prentice Hall Inc., NewJersey, 1984.

7. Geoffrey Gordon, 'System simulation', Prentice Hall, NJ, 1978.
8. Law, A.M. and W.D. Keltor, 'Simulation modelling analysis', McGraw Hill, 1982.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–115A	SUPPLY CHAIN MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of Supply chain and different aspects of supply chain management.						
Course Outcomes							
CO1	To impart knowledge about basics of Supply chain management and Supply chain						
CO2	To acquaint students with the different aspects involved in sourcing and procurement in supply chain management.						
CO3	To impart knowledge to students about Evaluating performance of Supply chain and decision making about Transportation, Storage and warehousing.						
CO4	To let student understand Quantitative tools for SCM, Information Technology in a Supply Chain:						

UNIT-I

Overview of supply chain management: Introduction, Definition, The Objective of a Supply Chain, The Importance of Supply Chain Decisions, Decision Phases in a Supply Chain, Process Views of a Supply Chain, Examples of Supply Chains.

Supply chain dynamics: Introduction, Coping with Dynamics in Supply chain. Bullwhip effect, Analysis of Bullwhip Effect, Impact of Lead time, Inventory management and Supply chain dynamics, offshoring and outsourcing Effect on SC dynamics and cost.

UNIT-II

Outsourcing and Make or Buy Decisions: Strategic Decisions and Core competencies, Tactical Decisions, Factors influencing make or buy decisions, Control of Production or Quality, Unreliable Suppliers, Suppliers Specialized knowledge and research, Small Volume Requirements, Limited Facilities, Workforce Stability, Multiple Sourcing Policy, Managerial and Procurement considerations, the Volatile nature of Make/Buy situation, Administration: Procedures and Personal.

Sourcing of Supply: Importance of Source Selection, Responsibilities for Source Selection, Evaluating a potential supplier, The criticality of Qualifying Sources, Competitive Bidding and Negotiation, Prerequisite for competitive bidding, Two step Bidding/Negotiation, Benefits and Risks of International Sourcing, Identifying and Qualifying an International Source.

UNIT-III

Supply Chain Performance: Achieving Strategic fit And Scope: Competitive and Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope**,** Challenges to Achieving and Maintaining, Strategic Fit, Supply chain drivers and metrics, Financial Measures of Performance, Drivers of Supply Chain Performance, Framework for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing.

Transportation, storage and warehousing: Introduction, Transportation mode choice, Transport operator decisions, Trucking sectors in India, Rail transport, Air Transport, Water transport, Transport network, Storage and warehousing, types of warehousing, risk pooling, IT Integration: Supply chain information system, Role of IT in SCM process, Business process Re-engineering, Internet and its applications in SCM.

UNIT-IV

Quantitative tools for SCM: Introduction, Forecasting, Demand forecast, Forecasting strategy & technique, Management of Inventories in SC, Linear programming, Routing models, pricing decisions, Introduction to MCDM approach.

Information Technology in a Supply Chain: The Role of IT in a Supply Chain, The Supply Chain IT Framework Customer Relationship Management, Internal Supply Chain Management, Supplier Relationship Management, The Transaction Management Foundation, The Future of IT in the Supply Chain, Risk Management in IT, Supply Chain IT in practice.

RECOMMENDED BOOKS:

1 Chopra, S., and Meindl, P., Supply chain Management: Strategy, Planning and Operations. Second Edition, Pearson Education (Singapore) Pte. Ltd, 2004.

2. Rangaraj, Supply Chain Management for Competitive Advantage, TMH.
3. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw-Hill Edition, 2003.
4. Doebler, D.W. and Burt, D.N., Purchasing and Supply Chain Management: Text and Cases, McGraw-Hill Publishing Company Limited, New Delhi, 1996.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTRM-111A	RESEARCH METHODOLOGY AND IPR						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	2	60	40	100	3

Objective	The objective of this course is to make the students capable of formulating the research problems/ proposals and get aware about the intellectual property and patent laws.
Course Outcomes	
CO 1	Student will be able to understand research problem formulation.
CO 2	Student will be able to analyze research related information and follow research ethics.
CO 3	Student will be able to understand the Patents, Designs, Trade and Copyright and able to apply the knowledge for patent.
CO 4	Student will be able to understand the concept of Patent Rights, Licensing and transfer of technology and able to apply the knowledge in new developments in IPR.

Unit-I

Meaning of research problem, Sources of research problem, Criteria, characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit-II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit-III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit-IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and Institutions.

RECOMMENDED BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: An introduction for science & engineering students" Kenwyn, South Africa : Juta& Co. Ltd., 1996
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Juta Academic; 2nd edition (April 28, 2004)
3. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners" SAGE Publications Ltd; Fourth edition (14 January 2014)
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers; Revised edition (July 25, 2007)
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks.* The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP-117A	ADVANCED METAL CASTING LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of foundry shop							
Course Outcomes								
CO1	To impart knowledge of practical evaluation of sand grades and moisture content in the moulding sand.							
CO2	To acquaint students with the different aspects involved in testing ADV, Permeability and DCS of Moulding/Core sand.							
CO3	To impart knowledge to students about determining grain size Mould Hardness and Compressive strength of the Mould.							
CO4	To let student understand how to prepare MMCs using Stir Casting process.							

List of Experiments:

1. To perform grading of sand for foundry purpose.
2. Determination of optimum moisture content in Green Sand Practice.
3. Determination of DCS of core sand.
4. Determination of permeability for molding sand mixtures.
5. Determination of acid demand value in a moulding sand sample.
6. To determine mould hardness.
7. To determine grain size and gran fines content in moulding Sand.
8. To determine compressive strength of the given mould sample
9. To determine grain size distribution and grain fines number for a sand mix.
10. To prepare advanced Metal Matrix Composites using Stir Casting.

Note: At Least eight experiments need to be performed by the students from the above mentioned list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP-119A	COMPUTER AIDED DESIGN AND MANUFACTURING LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	To acquaint the students with 2-D and 3-D modeling using design softwares.							
Course Outcomes								
CO1	To understand the basic solid modeling and applied features of the softwares.							
CO2	To learn and practice of surface techniques and surface creations using software.							
CO3	To learn and practice of assembly and detailed drafting.							
CO4	To let student understand how to prepare MMCs using Stir Casting process.							

List of Experiments:

The students will be required to carry out the following exercises or their equivalent tasks using a 3-D modeling software package (e.g. Solid-works/ Creo/ Ideas/ Solid Edge/UG/CATIA/ etc.). Practical must be performed on licensed version (Preferably the latest version) of any one of above mentioned software.

1 BASIC SOLID MODELING

Introduction & sketcher tools

a) CAD Tools and Applications: CAD - CAM - CAE
b) Parametric Feature Based Modelling and Parent-Child Relation
c) Design Intent and Associativity between 3 Modes
d) Modelling Software - Getting Started & Graphical User Interface
e) Sketch Entities and Tools
f) Dimensioning and Adding Relations to define the Sketch

Sketched Features (Boss / Base and Cut)

a) Base Features
b) Extrude & Revolve
c) Reference Geometry, Curves & 3D Sketch
d) Sweep & Loft

Editing & Refining Model

a) Editing Sketch, Sketch Plane and Editing Feature
b) Suppress / Un-Suppress Feature and Reordering Feature

2 ADVANCE FEATURES APPLIED FEATURES

a) Patterns & Mirror
b) Fillet/Round & Chamfer
c) Hole &Hole Wizard
d) Draft, Shell, Rib and Scale
e) Dome, Flex and Wrap

Multi Body

a) Indent Tool
b) Combine Bodies – Boolean Operations
c) Split, Move/Copy and Delete Bodies

Other Tools & Options

a) Design Table and Configurations
b) Adding Equations and Link Values
c) Tools - Measure and Mass Properties
d) Appearance - Edit Material, Colour and Texture
e) Options - System and Document Properties

3 SURFACING TECHNIQUES BASIC SURFACE CREATIONS

a) Extrude & Revolve
b) Sweep & Loft
c) Boundary Surface
d) Planar Surface

Other Derived Techniques

a) Offset Surface
b) Radiate Surface
c) Ruled Surface
d) Fill Surface
e) Mid Surface

Modify / Edit Surfaces

a) Fillet/Round
b) Extend
c) Trim &Untrim
d) Knit Surfaces
e) Delete and Patch

Surfaces for Hybrid Modelling

a) Thicken – Boss / Base and Cut
b) Replace face
c) End condition for Sketched feature - Up to Surface or Offset from Surface.
d) Solid body from closed surfaces

4 ASSEMBLY & MECHANISMS BOTTOM UP ASSEMBLY APPROACH

a) Inserting Components/Sub-Assemblies
b) Adding Mates - Standard & Advance
c) Editing Mates, Part and Replacing Components

Top down Approach & Mechanisms

a) Inserting New Part to Existing Assembly
b) Use of Layout Sketching
c) External References - In-context and Out-of-context, Locked and Broken

Assembly Features

a) Component Patterns & Mirrors
b) Cuts & Holes
c) Belt/Chain and Weld Bead

Representations of Assembly Components

a) Light Weight, Suppressed and Resolved
b) Hide, Transparency and Isolate
c) Exploded View

Assembly Check

a) Interference Detection,
b) Collision Detection and Physical Dynamics

Motion Study

c) Assembly Motion & Physical Simulation
d) Animation Wizard & Save as AVI file
e) Mechanism Analysis – Plot Displacement, Velocity and Acceleration Diagram

5 DETAILED DRAFTING

Introduction to Engineering Drawings

a) General Procedure for Drafting & Detailing
b) Inserting Drawing Views, Dimensioning and Adding Annotations
c) Drawing Templates & Sheet Format
d) Setting Options

Drawing Views

a) Model View & Standard 3 View
b) Projected View & Auxiliary View
c) Section & Aligned Section View
d) Detail View, Broken-out Section and Crop View.

Dimensioning

a) Standards, Rules and Guidelines
b) Dimension Insertion/Creation - Insert Model Items & Dimension tool

Annotations

a) Notes & Holes Callout
b) Datum & Geometric Tolerances
c) Surface Finish & Weld Symbols,Centre Mark & Centre line,BOM Balloon & Bill of Material

w.e.f. 2018-19

Audit Course-I

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTAD-101A	ENGLISH FOR RESEARCH PAPER WRITING						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to impart the knowledge of English for research paper writing.						
Course Outcomes							
CO1	To understand that how to improve writing skills and level of readability.						
CO2	To Learn about what to write in each section.						
CO3	To understand the skills needed when writing a title.						
CO4	To learn the skills required in writing the results, discussion and conclusions.						

Unit-I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit-II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit-III

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. Key skills needed when writing a Title, key skills needed when writing an abstract, key skills needed when writing an Introduction, skills needed when writing a Review of the Literature.

Unit-IV

Skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions, Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

RECOMMENDED BOOKS:

1. Goldbort R, "Writing for Science", Yale University Press (available on Google Books)
2. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press
3. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM. Highman's book.
4. Adrian Wallwork, "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTAD-103A	DISASTER MANAGEMENT						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The objective of this course is to impart the knowledge of disasters management.						
Course Outcomes							
CO1	To demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.						
CO2	To critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.						
CO3	To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.						
CO4	To critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.						

Unit-I

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit-II

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Unit-III

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

Unit-IV

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

RECOMMENDED BOOKS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies '"New Royal book Company.
2. Sahni, Pardeep (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTAD- 105A	SANSKRIT FOR TECHNICAL KNOWLEDGE						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to understand basic Sanskrit Language and Ancient Sanskrit literature related to science & technology.						
Course Outcomes							
CO1	Students will get a working knowledge in illustrious Sanskrit, the scientific language of the world.						
CO2	Learning of Sanskrit to improve brain functioning.						
CO3	Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.						
CO4	The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.						

Unit-I

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Unit-II

Order, Introduction of roots, Technical information about Sanskrit Literature

Unit-III

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

RECOMMENDED BOOKS:

1. Dr.Vishwas, “Abhyaspustakam” Samskrita-Bharti Publication, New Delhi
2. VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam “Teach Yourself Sanskrit” PrathamaDeeksha-, New Delhi Publication
3. Suresh Soni, “India’s Glorious Scientific Tradition” Ocean books (P) Ltd., New Delhi.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTAD-107A	VALUE EDUCATION						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The objective of this course is to understand value education, self-development, Imbibe good values in students and Let them know about the importance of character building.						
Course Outcomes							
CO1	To get knowledge of self-development.						
CO2	To learn the importance of Human values.						
CO3	To develop the overall personality.						
CO4	To know about the importance of character.						

Unit-I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

Unit-II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

Unit-III

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

Unit-IV

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively

RECOMMENDED BOOKS:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Second Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP-102A	MECHATRONICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to acquaint the knowledge of electronic devices and electromechanical systems, hydraulic and pneumatic systems, CNC, Robotics and PLC's.						
Course Outcomes							
CO1	To understand the concepts of Mechatronics, fundamental of electronics and digital circuits and electrical actuating circuits.						
CO2	To acquaint the knowledge of hydraulic system with its practical applications.						
CO3	To acquaint the knowledge of pneumatic system with its practical applications.						
CO4	To study the fundamentals of CNC, Robotics and programmable logic controllers (PLC's) and their use.						

UNIT-I

Introduction: The Mechatronics approach: A methodology for integrated design of Mechanical, Electronics and Electrical Control, Computer and Instrumentation.

Fundamentals of Electronics and digital circuits: Number systems: Binary, Octal, Hexadecimal, Conversion from Binary to Decimal, Octal and Hexadecimal and vice–versa, Binary arithmetic: Addition, subtraction, Multiplication and division, Boolean Algebra: Laws, De-Morgan's laws, Logic Gates, Truth tables, Karnaugh maps and logic circuits. Generation of Boolean function from truth tables and simplification, **Electrical actuating system:** Basic principle of electrical switching, Solenoids, Electrical relays, Representation of output devices, Electrical motors: A.C. motors, Stepper motors, Induction motor speed control.

UNIT-II

HYDRAULIC SYSTEMS:

Direction Control Valves: Poppet Valve, Spool Valve, Sliding Spool type DCV, Check Valve, Pilot operated check valve, Restriction check valve, 2 Way vale, 3 way valve, 4 way valve, Manually actuated valve, Mechanically actuated valve, Pilot operated DCV, Solenoid Actuated valve, Rotary Valve, Centre flow path configurations for three position four way valve, Shuttle valve

Pressure Control Valve: Simple and compound pressure Relief Valve, Pressure Reducing Valve, Unloading valve, sequence valve, counterbalance valve, Brake Valve

Flow Control Valves: Fixed and non-adjustable valve, adjustable, throttling, non-pressure compensated pressure control valve, Pressure/temperature compensated flow control valve, Shuttle and Fast exhaust valve, Time delay valve, Flow Control Valves, Fluid Conditioners, Hydraulic Symbols (ANSI),Hydraulic Circuit design: Control of Single and double acting cylinders, double pump Hydraulic System

UNIT-III

PNEUMATIC SYSTEM:

Air Generation and distribution: Air compressors, Air Receiver, Filters, intercoolers, After-coolers, Relief Valve, Air dryers, Primary and secondary lines, Piping layouts, Air Filters, Air Regulators, Air Lubricator, Actuators and output devices, Direction control valves, Flow control valves, junction elements, Pneumatic circuits, Control of Single and double acting cylinders.

UNIT-IV

INTRODUCTION TO CNC MACHINES AND ROBOTICS:

CNC Machines: NC machines, CNC machines, DNC machines, Machine structure, Slidways, Guideways, Slide Drives, Spindle, Robotics:Components of robots, Classification of robots, Robots application

PROGRAMMABLE LOGIC CONTROLLERS

Introduction - Principles of operation - PLC Architecture and specifications - PLC hardware Components, Analog & digital I/O modules, CPU & memory module - Programming devices - PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram. PLC programming Simple instructions - Manually operated switches - Mechanically operated Proximity switches - Latching relays, Applications of PLC.

RECOMMENDED BOOKS:

1. W. Bolton,Mechatronics, Pearson Education.
2. Majumdar,Pneumatic system, TMH.
3. Andrew Parr, Hydraulic and Pneumatic systems,TMH.
4. M.P. Groover,Automation, Production systems and computer integrated manufacturing, TMH.
5. Shetty and Kolk,Mechatronics system design, Thomson learning.
6. Mahalik,Mechatronics, TMH.
7. Anthony Esposito,Fluid power with application,Pearson Education.
8. K.P Ramachandran, M.S Balasundaram,Mechatronics, Wiley India.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks.* The student will attempt a total of *FIVE questions,* each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining/our questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP-104A	Industrial Tribology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	To develop a solution oriented approach by in depth knowledge of Industrial Tribology and address the underlying concepts, methods and application of Industrial Tribology.						
Course Outcomes							
CO 1	Students will be able to understand the fundamentals of tribology, friction and wear processes in contacts between different materials.						
CO 2	Students will be able to understand the material requirements for tribological applications and different surface treatment techniques.						
CO 3	Students will be able to study different types of lubricants and testing techniques.						
CO 4	Students will be able to study the maintenance and conservation techniques, testing specifications and standards.						

UNIT-I

Fundamentals of Tribology: Introduction to tribology and its historical background, Economic Importance of Tribology.**Friction and Wear:**Genesis of friction, friction in contacting rough surfaces, sliding and rolling friction, various laws and theory of friction. Stick-slip friction behavior, frictional heating and temperature rise. Friction measurement techniques.

Wear and wear types. Mechanisms of wear - Adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc., Wear of metals and non-metals. Wear models - asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage. Wear in various mechanical components, wear controlling techniques.

UNIT-II

Materials for Tribological Applications: An overview of engineering materials having potential for tribological application. Characterization and evaluation of Ferrous and non-ferrous materials for tribological requirements/applications, Composite materials (PM, CMC and MMC) for tribological applications.

Surface treatment techniques: Surface treatment techniques such as carburising, nitriding, induction hardening, hard facing, laser surface treatments, etcwith applications, Surface coating techniques such as electrochemical depositions, anodizing, thermal spraying, Chemical Vapour Deposition (CVD), Physical Vapour Deposition (PVD), etc. and their applications.

UNIT-III

Lubrication and lubricants: Boundary Lubrication, Mixed Lubrication, Full Fluid Film Lubrication, Hydrodynamic, Elastohydrodynamic lubrication, Primary role of lubricants in mitigation of friction and wear & heat transfer medium, Composition and properties of lubricants, Fundamentals - Mineral oil based liquid lubricants, Synthetic liquid lubricants, Solid lubricants, greases and smart lubricants, Characteristics of lubricants and greases, Rheology of lubricants, Evaluation and testing of lubricants.

UNIT-IV

Lubricants additives and application: Introduction to lubricant additives, Antioxidants and bearing corrosion inhibitors, Rust inhibitors, Viscosity improvers, Extreme pressure additives.

Consumption and conservation of lubricants: Lubricants for industrial machinery, Maintenance and conservation of lubricating oils, Storage and Handling of lubricants, Used lubricating oil, Environment and health hazards, Disposability and Recycling, Technical regulation for lubricants, Test specifications and standards for maintenance and management of industrial lubricants including greases and used oils, Selection of optimum lubricant for given application.

RECOMMENDED BOOKS:

1. I.M. Hutchings, Tribology, "Friction and Wear of Engineering Material ", Edward Arnold.

2. Gwidon W. Stachowiak, Andrew W. Batchelor, “Engineering Tribology” Butter worth, Heinemann.
3. T.A. Stolarski, "Tribology in Machine Design ", Industrial Press Inc.
4. E.P. Bowden and Tabor. D., "Friction and Lubrication ", Heinemann Educational Books Ltd.
5. A. Cameron, "Basic Lubrication theory ", Longman, U.K.
6. M.J. Neale (Editor), "Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-III

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP-106A	ADVANCED WELDING PROCESSES						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of Welding metallurgy and welding processes.						
Course Outcomes							
CO1	To impart knowledge about various Weld metallurgy and Weld arc characteristics.						
CO2	To acquaint students with the various welding power sources and their applications.						
CO3	To impart knowledge to students about Electrode coatings and Metal transfer phenomenon in weld metal transfer.						
CO4	To let student understand the basics of Solid state welding processes and some of the latest welding techniques.						

UNIT-I

WELDING METALLURGY: Introduction, Weld Metal Zone, Theory of solidification of metals and alloys, Homogeneous Nucleation, Heterogeneous Nucleation, Freezing of alloys, Epitaxial Solidification; Effect of Welding speed on Grain structure, Fusion boundary zone, Heat affected zone, Under bead zone, Grain Refined Zone, Partial transformed zone, Properties of HAZ

WELDING ARC: Definition of Arc, Structure and characteristics, Arc efficiency, arc blow, Electrical Characteristics of arc, Types of Welding Arcs, mechanism of arc initiation and maintenance, role of electrode polarity on arc behaviour and arc stability, analysis of the arc. Arc length regulation in mechanized welding processes.

UNIT-II

WELDING POWER SOURCES: Requirement of an Arc welding power sources, basic characteristics of power sources for various arc welding processes, duty cycles, Selection of a static Volt-Ampere characteristic for a welding process, AC/DC welding power source, DC rectifiers, thyristor controlled rectifiers, transistorized units, inverter systems, Mathematical Problems on Static volt ampere characteristics

UNIT-III

COATED ELECTRODES: Electrode coatings, classification of coatings of electrodes for SMAW, SAW fluxes, role of flux ingredients and shielding gases, classification of solid and flux code wires.

METAL TRANSFER & MELTING RATE: Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal transfer and melting rate.

UNIT-IV

SOLID STATE WELDING: Theory and mechanism of solid state welding,techniques and scope of friction welding, diffusion welding, cold pressure welding and ultrasonic welding, high energy rate welding,analysis of the Process.

WELDING TECHNIQUES: Technique, scope and application of the electron beam and laser welding processes,under water welding - process & problem.

RECOMMENDED BOOKS:

1. Raymond Sacks, —Welding: Principles & Practicesll McGraw-Hill
2. R.S.Parmar, —Welding processes & Technologyll, Khanna Publishers
3. R.S.Parmar, —Welding Engineering & Technologyll, Khanna Publishers
4. S.V. Nandkarni, —Modern Arc Welding Technology, Oxford & IBH publishing Co.
5. L.M.Gourd, —Principles of Welding Technologyll, ELBS/ Edward Arnold.
6. Richard L. Little —Welding & Welding Technologyll, Mc-Graw Hill.
7. Cary, Howard —Modern Welding Technology', prentice Hall, 1998.
8. Rossi —Welding Technologyll, Mc-Graw Hill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–108A	ADVANCED METAL CUTTING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of advanced cutting tools, tools geometry, mechanisms and analysis.						
Course Outcomes							
CO1	To impart knowledge about various functional related to tools geometry.						
CO2	To acquaint with the analysis of fundamental factors affecting tool forces						
CO3	To impart knowledge about cutting tool life and mathematical modelling for wear.						
CO4	To let student understand abrasive machining and its process simulation.						

UNIT-I

Introduction system of Tool nomenclature, Tool Geometry, Mechanism of Chip formation and forces in orthogonal cutting, Merchant's force diagram.

Oblique Cutting: Normal chip reduction coefficient under oblique cutting, true shear angle, effective rake, influx region consideration for deformation, direction of maximum elongation, effect of cutting variables on chip reduction co-efficient, forces system in oblique cutting, effect of wear land on force system, force system in milling, effect of helix angle.

UNIT-II

Fundamentals of Dynamometry, Theoretical determination of forces, angle relations, heat and temperature during metal cutting; distribution, measurement, analysis, theoretical estimation of work piece temperature, hot machining

Fundamental factors, which effect tool forces: Correlation of standard mechanized test. (Abuladze –relation), nature of contact and stagnant phenomenon, rates of strains, shear strain and normal strain distributions, cutting variables on cutting forces.

UNIT-III

Cutting Tools: Tools materials analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, wear of cutting tools, criterion, flank and crater wear analysis, optimum tool life, tool life equations, (Taylor's woxenetc) Tool life test, machining optimization, predominant types of wear; abrasive, adhesive, diffusion wear models, wear measurements and techniques, Major Test of tool wear oxidative mathematical modelling for wear, test of machinability and influence of metallurgy on machinability. Economics of metal machining

UNIT-IV

Abrasive Machining: Mechanics of grinding, cutting action of grit, maximum grit chip thickness, energy and grit force temperature during grinding, wheel wear, grinding, process simulation, testing of grinding wheels, mechanics of lapping and honing, free body abrasion.

RECOMMENDED BOOKS:

1. Sen & Bhattacharya,Principles of Machine tools, New Central Book Agency.
2. Brown,Machining of Metals, Prentice Hall.
3. Shaw,Principles of Metal cutting, Oxford I.B.H.
4. Arshimov&Alekree,Metal cutting theory & Cutting tool design, MIR Publications.
5. Machining Science & Application by Knowenberg Longman Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP-110A	Metrology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs.**
Objective	The main objective of the course is to deal with the basic principles of dimensional measuring instruments and precision measurement techniquesin achieving quality and reliability in the service of any product in dimensional control.						
Course Outcomes							
CO1	To understand the studentsabout the requirement of metrology and the concepts of limit, fits and gauges.						
CO2	To study the linear and angular measurements and the optical measurement tools and techniques.						
CO3	To understand how to use surface roughness and thread measuring instruments.						
CO4	To study the comparators, measurement through comparators and the advanced metrology concepts.						

UNIT-I

Introduction to metrology: Definition, types, need of inspection, terminologies, methods of measurement, selection of instruments, measurement errors, units, Measurement standards, calibration, statistical concepts in metrology.

Systems of Limits and Fits: Introduction, nominal size, tolerance limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard Institution system – British standard system, International standard system for plain and screwed work.

Limit Gauges: Taylor's principle – Design of limit gauges, computer aided tolerancing.

UNIT-II

Linear Measurement: Length standard, line and end standards, slip gauges – calibration of the slip gauges, dial indicator, micrometres. Measurement of angles and tapers: Different methods – bevel protractor – angle slip gauges – spirit levels– sine bar – sine plate, rollers and spheres.

Flat Surface Measurement: Measurement of flat surfaces – instruments used – straight edges– surface plates – optical flat and auto collimator.

Optical Measuring Instruments: Tool maker's microscope and its uses, collimators, optical projector, optical flats and their uses, interferometer.

UNIT-III

Surface Roughness Measurement: Introduction, terminology, specifying roughness on drawings, surface roughness parameters, factors affecting surface roughness, ideal surface roughness, roughness measurement methods, precautions in measurement, surface microscopy, surface finish softwares.

Screw Thread Measurement: Elements of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch, profile thread gauges.

Measurement through Comparators: Comparator: Features of comparators, classification of comparators, different comparators, advanced comparators, thread comparators.

UNIT-IV

Metrology of machine tools: Alignment and practical tests.

Gear Measurement: Gear measuring instruments, gear tooth profile measurement, measurement of diameter, pitch, pressure angle and tooth thickness.

Advanced Metrology: Advanced measuring machines, CNC systems, Laser vision, In-process gauging, 3D metrology, metrology softwares, Nano technology instrumentation, stage position metrology, testing and certification services,

optical system design, lens design, coating design, precision lens assembly techniques, complex opto mechanical assemblies, contact bonding and other joining technologies.

RECOMMENDED BOOKS:

1. K.J. Hume,Engineering Metrology, Macdonald and Co. (publisher) London.
2. Czichos, The Springer handbook of metrology and Testing, 2011.
3. Jay. L. Bucher, The Metrology Hand book, American Society for Quality, 2004.
4. Smith GT,Industrial Metrology, Spinger.
5. John W. Greve, Frank W. Wilson,Hand book of industrial metrology, PHI – New Delhi.
6. D.M. Anthony, Engineering Metrology, Pergamon Press.
7. Khare MK,Dimensional Metrology, OXFORD-IBH Publishers.
8. I C Gupta, "Engineering Metrology", 5th Edition, DanapathRai& Co, 2008.
9. R.K. Jain, "Engineering Metrology". 20th Edition, Khanna Publishers, 2007.
10. M. Mahajan, "Engineering Metrology", DhanapatiRai publications, 2007.
11. BIS standards on Limits & Fits (IS 919), Surface Finish (IS 2073), Machine Tool Alignment, 1993.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-IV

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–112A	**SEQUENCING AND SCHEDULING**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of different production and machine models of sequencing and scheduling.						
Course Outcomes							
CO1	To understand the concept of sequencing and scheduling.						
CO2	To study and practice for the extension of basic models and parallel machine models.						
CO3	To understand the concepts of the flow shop scheduling and practice for the flow shop scheduling models.						
CO4	To understand the job shop problems and simulation models for dynamic job shop problem.						

UNIT-I

Single-Machine Sequencing: Introduction, Preliminaries, Problems without Due Dates, Problems with Due Dates
Optimization Methods for the Single-Machine Problem: Introduction, Adjacent Pairwise Interchange Methods, A Dynamic Programming Approach, Dominance Properties, A Branch and Bound Approach.
Earliness and Tardiness Costs: Introduction, Minimizing Deviations from a Common Due Date, The Restricted Version, Asymmetric Earliness and Tardiness Costs, Quadratic Costs, Job-Dependent Costs, Distinct Due Dates,Sequencing for Stochastic Scheduling.

UNIT-II

Extensions of the Basic Model: Introduction, Non-simultaneous Arrivals, Related Jobs, Sequence-Dependent Setup Times, Stochastic Models with Sequence-Dependent Setup Times.
Parallel machine models: Introduction, Minimizing the Makespan, Minimizing Total Flow time, Stochastic Models.

UNIT-III

Flow Shop Scheduling: Introduction, Permutation Schedules, The Two-Machine Problem, Special Cases of The Three-Machine Problem, Minimizing the Makespan, Variations of the *m*-Machine Model, Stochastic flow shop scheduling.

UNIT-IV

The Job Shop Problem: Introduction, Types of Schedules, Schedule Generation, The Shifting Bottleneck Procedure, Neighborhood Search Heuristics.
Simulation Models for the Dynamic Job Shop: Introduction, Model Elements, Types of Dispatching Rules, Reducing Mean Flowtime, Meeting Due Dates.

RECOMMENDED BOOKS:

1. Michael Pinedoo, Scheduling: theory, algorithms and systems, Prentice Hall, New Delhi, 1995.
2. King, J.R. Production planning and control, Pergamon International Library, 1975.
3. Kenneth R. Baker, Introduction to sequencing and scheduling, John Wiley and Sons, 1974.
4. Kenneth R. Baker and Dan Trietsch, Principles of sequencing and scheduling, John Wiley and Sons, 2009.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–114A	**QUALITY ENGINEERING AND MANAGEMENT**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of quality tools and engineering for the improvement of product quality.						
Course Outcomes							
CO1	To understand the statistical concepts of quality and quality statistics.						
CO2	To study the quality control chartsin production process and practice for its use in problem solving.						
CO3	To understand the quality improvement tools.						
CO4	To study the ISO systems, failure analysis and testing.						

Unit-I

Introduction to Quality: An Historical Overview: Defining Quality, The Total Quality System, Total Quality Management, Economics of Quality, Quality, Productivity, and Competitive Position, Quality Costs, Success Stories.

Statistics for Quality: Variability in Populations, Some Definitions, Quality vs. Variability, Section I: Empirical Methods for Describing Populations, Section II: Mathematical Models for Describing Populations, Section III: Inference of Population Quality from a Sample.

Unit-II

Quality in Design: Planning for Quality, Product Planning, Product Design, Process Design.

Quality in Production-Process Control I: Process Control, The Control Charts, Measurement Control Charts, Attribute Control Charts, Summary on Control Charts, Process Capability, Measurement System Analysis,

Quality in Production-Process Control II: Derivation of Limits, Operating Characteristics of Control Charts, Measurement Control Charts for Special Situations.

Unit-III

Quality in Procurement: Importance of Quality in Supplies, Establishing a Good Supplier Relationship, Choosing and Certifying Suppliers, Specifying the Supplies Completely, Auditing the Supplier, Supply Chain Optimization Using Statistical Sampling for Acceptance,

Continuous Improvement of Quality: The Need for Continuous Improvement, The Problem-Solving Methodology, Quality Improvement Tools, Lean Manufacturing.

Unit-IV

A System for Quality: The Systems Approach, Dr. Deming's System, Dr.Juran's System, Dr.Feigenbaum's System, Baldrige Award Criteria, ISO 9000 Quality Management Systems, ISO 9001:2008 Requirements, The Six Sigma System.

RECOMMENDED BOOKS:

1. Grant &Leaveworth, Statistical Quality Control, McGraw Hill
2. Duncan,Quality Control & Industrial Statistics, Irwin Press
3. Juran,Quality Control Handbook, McGraw Hill.
4. Hansen,Quality Control, Prentice Hall
5. Thomason,An Introduction to reliability & control, Machinery Publishing.
6. A.V. Taylor, Total Quality Control, McGraw-Hill
7. K.S.Krishnamoorthi, V. Ram Krishnamoorthi,A First Course in Quality Engineering: Integrating Statistical and Management Methods of Quality, Second Edition, CRC Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weight of 12 marks*.

The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–116A	**RELIABILITY ENGINEERING**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of reliability analysis in industrial system. Students can get acquainted with different reliability calculation models.						
Course Outcomes							
CO1	To understand the concepts of reliability in industrial systems.						
CO2	To study the reliability determination methods and advanced evaluation techniques.						
CO3	To understand variousreliability prediction and evolution methods.						
CO4	To acquaint the fundamentals of reliability management and risk assessment.						

UNIT-I

Reliability Engineering: Reliability function,failure rate, Mean time between failures (MTBF), Mean time to failure (MTTF), mortality curve, useful life availability, maintainability, system effectiveness. Introduction to probability distributions.

Time to failure distributions: Exponential, normal, Gamma, Weibull; ranking of data, probability plotting techniques, Hazard plotting Concept of Bathtub Hazard Rate curve, Reliability evaluation of two-state device networks-series, parallel, k-out-of-m systems; Standby redundant systems, Reliability evaluation of three-state device networks-series and parallel.

UNIT-II

Reliability Determination and Prediction: Reliability Determination Methods: Network reduction technique, Path tracing technique, Decomposition technique, Delta-Star method.

Advanced Reliability Evaluation Concepts: Supplementary variables technique, Interference theory, Human reliability, Common cause failures, Fault trees, Failure mode and effect analysis

UNIT-III

Reliability Prediction Models: Series and parallel systems - RBD approach - Standby systems - m/n configuration - Application of Baye's theorem - cut and tie set method - Markov analysis - FTA - Limitations.

UNIT-IV

Reliability testing: Time acceleration factor, influence of acceleration factor in test planning, application to acceleration test, high temperature operating life acceleration model, temperature humidity bias acceleration model, temperature cycle acceleration model, vibration accelerator model, failure free accelerated test planning. Accelerated reliability growth.

Risk Assessment: Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.

RECOMMENDED BOOKS:

1. Charles E. Ebeling, “An introduction to Reliability and Maintainability engineering”, TMH, 2000.
2. Roy Billington and Ronald N. Allan, “Reliability Evaluation of Engineering Systems”, Springer, 2007.
3. Sharma S C, Inspection Quality Control and Reliability, Khanna Publishers.
4. Connor P.D.T.O. Practical Reliability Engineering”, John Wiley.
5. Naikan V N A Reliability Engineering and Life Testing”, PHI Learning Private Limited.
6. Prabhakar Murthy D N and Marvin R, “Product Reliability”, Springer-Verlag.
7. Dana Crowe and Alec Feinberg, Design for Reliability, CRC Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weight of 12 marks*.

The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–118A	**MECHATRONICS LAB**							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	To practice on electrical circuits, hydraulic and pneumatic systems and PLC's for their practical implications.							
Course Outcomes								
CO1	To understand the PLC using PLC simulators.							
CO2	To demonstrate and actuate the positioning using sensors, actuators and programming.							
CO3	To study the pneumatic and electro-pneumatic training system with simulation software.							
CO4	To design and test on hydraulic and pneumatic circuits.							

List of Experiments

1. To study and conduct exercises on PLC Simulator.
2. Control of conveyor manually and through programming, also programming using sensors and conveyor.
3. To study and conduct exercise on CNC lathe.
4. To study and conduct exercises on Robotic simulation software.
5. To study and conduct exercises on Pneumatic & Electro-Pneumatic Training System.
6. To study the stepper motor interface with PLC.
7. **Design and testing of hydraulic circuits such as**
   i) Pressure control
   ii) Flow control
   iii) Direction control
   iv)Design of circuit with programmed logic sequence, using an optional PLC in hydraulic.
   Electro hydraulic Trainer.
8. **Design and testing of pneumatic circuits such as**
   i. Pressure control
   ii. Flow control
   iii. Direction control
   iv. Circuits with logic controls
   v. Circuits with timers
   vi. Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.
9. To perform exercises on process control trainer.

Note: At least eight experiments should be performed from the above list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP–120A	INDUSTRIAL TRIBOLOGY LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	To study friction, wear mechanism of materials and performance of lubricants under various test conditions using concepts, methods and application of Industrial Tribology.							
Course Outcomes								
CO1	Students will be able to explain the friction phenomena and different wear processes in contacts between metallic, ceramic and polymeric surfaces.							
CO2	Students will be able to determine different types of lubricants, their grades, test standards and different properties of lubricants.							
CO3	Students will be able to understand the causes of tribological failures and surface characterization.							
CO4	Students will be able to use different types of tribo-test equipments and design of wear and friction test.							

List of Experiments

1. To study the friction and wear properties of a specimen (metallic/polymeric/ceramic surfaces) using wear and friction monitoring apparatus under dry sliding conditions.
2. To study the friction and wear properties of a specimen (metallic/polymeric/ceramic surfaces) using wear and friction monitoring apparatus under wet sliding conditions.
3. To study the effect of temperature on the friction and wear performance of composite materials using high temperature pin/ball on disc tester.
4. To study the variation of viscosity of lubricants with temperature.
5. To evaluate the wear and extreme pressure properties of a lubricating oil/ grease using four ball tester.
6. To study the surface characterization of wear components.
7. To study different types of industrial abrasives materials, properties and applications.
8. To determine abrasion index of a material with the help of dry abrasion test rig.
9. To access the adhesion and scratch resistance of surface coatings (hard or soft) using Scratch Tester.
10. To determine the erosive wear rate of different materials using Air Jet Erosion Tester under different conditions.
11. To demonstrate the pressure distribution of a lubricant in a journal bearing.

Note: At least eight experiments should be performed from the above list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTIP-122A	MINI PROJECT							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**4**	**2**	**-**	**-**	**100**	**100**	**3**
Objective	In case of mini project, they will solve a live problem using software/analytical/computational tools or fabricate an experimental setup.							
Course Outcomes								
CO 1	Students will learn to write technical reports.							
CO 2	Students will develop skills to present and defend their work in front of technically qualified audience.							

Students can take up small problems in the field of Industrialand Production engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Students will be required to submit a brief synopsis of 3-4 pages related to the topic by the first week of September.

w.e.f. 2018-19

Audit Course-II

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MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTAD- 102A	CONSTITUTION OF INDIA						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**

Objective	The main objective of the course is to impart the students with the knowledge of informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
Course Outcomes	
CO1	To discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO2	To discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3	To discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO4	To discuss the passage of the Hindu Code Bill of 1956.

Unit-I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)
Philosophy of the Indian Constitution: Preamble, Salient Features

Unit-II

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality, Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit-III

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit-IV

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

RECOMMENDED BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "framing of Indian Constitution", 1st Edition, 2015.
3. M. P. Jain, "Indian Constitution Law", 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTAD-104A	PEDAGOGY STUDIES						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The main objective of the course is to review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers and Identify critical evidence gaps to guide the development.						
Course Outcomes							
CO1	Understand the pedagogical practices being used by teachers in formal and informal classrooms in developing countries.						
CO2	Become aware of the evidence on the effectiveness of these pedagogical practices, in different conditions and with different population of learners.						
CO3	Understand the significance of teacher education (curriculum and practicum) and the school curriculum and guidance materials for effective pedagogy.						

Unit-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions. Overview of methodology and Searching.

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

Unit-II

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit-III

Professional development: alignment with classroom practices and follow-up support, Peer support

Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Unit-IV

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education

Curriculum and assessment, Dissemination and research impact.

RECOMMENDED BOOKS:

1. Ackers J, Hardman F, "Classroom interaction in Kenyan primary schools", Compare, 31 (2): 245-261.
2. Agrawal M, "Curricular reform in schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K, "Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?" International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ, "Culture and pedagogy: International comparisons in primary education". Oxford and Boston: Blackwell.
6. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign"

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTAD-106A	STRESS MANAGEMENT BY YOGA						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The main objective of the course is to achieve overall health of body and mind and to overcome stress						
Course Outcomes							
CO1	Develop healthy mind in a healthy body thus improving social health.						
CO2	Improve efficiency						
CO3	Learn the Yogasan						
CO4	Learn the Pranayam						

Unit-I

Definitions of Eight parts of yog. (Ashtanga)

Unit-II

Yam and Niyam. Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit-III

Asan and Pranayam

i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam

RECOMMENDED BOOKS:

1. Janardan Swami YogabhyasiMandal, "Yogic Asanas for Group Tarining-Part-I" : Nagpur
2. Swami Vivekananda, "Rajayoga or conquering the Internal Nature" AdvaitaAshrama (Publication Department), Kolkata

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(INDUSTRIAL & PRODUCTION ENGINEERING)

MTAD-108A	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	To learn how to achieve the highest goal happily. To become a person with stable mind, pleasing personality and determination. To awaken wisdom in students.						
Course Outcomes							
CO1	Students become aware about leadership.						
CO2	Students will learn how to improve communication skills						
CO3	Understand the team building and conflict						
CO4	Student will learn how to manage the time.						

Neetisatakam-Holistic development of personality

i) Verses- 19,20,21,22 (wisdom)
ii) Verses- 29,31,32 (pride & heroism)
iii) Verses- 26,28,63,65 (virtue)
iv) Verses- 52,53,59 (dont's)
v) Verses- 71,73,75,78 (do's)

Approach to day to day work and duties.

ShrimadBhagwadGeeta: Chapter 2-Verses 41, 47, 48,
Chapter 3-Verses 13, 21, 27, 35,
Chapter 6-Verses 5, 13, 17, 23, 35,
Chapter 18-Verses 45, 46, 48.

Statements of basic knowledge.

ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16, 17, 18

Personality of Role model. ShrimadBhagwadGeeta:

Chapter 2-Verses 17,

Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

RECOMMENDED BOOKS:

1. Swami Swarupananda, "Srimad Bhagavad Gita" Advaita Ashram (PublicationDepartment), Kolkata
2. P.Gopinath, "Bhartrihari's Three Satakam (Niti-sringar-vairagya) by, Rashtriya Sanskrit Sansthanam, New Delhi.

Third Semester
(Programme Elective-V)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING(3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING

MTIP-201A	ENTERPRISE RESOURCE PLANNING						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3
Objective	The main objective of the course is to impart the students with the knowledge of integrated applications to manage the business and automate many back office functions related to technology, services and human resources.						
Course Outcomes							
CO1	To study the basic principles and models of an enterprise.						
CO2	To understand the concepts of technology and architecture in ERP.						
CO3	To study ERP system packages.						
CO4	To study the ERP procurement issues.						

UNIT I

ENTERPRISE RESOURCE PLANNING:
Introduction, Evolution of ERP, Principle of ERP, Enabling Technologies, ERP Characteristics, Features of ERP, The advantages of ERP, Reasons for the Failure of ERP Implementation, Risk and governance issues in an ERP, ERP Framework, Business Blueprint, Business Engineering Vs. Business Process Re-Engineering, ERP Tools and Software, Demand Chain, Value Chain, and Supply Chain.

UNIT-II

ERP ARCHITECTURE: Need to Study ERP Architecture**,** Layered Architecture, Types of ERP Architecture, Two-tier Implementations, Three-tier Client/Server Implementations, Web-based architecture, Service-Oriented Architectures, Logical Architecture of an ERP System, Physical Architecture of an ERP System, and Evaluation Framework for ERP Acquisition.

UNIT III

ERP PACKAGE INTEGRATION AND IMPLEMENTATION: ERP market, SAP, People soft, BAAN company, ORACLE corporation, A comparative assessment and selection of ERP packages and modules, Sales Force Automation, Integration of ERP, Integration of ERP and the Internet, ERP implementation strategies, Comparison of Big Bang vs. Phased Approach, Implementation Strategy in Small and Medium Enterprise, Post Implementation Issues.

UNIT IV

OVERVIEW OF ARCHITECTURE OF DIFFERENT ERP SOFTWARES: Oracle overview, Architecture, A.I.M. and applications, SAP Software architecture overview, ERP before and after Y2K, Impact of Y2K on ERP Development, Risk and Governance Issues in an ERP

ERP MODULES: Finance module, Sales & Distribution module, Human Resources module, Plant Maintenance module, Quality Management module, Material management module, manufacturing management module.

RECOMMENDED BOOKS:

1. Sadagopan. S, ERP-A Managerial Perspective, Tata Mcgraw Hill,1999.
2. Jose Antonio Fernandez, the SAP R/3 Handbook, Tata Mcgraw Hill,1998.
3. Vinod Kumar Crag and N.K. Venkitakrishnan, Enterprise Resource Planning- Concepts and Practice, Prentice Hall of India,1998.
4. Garg &Venkitakrishnan,ERPWARE, ERP Implementation Framework, Prentice Hall,1999.
5. Thomas E Vollmann and BeryWhybark, Manufacturing and Control Systems, Galgothia Publications,1998.
6. Alexis Leon,Enterprise resource planning, Tata Mcgraw-Hill

Note: Thepaperwillhaveatotalof*NINEquestions.*QuestionNo.1,whichiscompulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all FourUnits).
All questions will have equal *weight of 12 marks*.The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING(3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING

MTIP-203A	DESIGN OF EXPERIMENTS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 hrs
Objective	To understand the various design of experiments techniques for optimization of problems.						
Course Outcomes							
CO1	To understand the concepts of Design of Experiment and statistical Methods.						
CO2	To understand the ANOVA and factorial design and fitting response curves and surfaces.						
CO3	To study the application of Taguchi Method and testing of hypothesis						
CO4	To study and implement the Response Surface Methodology.						

UNIT-I

IntroductiontoDesignedExperiments:
Introduction,Strategyofexperimentation,Sometypicalapplicationsofexperimentaldesign, Basic principles, Guidelines for designing experiments, Using statistical design in experimentation, A Checklist for Planning experiments, *Introduction to Minitab, Interface of Minitab, Customizing Minitab, Entering Data, Graphing Data, Printing Data and Graphs, Saving and Retrieving information.*

Basic Statistical Methods: Introduction, Basic statistical concepts, Types of Data, Graphical Presentation of Data. Descriptive Statistics: Measure of Location, Measure of Variation, The Normal Distribution, Counting, Minitab Commands to Calculate Descriptive Statistics.

Inferential Statistics: The Distribution of Sample Means (R Known), Confidence Interval for the Population Mean (σ Known), Hypothesis testing for one sample mean (σ Known), Hypothesis test for two sample means, Testing for Normality, *Hypothesis test and Confidence Intervals with Minitab.*

UNIT-II

Analysis of Variance: Introduction to Analysis of Variance, ANOVA assumptions and Validation, ANOVA Table, The sum of square approach to ANOVA calculations, Analysis of the fixed Effect model, Decomposition of the Total sum of squares. Statistical analysis, Estimation of the Model Parameters, Unbalanced Data, Model Accuracy Check, Practical interpretation of results. *ANOVA with Minitab*

Factorial Experiments: Basic definition and principles, Advantages of factorials, Two level factorial design, The 2^1 Factorial Experiment, The 2^2 Factorial Experiment, The 2^3 Factorial Design, Addition of Centre Cells to 2^k Designs. General Procedure for Analysis of 2^k designs. 2^k Factorial Designs in Minitab.

UNIT-III

Introduction to Taguchi Method: Introduction, Taguchi Quality loss function, Orthogonal Array, Properties of Orthogonal Array, Minimum number of experiments to be conducted, Static Problems, Dynamic Problems, Assumptions of the Taguchi method, Steps in Taguchi Method, Assessment of Factors and Interactions, Selection and Application of Orthogonal arrays, Data Analysis from Taguchi Experiments, Variable Data with main factors only, Variable Data with Interactions, Attribute Data Analysis, Confirmation Experiment, Confidence Intervals, Robust Design Approach. *Applications of Taguchi Method using Minitab*.

UNIT-IV

Introduction to Response Surface Methodology: Introduction, Terms in Quadratic Models, The method of steepest ascent, Analysis of Second order response surfaces, Experimental design for fitting response surfaces, 2k Designs with Centers, 3^k Factorial Designs, Box- Behnken Designs, Central Composite Designs, Analysis of Data from RSM Designs, Design Considerations for Response Surface Experiments. *Response Surface Designs in Minitab.*

RECOMMENDED BOOKS:

1. Douglas C Montgomery,Design and Analysis of Experiments, John Wiley
2. Paul G. Mathews,Design of Experiments with MINITAB, New Age International Publishers.
3. K. Krishnaiah, P. Shahabudeen,Applied Design of Experiments and Taguchi Methods,PHI.

4. Angela Dean and Daniel Voss,Design and Analysis of Experiments, Springer.
5. John P.W.M., Statistical Design and Analysis of Experiments, John Wiley
6. Montgomery D.C., Runger G. C., Introduction to Linear Regression Analysis, John Wiley
7. Myres R.H. and Montgomery D.C.,Response Surface Methodology Process and Product Optimization Using Designed Experiments, Wiley
8. G UNIPUB, White Plains,Introduction to Quality Engineering Taguchi, New York.
9. https://www.ee.iitb.ac.in/~apte/CV_PRA_TAGUCHI_INTRO.htm
10. www.ecs.umass.edu/mie/labs/mda/fea/sankar/chap2.html

Note: Thepaperwillhaveatotalof*NINEquestions.*QuestionNo.1, whichiscompulsory, shall be Objective Type and have contents from the entire syllabus (all Four Units).
All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from eachunit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING(3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING

MTIP–205A	STRATEGIC ENTREPRENEURSHIP						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To provide knowledge to the students about entrepreneurship concepts and various development programmeand policies.						
Course Outcomes							
CO1	To know about the small scale industries, scopes and the causes of their sickness.						
CO2	To know about the EDP and different government policies.						
CO3	To learn about business incubations and its future perspectives.						
CO4	To learn E-business marketing and developments.						

UNIT-I

Small Scale Industries: Definition and types of SSI's; Role, scope and performance in national economy; Problems of small scale industries.

Industrial Sickness: Definition; Causes of sickness; Indian scenario, Government help; Management strategies; Need for trained entrepreneurs

UNIT-II

Entrepreneurship Development Programme: Introduction, Origin of EDP's , Organizations involved in EDP's, Objectives of EDPs, Implementation of EDP's, Short comings of EDP's, Role in entrepreneurship development.

Step: Introduction, Origin, Status in India, Success and failure factors, Govt. polices and incentives, future prospects in India.

UNIT-III

Business Incubation: Introduction, Origin and development of business incubators in India and other countries, types of incubators, success parameters for a business incubator, Benefits to industries, institutes, government and society, future prospects, A few case studies (at least 2).

Project Management: Concept, Characteristics and Significance of Project Management, Components of Project Management, Project Life Cycle, Project Identification and Selection, Project Formulation and Appraisal.

UNIT-IV

Special Aspects of Entrepreneurship: Entrepreneurship, Social entrepreneurship, International entrepreneurship, Rural entrepreneurship, Community Development, Women entrepreneurship.

Network Marketing: Introduction, E-business, E-commerce, E-auction, A basic internet e-business architecture, A multi-tier e-business architecture.

RECOMMENDED BOOKS:

1. P.K. Gupta,Strategic Entrepreneurship, Everest Publishing House.
2. David Cleland,Project Management –Strategic Design and Implementation, McGraw Hill.
3. David H Holl,Entrepreneurship-New Venture Creation, Prentice Hall of India.
4. Steed &Steed,Sustainable Strategic Management, Prentice Hall of India.
5. Kotler,Marketing Management by Prentice Hall of India.
6. TarekKhalil,Management of Technology, McGraw Hill.
7. Henry Steiner,Engineering Economic Principles, McGraw Hill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Open Elective

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING(3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING

MTOE-201A	BUSINESS ANALYTICS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes							
CO1	Able to have knowledge of various business analysis techniques.						
CO2	Learn the requirement specification and transforming the requirement into different models.						
CO3	Learn the requirement representation and managing requirement assets.						
CO4	Learn the Recent Trends in Embedded and collaborative business						

Unit-I

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.
Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit-II

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.
Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit-III

Finalizing Requirements, Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements, Managing Requirements Assets: Change Control, Requirements Tools

Unit-IV

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

RECOMMENDED BOOKS:

1. James Cadle, "Business Analysis", BCS, The Chartered Institute for IT.
2. Erik Larson and, Clifford Gray, "Project Management: The Managerial Process", McGraw-Hill Education.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING(3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING

MTOE-203A	INDUSTRIAL SAFETY						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to aware students about the industrial safety maintenance and fault findings.						
Course Outcomes							
CO1	Understand the industrial safety.						
CO2	Analyze fundamentals of maintenance engineering.						
CO3	Understand the wear and corrosion and fault tracing.						
CO4	Understanding when to do periodic inceptions and apply the preventing maintenance.						

Unit-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-II

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion, Types of corrosion, Corrosion prevention methods.

Unit-III

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-IV

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

RECOMMENDED BOOKS:

1. Higgins & Morrow, "Maintenance Engineering Handbook", Da Information Services.
2. H. P. Garg, "Maintenance Engineering", S. Chand and Company.
3. Audels, "Pump-hydraulic Compressors", Mcgraw Hill Publication.
4. Winterkorn, Hans, "Foundation Engineering Handbook", Chapman & Hall London.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).
All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING(3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING

MTOE-205A	OPERATIONS RESEARCH						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to aware students about the dynamic programming to solve problems of discrete and continuous variables and model the real world problem and simulate it.						
Course Outcomes							
CO1	Students should be able to apply the dynamic programming to solve problems of discreet and continuous variables.						
CO2	Students should be able to apply the concept of non-linear programming						
CO3	Students should be able to carry out sensitivity analysis						
CO4	Student should be able to model the real world problem and simulate it.						

Unit-I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit-II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit-III

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit-IV

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

RECOMMENDED BOOKS:

1. H.A. Taha, "Operations Research, An Introduction", PHI, 2008
2. H.M. Wagner, "Principles of Operations Research", PHI, Delhi, 1982.
3. J.C. Pant, "Introduction to Optimisation: Operations Research", Jain Brothers, Delhi, 2008
4. Hitler Libermann, "Operations Research", McGraw Hill Pub. 2009
5. Pannerselvam, "Operations Research", Prentice Hall of India 2010
6. Harvey M Wagner, "Principles of Operations Research", Prentice Hall of India 2010

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING(3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING

MTOE-207A	COST MANAGEMENT OF ENGINEERING PROJECTS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the students with the knowledge of cost management for the engineering project and apply cost models to the real world projects.						
Course Outcomes							
CO1	Students should be able to learn the strategic cost management process.						
CO2	Students should be able to understand types of project and project team types						
CO3	Students should be able to carry out Cost Behavior and Profit Planning analysis.						
CO4	Student should be able to learn the quantitative techniques for cost management.						

Unit-I

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making, relevant cost, Differential cost, Incremental cost and Opportunity cost, Objectives of a Costing System, Inventory valuation, Creation of a Database for operational control, Provision of data for Decision-Making.

Unit-II

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning, Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents Project team, Role of each member, Importance Project site, Data required with significance, Project contracts, Types and contents, Project execution Project cost control, Bar charts and Network diagram, Project commissioning, mechanical and process.

Unit-III

Cost Behavior and Profit Planning Marginal Costing, Distinction between Marginal Costing and Absorption Costing, Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Standard Costing and Variance Analysis, Pricing strategies, Pareto Analysis, Target costing, Life Cycle Costing, Costing of service sector, Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control, Flexible Budgets, Performance budgets, Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-IV

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

RECOMMENDED BOOKS:

1. Charles Thomas Horngren, "Cost Accounting a Managerial Emphasis", Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, "Advanced Management Accounting"
3. Robert S Kaplan Anthony A. Alkinson, "Management & Cost Accounting"
4. Ashish K. Bhattacharya, "Principles & Practices of Cost Accounting", A. H. Wheeler publisher
5. N.D. Vohra, "Quantitative Techniques in Management", Tata McGraw Hill Book Co. Ltd.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING(3rd semester)
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING

MTOE-209A	COMPOSITE MATERIALS						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the students with the knowledge of composites, its materials, analysis, fabrication, and performance analysis.						
Course Outcomes							
CO1	Students should be able to learn the classification and characteristics of composite materials.						
CO2	Students should be able to understand about different fabrication techniques related to metal matrix composites.						
CO3	Students should be able to understand about different fabrication techniques related to polymer matrix composites.						
CO4	Student should be able to do the analyses of the composite materials under different loading conditions.						

UNIT–I

INTRODUCTION: Definition – Classification and characteristics of Composite materials, Advantages and application of composites, Functional requirements of reinforcement and matrix, Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures, Iso-strain and Iso-stress conditions.

UNIT – II

Manufacturing of Metal Matrix Composites: Casting, Solid State diffusion technique, Cladding, Hot iso static pressing, Properties and applications.

Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration, Liquid phase sintering, Manufacturing of Carbon, Carbon composites, Knitting, Braiding, Weaving. Properties and applications.

UNIT–III

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs, hand layup method, Autoclave method, Filament winding method, Compression moulding, Reaction injection moulding, Properties and applications.

UNIT – IV

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

RECOMMENDED BOOKS:

1. R.W.Cahn, "Material Science and Technology" VCH, West Germany.
2. WD Callister, Jr, "Materials Science and Engineering, An introduction"
3. Balasubramaniam, "John Wiley & Sons", NY, Indian edition, 2007.
4. Lubin, "Hand Book of Composite Materials"
5. K.K.Chawla, "Composite Materials"
6. Deborah D.L. Chung, "Composite Materials Science and Applications"
7. Danial Gay, Suong V. Hoa, and Stephen W. Tasi, "Composite Materials Design and Applications"

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING(3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING

MTOE-211A	WASTE TO ENERGY						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the students with the knowledge of generation of energy from the waste.						
Course Outcomes							
CO1	Students should be able to learn the classification of waste as a fuel and biomass pyrolysis.						
CO2	Students should be able to learn gasification process and different types of gasifiers.						
CO3	Students should be able to learn different combustors for biomass.						
CO4	Student should be able to learn the Biogas plant technology different biomass conversions processes for different applications.						

Unit-I

Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW, Conversion devices, Incinerators, gasifiers, digestors.

Biomass Pyrolysis: Pyrolysis, Types, slow fast, Manufacture of charcoal, Methods, Yields and application, Manufacture of pyrolytic oils and gases, yields and applications.

Unit-II

Biomass Gasification: Gasifiers, Fixed bed system, Downdraft and updraft gasifies, Fluidized bed gasifiers, Design, construction and operation, Gasifier burner arrangement for thermal heating, Gasifier engine arrangement and electrical power, Equilibrium and kinetic consideration in gasifier operation.

Unit-III

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-IV

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

RECOMMENDED BOOKS:

1. Desai, Ashok V, "Non-Conventional Energy", Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. and Mahdi, S. S., "Biogas Technology - A Practical Hand Book - Vol. I & II", Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Challal, D. S, "Food, Feed and Fuel from Biomass", IBH Publishing Co. Pvt. Ltd., 1991.
4. C. Y. WereKo-Brobby and E. B. Hagan, "Biomass Conversion and Technology", John Wiley & Sons, 1996.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING(3rd semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING

MTIP-207A	DISSERTATION PHASE – I							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical Marks	Total	Time (Hrs.)
0	0	20	10	-	100	-	100	-
Objective	The main objective of this course is to plan a research work (which includes the problem formulation/literature review, proposed objectives, proposed methodologies and references) in the field of Industrial and Production Engineering or interrelated fields of applications.							
Course Outcomes								
CO 1	Students will be exposed to various self-learning topics.							
CO 2	Students will be exposed to an exhaustive survey of the literature such as books, national/international refereed journals, resource persons and industrial surveys for the selection/ identification of engineering/research problem.							
CO 3	Students will be able to set the research objectives of the identified engineering/research problem.							
CO 4	Students will learn modern tools/techniques related to the identified engineering/research problem for the solution and able to learn technical report writing skills.							
CO 5	Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.							

The students will start their research work in third semester with a research problem having research potential involving scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.

The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his/her supervisor and the topic of dissertation must be mutually decided by the supervisor and student.

The students will be required to submit a progress report related to their dissertation work by the end of September. The progress report will cover the following:

- The goal set for the period.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.

The progress report must be at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The students will be required to appear for comprehensive Seminar & Viva-voce and submit a synopsis report based on their progress related to the dissertation as per the presentation date mentioned in the academic calendar for the session. The synopsis report will be submitted in the same format as that of the thesis and will contain the following:

1. Introduction
2. Literature Survey
3. Gaps in Literature
4. Objectives of the Proposed Work
5. Methodology
6. References

*** Student will choose his/her guide in the end of second semester.**

w.e.f. 2018-19

Fourth Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING(4th semester)

(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: INDUSTRIAL & PRODUCTION ENGINEERING

MTIP-202A	DISSERTATION PHASE -II							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**32**	**16**	**-**	**100**	**200**	**300**	**-**
Objective	The main objective of the course is to make the students able to do some good research in the field of their interests related to Industrial and Production Engineering or interrelated fields of applications.							
Course Outcomes								
CO 1	Students will be able to design solutions for engineering problems that meet the specified needs with appropriate considerations.							
CO 2	Students will be able to conduct investigations of engineering problems using research-based knowledge and experimental/research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.							
CO 3	Students will be able to apply resources and modern engineering tools and techniques with an understanding of the limitations.							
CO 4	Students will be able to either work in a research environment or in an industrial environment.							
CO 5	Students will be conversant with technical report writing, professional ethics, responsibilities and norms of the engineering practice.							
CO 6	Students will be able to present and convince their topic of study to the engineering community.							

The students are required to continue Analytical/Experimental/Computational/Industrial Problems or Case studies investigations in the field of Industrial and Production Engineering or other related fields which have been finalized in the third semester. They would be working under the supervision of a faculty member.

The students will be required to submit a progress report duly signed by their respective supervisors to the department, related to their dissertation work in the last week of March. The progress report will cover the following:

- The goal set for the period.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.
- References

The progress report must be of at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The candidate has to prepare a detailed dissertation report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up/numerical details/industrial case study etc. as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study.

The final dissertation will be submitted in the end of semester as per academic calendar for the session, which will be evaluated by internal as well as external examiners based upon his/her research work. At least one publication is expected before final submission of the dissertation from every student in peer reviewed referred journals or reputed conference from the work done by them in their dissertation. The dissertation should be presented in standard format as provided by the department.

The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a supervisor, co-supervisor etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his supervisor.

w.e.f. 2018-19

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Established by the State Legislature Act XII of 1956

('A+' Grade, NAAC Accredited)

MASTER OF TECHNOLOGYINMECHANICAL ENGINEERING

(CREDIT BASED)(w. e. f. 2018-19)

SPECIALIZATION: MECHANICAL ENGINEERING

SEMESTER-1

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTME-101	Industrial Engineering & Ergonomics	3	0	0	3	3	60	40	-	100	3
2	MTIP-103A	Computer Aided Design and Manufacturing	3	0	0	3	3	60	40	-	100	3
3		*Programme Elective-I	3	0	0	3	3	60	40	-	100	3
4		**Programme Elective-II	3	0	0	3	3	60	40	-	100	3
5	MTRM-111A	Research Methodology and IPR	2	0	0	2	2	60	40	-	100	3
6	MTME-103	Industrial Engineering Lab	0	0	4	4	2	-	40	60	100	3
7	MTIP-119A	Computer Aided Design and Manufacturing Lab	0	0	4	4	2	-	40	60	100	3
8		***Audit Course-I	2	0	0	2	-	-	100		100	3
					Total	**24**	**18**	**300**	**280**	**120**	**700**	

***PROGRAMME ELECTIVE- I for MTME 1st Semester**		
1.	MTIP-105A	Tool Engineering
2.	MTIP-107A	Advanced Engineering Materials
3.	MTIP-109A	Non – Conventional Machining

****PROGRAMME ELECTIVE- II for MTME 1st Semester**		
1.	MTIP-111A	Product Design and Development
2.	MTIP-113A	Simulation of Industrial Systems
3.	MTIP-115A	Supply Chain Management

AUDIT COURSE – I for MTME 1st Semester		
1.	MTAD-101A	English for Research Paper Writing
2.	MTAD-103A	Disaster Management
3.	MTAD-105A	Sanskrit for Technical Knowledge
4.	MTAD-107A	Value Education

Note: 1. The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2. ***Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

3. The programme elective I & II and Audit course-I are common with M. Tech. (I&P). The course starts with MTIP code is common with M. Tech. (I&P)

w.e.f. 2018-19

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING

(CREDIT BASED) (w. e. f. 2018-19)

SPECIALIZATION: MECHANICAL ENGINEERING

SEMESTER-II

S No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTME-102	Operation Research & Optimization Techniques	3	0	0	3	3	60	40	-	100	3
2	MTME-104	Refrigeration & Cryogenics	3	0	0	3	3	60	40	-	100	3
3		*Programme Elective-III	3	0	0	3	3	60	40	-	100	3
4		**Programme Elective-IV	3	0	0	3	3	60	40	-	100	3
5	MTME -106	Advance Welding Lab	0	0	4	4	2	-	40	60	100	3
6	MTME-108	Refrigeration & Cryogenics Lab	0	0	4	4	2	-	40	60	100	3
7	MTME-110	Mini Project	0	0	4	4	2	-	-	100	100	3
8		***Audit Course-II	2	0	0	2	-	-	100	-	100	3
					Total	**26**	**18**	**240**	**240**	**220**	**700**	

***PROGRAMME ELECTIVE-II for MTME 2nd Semester**		
1.	MTIP-106A	Advanced Welding Processes
2.	MTIP-108A	Advanced Metal Cutting
3.	MTIP- 110A	Metrology

****PROGRAMME ELECTIVE - IV for MTME 2nd Semester**		
1.	MTIP-112A	Sequencing and Scheduling
2.	MTIP-114A	Quality Engineering and Management
3.	MTIP-116A	Reliability Engineering

AUDIT COURSE–II for MTME 2nd Semester		
1.	MTAD-102A	Constitution of India
2.	MTAD-104A	Pedagogy Studies
3.	MTAD-106A	Stress Management by Yoga
4.	MTAD-108A	Personality Development through Life Enlightenment Skills

Note: 1. The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2. ***Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

3. The programme elective III& IV and Audit course-II are common with M. Tech. (I&P). The course starts with MTIP code is common with M. Tech. (I&P)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING
(CREDIT BASED) (w. e. f. 2018-19)
SPECIALIZATION: MECHANICAL ENGINEERING

SEMESTER-III

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1		*Programme Elective-V	3	0	0	3	3	60	40	-	100	3
2		**Open Elective	3	0	0	3	3	60	40	-	100	3
3	MTME-201	Dissertation Phase-I	0	0	20	20	10	-	100	-	100	--
					Total	**26**	**16**	**120**	**180**		**300**	

***PROGRAMME ELECTIVE-V for MTME 3rd Semester**		
1.	MTIP-201A	Enterprise Resource Planning
2.	MTIP-203A	Design of Experiments
3.	MTME-205A	Strategic Entrepreneurship

****OPEN ELECTIVE for MTME 3rd Semester**		
1.	MTOE-201A	Business Analytics
2.	MTOE-203A	Industrial Safety
3.	MTOE-205A	Operations Research
4.	MTOE-207A	Cost Management of Engineering Projects
5.	MTOE-209A	Composite Materials
6.	MTOE-211A	Waste to Energy

Note: 1 The programme elective-V and Open elective are common with M. Tech. (I&P). The course starts with MTIP code is common with M. Tech. (I&P)

SEMESTER-IV

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of Exam (Hrs.)
1	MTME-202	Dissertation Phase-II	0	0	32	32	16	-	100	200	300	--
					Total	**32**	**16**		**100**	**200**	**300**	

Total credits=68

INSTRUCTIONS FOR PAPER SETTER

1. The question paper is to be attempted in **THREE Hours**.
2. Maximum Marks for the paper are **60.**
3. The syllabus for the course is divided into **FOUR units.**
4. The paper will have a total of **NINE questions.**
5. **Question No. 1,** which is compulsory, shall be OBJECTIVE Type **and have content from the entire syllabus (all Four Units).**

   Q. No. 2 & 3 from Unit I

   Q. No. 4 & 5 from Unit II

   Q. No. 6 & 7 from Unit III

   Q. No. 8 & 9 from Unit IV

6. All questions will have equal **weightage of 12 marks.**
7. The candidate will attempt a total of **FIVE questions**, each of 12 marks. Q. No. 1 is compulsory. The candidate shall attempt remaining **four** questions by selecting **only one question from each unit.**
8. A question may have any number of sections labeled as 1(a), 1(b), 1(c), 1(d), ---- 2(a), 2(b), --.A section may further have any number of subsections labeled as (i), (ii), (iii),.
9. **SPECIAL INSRUCTIONS FOR Q. No. 1 ONLY**

   Question No. 1, which is compulsory, shall be OBJECTIVE/ short answer type **and have content from the entire syllabus (all Four Units).**

   Emphasis is to be given on the basic concepts, analytical reasoning and understanding of the various topics in the subject. This question may have a number of parts and/or subparts. The short questions could be combination of following types:

   i. Multiple Choice
   ii. Yes/ No choice
   iii. Fill in Blanks type
   iv. Short numerical computations
   v. Short Definitions
   vi. Matching of Tables

The above mentioned question types is **only a Guideline**. Examiner could set the question as per the nature of the subject.

w.e.f. 2018-19

First Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTME–101	INDUSTRIAL ENGINEERING & ERGONOMICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To provide knowledge necessary to either initiate a new or improve an existing ergonomics						
Course Outcomes							
CO1	Understand ergonomics and its three major components. Outline the components of a system.						
CO2	Describe the components of office and shop floor ergonomic evaluations.						
CO3	Study the common risk factors and areas for ergonomic improvement within foundries						
CO4	Describe how to evaluate, select and implement ergonomic solutions						

UNIT-I

Introduction to industrial engineering and productivity, measurement of productivity, introduction to work study, methods study principles and motion economy, filming techniques and micro-motion analysis.
Introduction to work measurement, Time study, performance allowances, works sampling.

UNIT-II

Introduction of Ergonomics, system approach to ergonomic model, Area of study covered under ergonomics, man/machine systems, characteristics of man machine system, limitation of man & machine with respect to each other, Design approach: Work design consideration, General principles for carrying out the physical activities,Design of workplace, machine at workplace, seat for workplace, posture-standing at work, seated at work, work station heights and seat geometry.

UNIT-III

Controls: Criteria for control design, Hand controls and foot controls, Relationship between controls and display instruments, location of controls and displays, controls for high precision work (push buttons, switches, knob etc.),**Displays**:- Types of displays, Design recommendation for quantitative displays.
Workload: static and dynamic muscular work, physical workload, measurement of physical workload, mental workload, measurement of metal workload.

UNIT-IV

Climates: (a) Heat Humidity- Fundamentals of human thermal regulation, measuring the thermal environment, work in hot climate, work in cold climate, protection against climatic extremesand effect of climate on performance.
(b) Vibration-Terminology, response of body to low frequency (LF) vibration, Discomfort and effect of vibrations on health of worker, high frequency (HF) vibration, effect of H.F. vibrations, methods of reducing vibration.
(c) Noise- Terminology, physiological effects of noise, annoyance of noise, speed interference, hearing loss temporary and permanent thread hold shift, effect of noise on performance reduction of noise, personal noise protection,

RECOMMENDED BOOKS:

1. Method Engineering study – Krick, S.V.
2. Work study and Ergonics- Shah, H.S. – Dhanpat Rai & Sons-1988
3. Introduction of Ergonomics-Bridger-Tata McGraw Hill 1995
4. Work Study – Khanna- Dhanpat Rai & Sons- 1995
5. Work study and Ergonomics-Suresh Dalela, Saurabh.
6. Industrial Ergonomics- Khan, M.I. – PHI Learning.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTIP–103A	COMPUTER AIDED DESIGN AND MANUFACTURING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to understand about the technology of computers for the design, process planning and manufacturing the products.						
Course Outcomes							
CO1	To understand the fundamentals and applications of computers in the field of designing and manufacturing and the transformation of geometricmodels.						
CO2	To understand the concepts of G.T. and FMS.						
CO3	To know the use of computers in process planning and shop floor control.						
CO4	To learn the basics of AGV and coding systems for CNC.						

UNIT I

Fundamentals of CAD: Introduction to CAD/CAM, Historical Development, Industrial Look at CAD/CAM, Application of computers in design, creating manufacturing database, Benefits of CAD. Computer Hardware, Graphic input devices, display devices, Graphics output devices, Central processing unit (CPU).

Geometric transformations: 2D and 3D; transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous representations, concatenated representation; Orthographic projections, Numerical Problems

UNIT II

Group Technology and Cellular Manufacturing

Part families, parts classifications and coding, Production flow Analysis, cellular Manufacturing-composite part concept, machine cell design, applications of group technology, Grouping parts and machines by Rank order clustering technique, Arranging machines in a G.T. cell.

Flexible Manufacturing

Introduction, FMS components, Flexibility in Manufacturing – machine, Product, Routing, Operation, types of FMS, FMS layouts, FMS planning and control issues, deadlock in FMS, FMS benefits and applications.

UNIT III

Process Planning

Introduction, Manual process planning, Computer aided process planning – variant, generative, Decision logic- decision tables, decision trees, Introduction to Artificial intelligence.

Shop Floor Control

Introduction, Shop floor control features, Major displays, Major reports, Phases of SFC Order Release, Order Scheduling, Order Progress, Manufacturing control, Methodology, Applications, Shop floor data collections, Types of data collection system, Data input techniques, Automatic data, Collection system.

UNIT IV

CNC Basics and Part Programming

Introduction, Historical Background, Basic Components of an NC, Steps in NC, Verifications of Numerical control machine tool programs, Classification of NC Machine tool, Basics of motion control and feedback for NC M/C, NC part programming, Part programming methods, Modern Machining system, Automatically programmed tools, DNC, Adaptive control

Automated Guided Vehicle

Introduction, History, Features, Functions of AGV, Types of AGV, Safety consideration for AGV, Design of AGV.

RECOMMENDED BOOKS:

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
3. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
6. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
7. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
8. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall
9. Chang, Wang &Wysk Computer Aided Manufacturing. Prentice Hall
10. Kundra&Rao, Numerical Control and Computer Aided Manufacturing by, Rao and Tiwari, Tata Mc-Graw Hill.
11. Mattson, CNC programming Principles and applications, Cengage Learning India Pvt. Ltd. Delhi

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-I

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTIP–105A	TOOL ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to impart the students with the knowledge of various aspects of design of different types of Tools and fixtures used in Industries.						
Course Outcomes							
CO1	To impart knowledge of materials for cutting tool and design of cutting tools.						
CO2	To acquaint students with various kinds of Gages and Work holding devices.						
CO3	To impart knowledge to students about Drill jigs and Fixtures.						
CO4	To let student understand the tool design process for NC Machine tools						

UNIT-I

Cutting Tool Materials: Introduction and desirable properties, Carbon and Medium-Alloy Steels, High-Speed Steels, Cast-Cobalt Alloys, Carbides, Coated Tools, Alumina-Based Ceramics, Cubic Boron Nitride, Silicon-Nitride Based Ceramics, Diamond, Reinforced Tool Materials, Cutting-Tool Reconditioning.

Design of Cutting Tools Basic Requirements, Mechanics and Geometry of Chip Formation, General Considerations for Metal Cutting, Design of single point Cutting Tools, Design of Milling Cutters, Design of Drills and Drilling, Design of Reamers, Design of Taps, Chip Breakers.

UNIT-II

Gages and Gage Design: Limits fits and tolerances, Geometrical tolerances-specification and measurement, Types of gages, Gage design, gage tolerances, Material for Gages.

Work Holding Devices: Basic requirements of work holding devices, Location: Principles, methods and devices, Clamping: Principles, methods and devices.

UNIT-III

Drill Jigs: Definition and types of Drill Jigs, Chip Formation in Drilling, General Considerations in the Design of Drill Jigs, Drill Bushings, Drill Jigs, and Modern Manufacturing

Design of Fixtures: Fixtures and Economics , Types of Fixtures , Milling Fixtures , Boring Fixtures, Broaching Fixtures, Lathe Fixtures, Grinding

UNIT-IV

Tool Design for Numerically Controlled Machine Tools: Fixture Design for Numerically Controlled Machine Tools, Cutting Tools for Numerical Control, Tool-holding Methods for Numerical Control.

RECOMMENDED BOOKS:

1. ASTME, “Fundamentals of Tool Design”, Prentice Hall of India, 1983.
2. Donaldson, “Tool Design”, Tata-McGraw Hill, 3rd Edition, 2000.
3. Joshi P.H., “Jigs and Fixtures”, Tata-McGraw Hill, 2010.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTIP–107A	ADVANCED ENGINEERING MATERIALS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	60	40	100	3 hrs
Objective	The objective of the course is to impart the students with the knowledge of various advanced and smart materials.						
Course Outcomes							
CO1	To impart knowledge of Piezoelectric and shape memory alloys.						
CO2	To acquaint students with deep know how about Electro-rheological and composite						
CO3	ToimpartknowledgetostudentsaboutMEMSsystemsandHightemperature						
CO4	To let student understand the processing and characteristics of powder metallurgy processes and structural materials.						

UNIT-I

Introduction to advanced Engineering materials: Classes of Materials and their usage, Historical Perspective, Intelligent Materials, Structural Materials, Functional Materials, Primitive Functions of Intelligent Materials, Intelligence inherent in Materials, Materials Intelligently Harmonizing with humanity, Biomimetic.

Smart Materials and Structural Systems: Introduction, Actuator Materials, Sensing Technologies, Micro-sensors, Intelligent systems, Hybrid Smart Materials, Passive Sensory Smart Structures, Reactive Actuator based smart structures, Active Sensing and Reactive smart structures, smart skins, Aero-elastic tailoring of airfoils, Synthesis of future smart systems.

UNIT-II

Electrocaloric Effect: An Introduction, History of Electrocaloric Cooling,Mechanism of working ofElectrocaloric Cooling, Electrocaloric Materials, Performance of Electrocaloric Materials.

Heat Resistant Steels: Conventional Heat-Resistant Steels, Silicon-Bearing High Chromium Heat-Resistant Steels,Nitride-Strengthened Reduced Activation Heat-Resistant Steels, China Low Activation Martensitic SteelNitride-Strengthened Steels,Microstructural Stability

UNIT-III

Smart Micro-systems: Silicon Capacitive Accelerometer, Piezo-resistive Pressure sensor, Conductometric Gas sensor, An Electrostatic Comb-drive, Magnetic Microrelay, Portable Blood Analyser, Piezoelectric Inkjet Print Head.

Buckyballs to robotics: Bucky ball, Nano Structure of Fullerene, Carbon Nanotubes, Nano Diamond, Boron nitride nanotubes, Single electron transistors, Molecular machine, Nano Biometrics, Nano Robots,

UNIT-IV

Nano-Alloys: Introduction, Chemical Synthesis: General Concepts, Reduction of Metallic Salts, The Organometallic Route: Thermal Decomposition Method, Other Chemical Methods for synthesis of Nano-alloys,Physical Routes for synthesis of Nano-Alloys;Experimental Techniques and Examples.

Shape memory alloys (SMA): Shape memory effect and the metallurgical phenomenon of SMA, Types of SMA, One way and Two way Shape memory effect. Temperature assisted shape memory effect, Applications.

RECOMMENDED BOOKS:

1. Gandhi, M.V. and Thompson, B.S., Smart materials and Structures, Chapman & Hall,1992.
2. Ananthasuresh G.K., Vinoy K.J., Micro and Smart Systems, Wiley India.
3. Wei Yan, Wei Wang, 9-12 Cr Heat Resistant Steels, Engineering Material series, Springer International.
4. Damien Alloyeau, Christine Mottet, Nanoalloys Synthesis, Structure and Properties, Springer International.
5. Tatiana Correia, Qi Zhang, Electrocaloric Materials: New Generation of Coolers
6. Otsuka, K. and Wayman, C. M., Shape memory materials, C.U.P,1998
7. Taylor, W., Pizoelectricity, George Gorden and Breach Sc. Pub.,1985

8. Mallick, P.K., Fiber Reinforced Composites Materials, Manufacturing andDesign. Marcel Dekker Inc, New York,1993.
9. Rama Rao, P. (ed.), Advances in Materials and their applications, Wiley EasternLtd.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q.

No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTIP–109A	NON-CONVENTIONAL MACHINING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To acquaint the students with the advanced technologies and processes in various streams of Non-conventional machining.						
Course Outcomes							
CO1	To impart knowledge of Various Non-conventional Mechanical Working Processes, technology, process parameters and analysis for metal removal for these processes.						
CO2	To acquaint students with deep knowhow about chemical and electrochemical machining processes,						
CO3	To impart knowledge to students about various kinds of Electric discharge machining processes, process parameters associated with these processes and various process characteristics.						
CO4	To let student understand the working and technology associated with Laser Beam machining and Electron beam machining processes.						

UNIT-I

Introduction, Need of Non-conventional machining processes, Characteristics of conventional and Non-conventional Machining processes. **Mechanical Working Processes**: **Abrasive Jet Machining:** Machining setup, Abrasives, Process Parameters, Machining Characteristics, Material removal models in AJM, Process capability, Advantages, limitations, Applications

Water Jet Machining: Basic mechanism of Water jet machining setup, Process parameters, Catcher, Process capabilities, Advantages, limitations, Applications **Abrasive Water Jet Machining process:** Working Principle, AWJM Machine, Process Variables, Mechanism of Metal Removal, Cutting Parameters, Process capabilities, Applications, Environmental issues.

Ultrasonic Machining: Fundamental principles, Equipment, Magnetostriction, Elements of process, Mechanics of cutting, Analysis of Process Parameters, Process capabilities, Economic considerations. Applications, Limitations

UNIT-II

Chemical Machining: Introduction, Fundamental Principles, Process Parameters; Maskants and Etchants, Advantages, Limitations, Applications.

Electrochemical Machining Processes: Introduction, Classification of ECM Processes, Fundamentals Principles of ECM, Elements of ECM, ECM Machine Tool Process, Determination of Metal Removal Rate, Evaluation of Metal Removal of an alloy, Electrochemistry of ECM, Cathode and Anode reaction, Dynamics of ECM, Self-Regulating feature of ECM, Process Parameters, Process capabilities, Electrochemical Deburring. **Electrochemical Grinding:** Schematics, Electrochemistry, Process Parameters, Process capabilities, Applications, Advantages, Limitations.

UNIT-III

EDM: Introduction, Basic Principles & Schematics, Process Parameters, Characteristics of EDM, Dielectric, Electrode Material, Modeling of Material Removal, Spark Erosion Generators, Analysis and Metal Removal Rate in RC circuit, Selection of Tool Material and Tool Design, Di-Electric system, Process Variables, Dielectric Pollution and its effects, Process Characteristics, Applications, Electric Discharge Grinding and Electric Discharge Diamond Grinding; **Wire EDM**: Working Principle, Wire EDM Machine, Advances in Wire-cut EDM Process Variables, Process Characteristics, Applications.

UNIT-IV

Laser Beam Machining Back Ground, Production of Laser, Working Principle of LBM, Types of LASERS, Process Characteristics, Metallurgical effects, Advantages and Limitations, Applications.

Electron Beam Machining:

Electron Beam Action, Generation and control of Electron beam, Theory of Electron Beam Machining, Process Parameters, Process capabilities, Applications.

High Energy Rate Forming, Electro-Hydraulic Forming, Explosive Forming, Hot Machining Analysis of the Process.

RECOMMENDED BOOKS:

1. V.K. Jain, Advanced Machining Processes, Allied Publishers Pvt Ltd
2. P.C. Pandey and H.S. Shan,Modern Machining Processes, Tata McGraw- Hill
3. M. K. Singh, Unconventional Manufacturing Process, New Age Publishers
4. J. A. Mcgeough, Advanced Methods of Machining,Springer.
5. Benedict, Non-Traditional Manufacturing Process, CRC pub.
6. P. K. Mishra, Nonconventional manufacturing,Narosa Publishers

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).
All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-II

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTIP-111A	PRODUCT DESIGN AND DEVELOPMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The objective of the course is to understand about the product design and developments with inputs from aesthetics, ergonomics, design for manufacturing ease and cost effectiveness apart from reliability and durability and other considerations.						
Course Outcomes							
CO1	To understand the concept of product design, design considerations, design practiced by the industry, production and marketing, and aesthetics.						
CO2	To provide a detailed fundamental approach to several primary processes and design guidelines for manufacturing, assembly and environment.						
CO3	To discuss the human factor engineering and the concept of value engineering.						
CO4	To study the modern approaches to product design, concept of product development and its manufacturing and economic aspects.						

UNIT-I

INTRODUCTION: Introduction to product design, Design by evolution and innovation, Essential factors of product design, Production consumption cycle, Flow and value addition in production consumption cycle, Morphology of design.

PRODUCT DESIGN PRACTICE AND INDUSTRY: Product strategies, Time to market, Analysis of the product, Basic design considerations, Role of aesthetics in product design.

UNIT-II

DESIGN FOR MANUFACTURE AND ASSEMBLY: Overview and motivation, Basic method: Design guidelines: Design for assembly, Design for piece part production, Advanced method: Manufacturing cost analysis, cost driver modeling, Critique for design for assembly method.

DESIGN FOR THE ENVIRONMENT: Environmental objectives, Basic DFE methods, Design guidelines, Life cycle assessment, Techniques to reduce environmental impact.

UNIT-III

HUMAN ENGINEERING CONSIDERATIONS IN PRODUCT DESIGN: Human being as applicator of forces, Anthropometry, the design of controls, the design of displays, Man/Machine information exchange, Workplace layout from ergonomic considerations.

VALUE ENGINEERING: Value, Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, value analysis job plan, creativity, steps to problem solving and value analysis, value analysis tests, value engineering idea generation check list, Cost reduction through value engineering-case study, materials and process selection in value engineering.

UNIT-IV

MODERN APPROACHES TO PRODUCT DESIGN: Concurrent design, Quality function deployment (QFD), Rapid prototyping, 3D printing, Introduction to 4D printing.

PRODUCT DEVELOPMENT: A modern product development process, reverse engineering and redesign product development process, product life cycle, product development teams, Product development planning, Manufacturing & economic aspects of product development.

RECOMMENDED BOOKS:

1. Kail T Ulrich and Steven D Eppinger, "Product Design and Development, TMH.
2. AK Chitale and Gupta, "Product Design and Engineering, PHI.
3. Niebel& Draper, "Product Design and Process Engineering", McGraw-Hill.
4. Kevin Otto & Kristin Wood, "Product Design-Techniques in reverse engineering and new product development"Pearson.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)

(Credit based)

MTIP–113A	SIMULATION OF INDUSTRIAL SYSTEMS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of industrial systems and its simulation.						
Course Outcomes							
CO1	To explain the concept of industrial simulation systems and its models of simulation.						
CO2	To understand the simulation of discrete and queueing systems.						
CO3	To understand the simulation if inventory systems and design of simulation experiments.						
CO4	To simulate the industrial problems like reliability problems,computertimesharingproblem and understand the simulation languages.						

UNIT-I

Introduction and overview: concept of system, system environment, elements of system, system modeling, types of models, Monte Carlo method, system simulation, simulation - a management laboratory, advantages & limitations of system simulation, continuous and discrete systems.

Simulation of continuous systems: characteristics of a continuous system, comparison of numerical integration with continuous simulation system. Simulation of an integration formula.

UNIT-II

Simulation of discrete system: Time flow mechanisms, Discrete and continuous probability density functions. Generation of random numbers, testing of random numbers for randomness and for auto correlation, generation of random variates for discrete distribution, generation of random variates for continuous probability distributions-binomial, normal, exponential and beta distributions; combination of discrete event and continuous models.

Simulation of queuing systems: Concept of queuing theory, characteristic of queues, stationary and time dependent queues, queue discipline, time series analysis, measure of system performance.

Kendall's notation, auto covariance and auto correlation function, auto correlation effects in queuing systems, simulation of single server queues, multi-server queues, queues involving complex arrivals and service times with blanking and reneging.

UNIT-III

Simulation of inventory systems: Rudiments of inventory theory, MRP, in-process inventory. Necessity of simulation in inventory problems, forecasting and regression analysis, forecasting through simulation, generation of Poisson and Erlang variates, simulation of complex inventory situations.

Design of Simulation experiments: Length of run, elimination of initial bias, Variance, Variance reduction techniques, stratified sampling, antipathetic sampling, common random numbers, time series analysis, spectral analysis, model validation, optimization procedures, search methods, single variable deterministic case search, single variable non-deterministic case search, and regenerative technique.

UNIT-IV

Simulation of PERT: Simulation of - maintenance and replacement problems, capacity planning, production systems, reliability problems, computer time sharing problem, the elevator system.

Simulation Languages: Continuous and discrete simulation languages, block structured continuous languages, special purpose simulation languages, SIMSCRIPT, GPSS SIMULA importance and limitations of special purpose languages.

RECOMMENDED BOOKS:

1. Loffick, Simulation and Modelling - Tata McGraw Hill
2. DeoNarsingh, System Simulation with Digital Computer - Prentice Hall
3. Hira, D.S., System Simulation-S. Chand & Co.
4. Meelamkavil, Computer Simulation and Modelling - John Willey
5. Gorden, System Simulation - Prentice hall
6. Jerry Banks and John, S. Carson II, 'Discrete – Event System Simulation', Prentice Hall Inc., NewJersey, 1984.
7. Geoffrey Gordon, 'System simulation', Prentice Hall, NJ, 1978.
8. Law, A.M. and W.D. Keltor, 'Simulation modelling analysis', McGraw Hill, 1982.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTIP–115A	SUPPLY CHAIN MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of Supply chain and different aspects of supply chain management.						
Course Outcomes							
CO1	To impart knowledge about basics of Supply chain management and Supply						
CO2	To acquaint students with the different aspects involved in sourcing and procurement in supply chain management.						
CO3	To impart knowledge to students about Evaluating performance of Supply chain and decision making about Transportation, Storage and warehousing.						
CO4	To let student understand Quantitative tools for SCM, Information Technology in a Supply Chain:						

UNIT-I

Overview of supply chain management: Introduction, Definition, The Objective of a Supply Chain, The Importance of Supply Chain Decisions, Decision Phases in a Supply Chain, Process Views of a Supply Chain, Examples of Supply Chains.

Supply chain dynamics: Introduction, Coping with Dynamics in Supply chain. Bullwhip effect, Analysis of Bullwhip Effect, Impact of Lead time, Inventory management and Supply chain dynamics, offshoring and outsourcing Effect on SC dynamics and cost.

UNIT-II

Outsourcing and Make or Buy Decisions: Strategic Decisions and Core competencies, Tactical Decisions, Factors influencing make or buy decisions, Control of Production or Quality, Unreliable Suppliers, Suppliers Specialized knowledge and research, Small Volume Requirements, Limited Facilities, Workforce Stability, Multiple Sourcing Policy, Managerial and Procurement considerations, the Volatile nature of Make/Buy situation, Administration: Procedures and Personal.

Sourcing of Supply: Importance of Source Selection, Responsibilities for Source Selection, Evaluating a potential supplier, The criticality of Qualifying Sources, Competitive Bidding and Negotiation, Prerequisite for competitive bidding, Two step Bidding/Negotiation, Benefits and Risks of International Sourcing, Identifying and Qualifying an International Source.

UNIT-III

Supply Chain Performance: Achieving Strategic fit And Scope: Competitive and Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope**,** Challenges to Achieving and Maintaining, Strategic Fit, Supply chain drivers and metrics, Financial Measures of Performance, Drivers of Supply Chain Performance, Framework for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing.

Transportation, storage and warehousing: Introduction, Transportation mode choice, Transport operator decisions, Trucking sectors in India, Rail transport, Air Transport, Water transport, Transport network, Storage and warehousing, types of warehousing, risk pooling, IT Integration: Supply chain information system, Role of IT in SCM process, Business process Re-engineering, Internet and its applications in SCM.

UNIT-IV

Quantitative tools for SCM: Introduction, Forecasting, Demand forecast, Forecasting strategy & technique, Management of Inventories in SC, Linear programming, Routing models, pricing decisions, Introduction to MCDM approach.

Information Technology in a Supply Chain: The Role of IT in a Supply Chain, The Supply Chain IT Framework Customer Relationship Management, Internal Supply Chain Management, Supplier

Relationship Management, The Transaction Management Foundation, The Future of IT in the Supply Chain, Risk Management in IT, Supply Chain IT in practice.

RECOMMENDED BOOKS:

1) Chopra, S., and Meindl, P., Supply chain Management: Strategy, Planning and Operations. Second Edition, Pearson Education (Singapore) Pte. Ltd, 2004.
2) Rangaraj, Supply Chain Management for Competitive Advantage, TMH.
3) Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw-Hill Edition, 2003.
4) Doebler, D.W. and Burt, D.N., Purchasing and Supply Chain Management: Text and Cases, McGraw-Hill Publishing Company Limited, New Delhi, 1996.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTRM-111A	RESEARCH METHODOLOGY AND IPR						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	2	60	40	100	3
Objective	The objective of this course is to make the students capable of formulating the research problems/ proposals and get aware about the intellectual property and patent laws.						
Course Outcomes							
CO 1	Student will be able to understand research problem formulation.						
CO 2	Student will be able to analyze research related information and follow research ethics.						
CO 3	Student will be able to understand the Patents, Designs, Trade and Copyright and able to apply the knowledge for patent.						
CO 4	Student will be able to understand the concept of Patent Rights, Licensing and transfer of technology and able to apply the knowledge in new developments in IPR.						

Unit-I

Meaning of research problem, Sources of research problem, Criteria, characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit-II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit-III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit-IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and Institutions.

RECOMMENDED BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: An introduction for science & engineering students" Kenwyn, South Africa : Juta& Co. Ltd., 1996
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Juta Academic; 2nd edition (April 28, 2004)
3. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners" SAGE Publications Ltd; Fourth edition (14 January 2014)
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers; Revised edition (July 25, 2007)

9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTME-103	INDUSTRIAL ENGINEERING LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	Student will be able to take the right decisions to optimize resources utilization by							
Course Outcomes								
CO1	Student will be able to take the right decisions to optimize resources utilization by improving productivity of the Lands, Buildings, People, Materials, Machines, Money, Methods and Management effectively							
CO2	Student will understand to eliminate unproductive activities under the control of the Management, Supervisor, worker and the Design of Products and Processes							
CO3	Student will introduce with different attributes and variables chart and draw them to find number of defects and defectives in required sample size.							
CO4	Student will get the knowledge to design the Man Machine System to improve Human Efficiency and reduce the effort of the workers through ergonomics.							

List of Experiments:

1. P-CHART FOR FRACTION DEFECTIVES
2. C- CHART FOR NUMBER OF DEFECTIVES (CONSTANT SAMPLE SIZE)
3. OPERATING CHARECTERSTIC CURVE OF SINGLE SAMPLING ATTRIBUTES PLAN
4. TEST FOR NORMALITY OF SAMPLE MEANS(NORMAL DISTRIBUTION)
5. X, R – CHARTS & PROCESS CAPBILITY
6. PIN BOARD STUDY EXPERIMENT
7. TO DRAW TWO HANDED PROCESS CHART FOR BOLT, WASHER & NUT ASSEMBLY
8. MULTIPLE ACTIVITY CHART (OR) MAN MACHINE CHART
9. ERGOCYCLE EXERCISE

Note: At Least eight experiments need to be performed by the students from the above mentioned list.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTIP-119A	COMPUTER AIDED DESIGN AND MANUFACTURING LAB							
Lecture	Tutorial	Practical	Credit	Major Test	Minor	Practical	Total	Time
0	0	4	2	-	40	60	100	3 hrs
Objective	To acquaint the students with 2-D and 3-D modeling using design softwares.							
Course Outcomes								
CO1	To understand the basic solid modeling and applied features of the softwares.							
CO2	To learn and practice of surface techniques and surface creations using software.							
CO3	To learn and practice of assembly and detailed drafting.							
CO4	To let student understand how to prepare MMCs using Stir Casting process.							

List of Experiments:

The students will be required to carry out the following exercises or their equivalent tasks using a 3-D modeling software package (e.g. Solid-works/ Creo/ Ideas/ Solid Edge/UG/CATIA/ etc.). Practical must be performed on licensed version (Preferably the latest version) of any one of above mentioned software.

1 BASIC SOLID MODELING

Introduction & sketcher tools

a) CAD Tools and Applications: CAD - CAM - CAE
b) Parametric Feature Based Modelling and Parent-Child Relation
c) Design Intent and Associativity between 3 Modes
d) Modelling Software - Getting Started & Graphical User Interface
e) Sketch Entities and Tools
f) Dimensioning and Adding Relations to define the Sketch

Sketched Features (Boss / Base and Cut)

a) Base Features
b) Extrude & Revolve
c) Reference Geometry, Curves & 3D Sketch
d) Sweep & Loft

Editing & Refining Model

a) Editing Sketch, Sketch Plane and Editing Feature
b) Suppress / Un-Suppress Feature and Reordering Feature

2 ADVANCE FEATURES APPLIED FEATURES

a) Patterns & Mirror
b) Fillet/Round & Chamfer
c) Hole &Hole Wizard
d) Draft, Shell, Rib and Scale
e) Dome, Flex and Wrap

Multi Body

a) Indent Tool
b) Combine Bodies – Boolean Operations
c) Split, Move/Copy and Delete Bodies

Other Tools & Options

a) Design Table and Configurations
b) Adding Equations and Link Values
c) Tools - Measure and Mass Properties
d) Appearance - Edit Material, Colour and Texture
e) Options - System and Document Properties

3 SURFACING TECHNIQUES BASIC SURFACE CREATIONS

a) Extrude & Revolve
b) Sweep & Loft
c) Boundary Surface
d) Planar Surface

Other Derived Techniques

a) Offset Surface
b) Radiate Surface
c) Ruled Surface
d) Fill Surface
e) Mid Surface

Modify / Edit Surfaces

a) Fillet/Round
b) Extend
c) Trim &Un-trim
d) Knit Surfaces
e) Delete and Patch

Surfaces for Hybrid Modelling

a) Thicken – Boss / Base and Cut
b) Replace face
c) End condition for Sketched feature - Up to Surface or Offset from Surface.
d) Solid body from closed surfaces

4 ASSEMBLY & MECHANISMS BOTTOM UP ASSEMBLY APPROACH

a) Inserting Components/Sub-Assemblies
b) Adding Mates - Standard & Advance
c) Editing Mates, Part and Replacing Components

Top down Approach & Mechanisms

a) Inserting New Part to Existing Assembly
b) Use of Layout Sketching
c) External References - In-context and Out-of-context, Locked and Broken

Assembly Features

a) Component Patterns & Mirrors
b) Cuts & Holes
c) Belt/Chain and Weld Bead

Representations of Assembly Components

a) Light Weight, Suppressed and Resolved
b) Hide, Transparency and Isolate
c) Exploded View

Assembly Check

a) Interference Detection,
b) Collision Detection and Physical Dynamics

Motion Study

c) Assembly Motion & Physical Simulation
d) Animation Wizard & Save as AVI file
e) Mechanism Analysis – Plot Displacement, Velocity and Acceleration Diagram

5 DETAILED DRAFTING

Introduction to Engineering Drawings

a) General Procedure for Drafting & Detailing
b) Inserting Drawing Views, Dimensioning and Adding Annotations
c) Drawing Templates & Sheet Format
d) Setting Options

Drawing Views

a) Model View & Standard 3 View
b) Projected View & Auxiliary View

c) Section & Aligned Section View
d) Detail View, Broken-out Section and Crop View.

Dimensioning
a) Standards, Rules and Guidelines
b) Dimension Insertion/Creation - Insert Model Items & Dimension tool
Annotations
a) Notes & Holes Callout
b) Datum & Geometric Tolerances
c) Surface Finish & Weld Symbols,Centre Mark & Centre line,BOM Balloon & Bill of Material

w.e.f. 2018-19

Audit Course-I

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTAD-101A	ENGLISH FOR RESEARCH PAPER WRITING						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to impart the knowledge of English for research paper writing.						
Course Outcomes							
CO1	To understand that how to improve writing skills and level of readability.						
CO2	To Learn about what to write in each section.						
CO3	To understand the skills needed when writing a title.						
CO4	To learn the skills required in writing the results, discussion and conclusions.						

Unit-I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit-II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit-III

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. Key skills needed when writing a Title, key skills needed when writing an abstract, key skills needed when writing an Introduction, skills needed when writing a Review of the Literature.

Unit-IV

Skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions, Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

RECOMMENDED BOOKS:

1. Goldbort R, "Writing for Science", Yale University Press (available on Google Books)
2. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press
3. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM. Highman's book.
4. Adrian Wallwork, "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTAD-103A	DISASTER MANAGEMENT						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to impart the knowledge of disasters management.						
Course Outcomes							
CO1	To demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.						
CO2	To critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.						
CO3	To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.						
CO4	To critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.						

Unit-I

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit-II

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Unit-III

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

Unit-IV

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

RECOMMENDED BOOKS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTAD- 105A	SANSKRIT FOR TECHNICAL KNOWLEDGE						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The objective of this course is to understand basic Sanskrit Language and Ancient Sanskrit literature related to science & technology.						
Course Outcomes							
CO1	Students will get a working knowledge in illustrious Sanskrit, the scientific language of the world.						
CO2	Learning of Sanskrit to improve brain functioning.						
CO3	Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.						
CO4	The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.						

Unit-I

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Unit-II

Order, Introduction of roots, Technical information about Sanskrit Literature

Unit-III

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

RECOMMENDED BOOKS:

1. Dr.Vishwas, “Abhyaspustakam” Samskrita-Bharti Publication, New Delhi
2. VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam “Teach Yourself Sanskrit” Prathama Deeksha-, New Delhi Publication
3. Suresh Soni, “India’s Glorious Scientific Tradition” Ocean books (P) Ltd., New Delhi.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (1st Sem.)
(Credit based)

MTAD-107A	VALUE EDUCATION						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The objective of this course is to understand value education, self-development, Imbibe good values in students and Let them know about the importance of character building.						
Course Outcomes							
CO1	To get knowledge of self-development.						
CO2	To learn the importance of Human values.						
CO3	To develop the overall personality.						
CO4	To know about the importance of character.						

Unit-I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgments

Unit-II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

Unit-III

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

Unit-IV

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, studying effectively

RECOMMENDED BOOKS:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Second Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTME-102	OPERATION RESEARCH & OPTIMIZATION TECHNIQUES						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of this course is to aware students about the dynamic programming to solve problems of discrete and continuous variables and model the real world problem and simulate it.						
Course Outcomes							
CO1	Students should be able to apply the dynamic programming to solve problems of discreet and continuous variables.						
CO2	Students should be able to apply the concept of non-linear programming						
CO3	Students should be able to carry out sensitivity analysis						
CO4	Student should be able to model the real world problem and simulate it.						

UNIT:-1

Introduction to Operation Research: Operation Research approach, scientific methods, introduction to models and modelling techniques, general methods for Operation Research models, methodology and advantages of Operation Research, history of Operation Research.

Linear Programming (LP): Introduction to LP and formulation of Linear Programming problems, Graphical solution method, alternative or multiple optimal solutions, Unbounded solutions, Infeasible solutions, Maximization – Simplex Algorithm, Minimization – Simplex Algorithm using Big-M method, Two phase method, Duality in linear programming, Integer linear programming.

UNIT:-2

Transportation & Assignment Problems: Introduction to Transportation problems, various methods of Transportation problem, Variations in Transportation problem, introduction to Assignment problems, variations in Assignment problems.

Network Analysis: Network definition and Network diagram, probability in PERT analysis, project time cost trade off, introduction to resource smoothing and allocation.

UNIT:-3

Inventory Model: Introduction to inventory control, deterministic inventory model, EOQ model with quantity discount.

Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality, Recursive equations –Forward and backward recursions.

UNIT:-4

Queuing Models & Simulation: Concepts relating to queuing systems, basic elements of queuing model, role of Poison & exponential distribution, concepts of birth and death process. Introduction & steps of simulation method, distribution functions and random number generation.

Advanced Topics in Optimization

Piecewise linear approximation of a nonlinear function Multi objective optimization – Weighted and constrained methods; Multi level optimization Direct and indirect search methods Evolutionary algorithms for optimization and search Applications in mechanical engineering

RECOMMENDED BOOKS:

1. Gupta P.K, Hira and D.S., operation research, sultan chand and sons, New Delhi.1994.
2. Kanti Swarup, Gupta P.K. & Man Mohan, Operation Research, sultan chand and sons, New Delhi.1990.
3. Mittal K.V., Optimization Methods in Operation Research and system Analysis, New Age International (P) ltd., New Delhi,1992.
4. Rao S.S., Optimization Theory and applications, wlley Eastern ltd. New Delhi,1991.
5. Sharma, S.D., Optimization Research, Kedar Nath and RamNath.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks.* The student will attempt a total of *FIVE questions,* each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining/our questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTME-104	REFRIGERATION & CRYOGENICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to aware students about the different refrigeration systems and their applications simulate these with cryogenics to address and find the solution of various environmental and industrial issues.						
Course Outcomes							
CO 1	Understand the basic principles of refrigeration and cryogenic						
CO 2	Student should analyze air refrigeration systems, vapor compression refrigeration systems, vapour absorption refrigeration systems, and steam jet refrigeration systems						
CO 3	Student should be able to understand the properties, applications and environmental issues of different refrigerants						
CO 4	Student should operate and analyze the refrigeration and air conditioning systems.						

UNIT-I

Introduction: Lubrication of reverse carnot cycle with vapour as a refrigerant, simple vapour compression cycle, Pressure- Enthaply diagram, Ewing's construction, suction state for max. COP standard rating cycle & effect of operating conditions (evaporator pressure, condenser pressure, suction vapour superheat, liquid sub cooling, liquid vapour regenerative heat exchanger) deviation of actual compression cycle with that of theoretical.

UNIT-II

AIR REFRIGERATION SYSTEM: Reverse Carnot cycle, most efficient refrigeration, Bell cooling the aero plane, simple cooling & simple evaporative type, Bootstrap & Bootstrap evaporative type, Regenerative type, reduced ambient, limitations, merit & comparison. Multi Temperature: Method of improving the COP, Optimum interstate pressure for two stages refrigeration system, multistage or compound compression with flash intercooler, single expansion valve & multi expansion valve, multi evaporator system with single compressor, individual compressor with compound compression, single expansion valve & multi expansion valve

UNIT-III

Vapour Absorption System:
Simple Vapour absorption system, Max, Coefficient of performance, Modification of simple vapour absorption system, Actual vapour absorption cycle and its representation on Enthalpy- Composition diagram, Absorption systm calculations, Rich and Poor solution concentrations, Lithium & Bromide water system.

UNIT-IV

CRYOGENICS:
Limitation of simple vapour compression system, Multi-stage system, Cascade system, Production of solid carbon dioxide, Joule- Thomson effect, Liquefaction of gases, Hydrogen ,Helium, application of low temperature, Cryogenic insulation. Steam Jet Refrigeration: Steam jet Refrigerator, component of steam jet refrigeration plant, advantages of steam jet refrigeration system, Performance of system, determination of equilibrium concentration.

RECOMMENDED BOOKS:

1. Mechanical Refrigeration by Sporks and Diffio
2. ASHRE Handbook (Fundamentals) ASHRE.
3. Thermal Environment by Threlkeld.
4. Refrigeration & Air-Conditioning by C.P. Arora.
5. Refrigeration & Air-Conditioning by Stocker
6. Cascade system Ejector Comparison system, Method, Use of pre-cooling, liquefaction.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks.* The student will attempt a total of *FIVE questions,* each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining/our questions by selecting only one question from each unit.*

Programme Elective-III

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTIP-106A	ADVANCED WELDING PROCESSES						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of Welding metallurgy and welding processes.						
Course Outcomes							
CO1	To impart knowledge about various Weld metallurgy and Weld arc characteristics.						
CO2	To acquaint students with the various welding power sources and their applications.						
CO3	To impart knowledge to students about Electrode coatings and Metal transfer phenomenon in weld metal transfer.						
CO4	To let student understand the basics of Solid state welding processes and some of the latest welding techniques.						

UNIT-I

WELDING METALLURGY: Introduction, Weld Metal Zone, Theory of solidification of metals and alloys, Homogeneous Nucleation, Heterogeneous Nucleation, Freezing of alloys, Epitaxial Solidification; Effect of Welding speed on Grain structure, Fusion boundary zone, Heat affected zone, Under bead zone, Grain Refined Zone, Partial transformed zone, Properties of HAZ

WELDING ARC: Definition of Arc, Structure and characteristics, Arc efficiency, arc blow, Electrical Characteristics of arc, Types of Welding Arcs, mechanism of arc initiation and maintenance, role of electrode polarity on arc behaviour and arc stability, analysis of the arc. Arc length regulation in mechanized welding processes.

UNIT-II

WELDING POWER SOURCES: Requirement of an Arc welding power sources, basic characteristics of power sources for various arc welding processes, duty cycles, Selection of a static Volt-Ampere characteristic for a welding process, AC/DC welding power source, DC rectifiers, thyristor controlled rectifiers, transistorized units, inverter systems, Mathematical Problems on Static volt ampere characteristics

UNIT-III

COATED ELECTRODES: Electrode coatings, classification of coatings of electrodes for SMAW, SAW fluxes, role of flux ingredients and shielding gases, classification of solid and flux code wires.

METAL TRANSFER & MELTING RATE: Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal transfer in various welding processes, effective of polarity on metal transfer and melting rate.

UNIT-IV

SOLID STATE WELDING: Theory and mechanism of solid state welding,techniques and scope of friction welding, diffusion welding, cold pressure welding and ultrasonic welding, high energy rate welding,analysis of the Process.

WELDING TECHNIQUES: Technique, scope and application of the electron beam and laser welding processes,under water welding - process & problem.

RECOMMENDED BOOKS:

1. Raymond Sacks, —Welding: Principles & Practices McGraw-Hill
2. R.S.Parmar, —Welding processes & Technology , Khanna Publishers
3. R.S.Parmar, —Welding Engineering & Technology , Khanna Publishers
4. S.V. Nandkarni, —Modern Arc Welding Technology, Oxford & IBH publishing Co.
5. L.M.Gourd, —Principles of Welding Technology , ELBS/ Edward Arnold.
6. Richard L. Little —Welding & Welding Technology , Mc-Graw Hill.
7. Cary, Howard —Modern Welding Technology', prentice Hall, 1998.

8. Rossi —Welding Technology , Mc-Graw Hill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).
All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTIP–108A	ADVANCED METAL CUTTING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of advanced cutting tools, tools geometry, mechanisms and analysis.						
Course Outcomes							
CO1	To impart knowledge about various functional related to tools geometry.						
CO2	To acquaint with the analysis of fundamental factors affecting tool forces						
CO3	To impart knowledge about cutting tool life and mathematical modelling for wear.						
CO4	To let student understand abrasive machining and its process simulation.						

UNIT-I

Introduction system of Tool nomenclature, Tool Geometry, Mechanism of Chip formation and forces in orthogonal cutting, Merchant's force diagram.

Oblique Cutting: Normal chip reduction coefficient under oblique cutting, true shear angle, effective rake, influx region consideration for deformation, direction of maximum elongation, effect of cutting variables on chip reduction co-efficient, forces system in oblique cutting, effect of wear land on force system, force system in milling, effect of helix angle.

UNIT-II

Fundamentals of Dynamometry, Theoretical determination of forces, angle relations, heat and temperature during metal cutting; distribution, measurement, analysis, theoretical estimation of work piece temperature, hot machining

Fundamental factors, which effect tool forces: Correlation of standard mechanized test. (Abuladze – relation), nature of contact and stagnant phenomenon, rates of strains, shear strain and normal strain distributions, cutting variables on cutting forces.

UNIT-III

Cutting Tools: Tools materials analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, wear of cutting tools, criterion, flank and crater wear analysis, optimum tool life, tool life equations, (Taylor's woxenetc) Tool life test, machining optimization, predominant types of wear; abrasive, adhesive, diffusion wear models, wear measurements and techniques, Major Test of tool wear oxidative mathematical modelling for wear, test of machinability and influence of metallurgy on machinability. Economics of metal machining

UNIT-IV

Abrasive Machining: Mechanics of grinding, cutting action of grit, maximum grit chip thickness, energy and grit force temperature during grinding, wheel wear, grinding, process simulation, testing of grinding wheels, mechanics of lapping and honing, free body abrasion.

RECOMMENDED BOOKS:

1. Sen & Bhattacharya,Principles of Machine tools, New Central Book Agency.
2. Brown,Machining of Metals, Prentice Hall.
3. Shaw,Principles of Metal cutting, Oxford I.B.H.
4. Arshimov&Alekree,Metal cutting theory & Cutting tool design, MIR Publications.
5. Machining Science & Application by Knowenberg Longman Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTIP-110A	Metrology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs.**
Objective	The main objective of the course is to deal with the basic principles of dimensional measuring instruments and precision measurement techniquesin achieving quality and reliability in the service of any product in dimensional control.						
Course Outcomes							
CO1	To understand the studentsabout the requirement of metrology and the concepts of limit, fits and gauges.						
CO2	To study the linear and angular measurements and the optical measurement tools and techniques.						
CO3	To understand how to use surface roughness and thread measuring instruments.						
CO4	To study the comparators, measurement through comparators and the advanced metrology concepts.						

UNIT-I

Introduction to metrology: Definition, types, need of inspection, terminologies, methods of measurement, selection of instruments, measurement errors, units, Measurement standards, calibration, statistical concepts in metrology.

Systems of Limits and Fits: Introduction, nominal size, tolerance limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard Institution system – British standard system, International standard system for plain and screwed work.

Limit Gauges: Taylor's principle – Design of limit gauges, computer aided tolerancing.

UNIT-II

Linear Measurement: Length standard, line and end standards, slip gauges – calibration of the slip gauges, dial indicator, micrometres. Measurement of angles and tapers: Different methods – bevel protractor – angle slip gauges – spirit levels– sine bar – sine plate, rollers and spheres.

Flat Surface Measurement: Measurement of flat surfaces – instruments used – straight edges– surface plates – optical flat and auto collimator.

Optical Measuring Instruments: Tool maker's microscope and its uses, collimators, optical projector, optical flats and their uses, interferometer.

UNIT-III

Surface Roughness Measurement: Introduction, terminology, specifying roughness on drawings, surface roughness parameters, factors affecting surface roughness, ideal surface roughness, roughness measurement methods, precautions in measurement, surface microscopy, surface finish softwares.

Screw Thread Measurement: Elements of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch, profile thread gauges.

Measurement through Comparators: Comparator: Features of comparators, classification of comparators, different comparators, advanced comparators, thread comparators.

UNIT-IV

Metrology of machine tools: Alignment and practical tests.

Gear Measurement: Gear measuring instruments, gear tooth profile measurement, measurement of diameter, pitch, pressure angle and tooth thickness.

Advanced Metrology: Advanced measuring machines, CNC systems, Laser vision, In-process gauging, 3D metrology, metrology softwares, Nano technology instrumentation, stage position metrology, testing and certification services, optical system design, lens design, coating design, precision lens assembly techniques, complex opto mechanical assemblies, contact bonding and other joining technologies.

RECOMMENDED BOOKS:

1. K.J. Hume,Engineering Metrology, Macdonald and Co. (publisher) London.
2. Czichos, The Springer handbook of metrology and Testing, 2011.
3. Jay. L. Bucher, The Metrology Hand book, American Society for Quality, 2004.
4. Smith GT,Industrial Metrology, Spinger.
5. John W. Greve, Frank W. Wilson,Hand book of industrial metrology, PHI – New Delhi.
6. D.M. Anthony, Engineering Metrology, Pergamon Press.
7. Khare MK,Dimensional Metrology, OXFORD-IBH Publishers.
8. I C Gupta, "Engineering Metrology", 5th Edition, Danapath Rai & Co, 2008.
9. R.K. Jain, "Engineering Metrology". 20th Edition, Khanna Publishers, 2007.
10. M. Mahajan, "Engineering Metrology", Dhanapati Rai publications, 2007.
11. BIS standards on Limits & Fits (IS 919), Surface Finish (IS 2073), Machine Tool Alignment, 1993.

Note: The paper will have a total of *NINE questions*. Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Programme Elective-IV

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTIP–112A	SEQUENCING AND SCHEDULING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of different production and machine models of sequencing and scheduling.						
Course Outcomes							
CO1	To understand the concept of sequencing and scheduling.						
CO2	To study and practice for the extension of basic models and parallel machine models.						
CO3	To understand the concepts of the flow shop scheduling and practice for the flow shop scheduling models.						
CO4	To understand the job shop problems and simulation models for dynamic job shop problem.						

UNIT-I

Single-Machine Sequencing: Introduction, Preliminaries, Problems without Due Dates, Problems with Due Dates

Optimization Methods for the Single-Machine Problem: Introduction, Adjacent Pairwise Interchange Methods, A Dynamic Programming Approach, Dominance Properties, A Branch and Bound Approach.

Earliness and Tardiness Costs: Introduction, Minimizing Deviations from a Common Due Date, The Restricted Version, Asymmetric Earliness and Tardiness Costs, Quadratic Costs, Job-Dependent Costs, Distinct Due Dates,Sequencing for Stochastic Scheduling.

UNIT-II

Extensions of the Basic Model: Introduction, Non-simultaneous Arrivals, Related Jobs, Sequence-Dependent Setup Times, Stochastic Models with Sequence-Dependent Setup Times.

Parallel machine models: Introduction, Minimizing the Makespan, Minimizing Total Flow time, Stochastic Models.

UNIT-III

Flow Shop Scheduling: Introduction, Permutation Schedules, The Two-Machine Problem, Special Cases of The Three-Machine Problem, Minimizing the Makespan, Variations of the *m*-Machine Model, Stochastic flow shop scheduling.

UNIT-IV

The Job Shop Problem: Introduction, Types of Schedules, Schedule Generation, The Shifting Bottleneck Procedure, Neighborhood Search Heuristics.

Simulation Models for the Dynamic Job Shop: Introduction, Model Elements, Types of Dispatching Rules, Reducing Mean Flowtime, Meeting Due Dates.

RECOMMENDED BOOKS:

1. Michael Pinedoo, Scheduling: theory, algorithms and systems, Prentice Hall, New Delhi, 1995.
2. King, J.R. Production planning and control, Pergamon International Library, 1975.
3. Kenneth R. Baker, Introduction to sequencing and scheduling, John Wiley and Sons, 1974.
4. Kenneth R. Baker and Dan Trietsch, Principles of sequencing and scheduling, John Wiley and Sons, 2009.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)

(Credit based)

MTIP–114A	**QUALITY ENGINEERING AND MANAGEMENT**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of quality tools and engineering for the improvement of product quality.						
Course Outcomes							
CO1	To understand the statistical concepts of quality and quality statistics.						
CO2	To study the quality control chartsin production process and practice for its use in problem solving.						
CO3	To understand the quality improvement tools.						
CO4	To study the ISO systems, failure analysis and testing.						

Unit-I

Introduction to Quality: An Historical Overview: Defining Quality, The Total Quality System, Total Quality Management, Economics of Quality, Quality, Productivity, and Competitive Position, Quality Costs, Success Stories.

Statistics for Quality: Variability in Populations, Some Definitions, Quality vs. Variability, Section I: Empirical Methods for Describing Populations, Section II: Mathematical Models for Describing Populations, Section III: Inference of Population Quality from a Sample.

Unit-II

Quality in Design: Planning for Quality, Product Planning, Product Design, Process Design.

Quality in Production-Process Control I: Process Control, The Control Charts, Measurement Control Charts, Attribute Control Charts, Summary on Control Charts, Process Capability, Measurement System Analysis,

Quality in Production-Process Control II: Derivation of Limits, Operating Characteristics of Control Charts, Measurement Control Charts for Special Situations.

Unit-III

Quality in Procurement: Importance of Quality in Supplies, Establishing a Good Supplier Relationship, Choosing and Certifying Suppliers, Specifying the Supplies Completely, Auditing the Supplier, Supply Chain Optimization Using Statistical Sampling for Acceptance,

Continuous Improvement of Quality: The Need for Continuous Improvement, The Problem-Solving Methodology, Quality Improvement Tools, Lean Manufacturing.

Unit-IV

A System for Quality: The Systems Approach, Dr. Deming's System, Dr.Juran's System, Dr.Feigenbaum's System, Baldrige Award Criteria, ISO 9000 Quality Management Systems, ISO 9001:2008 Requirements, The Six Sigma System.

RECOMMENDED BOOKS:

1. Grant &Leaveworth, Statistical Quality Control, McGraw Hill
2. Duncan,Quality Control & Industrial Statistics, Irwin Press
3. Juran,Quality Control Handbook, McGraw Hill.
4. Hansen,Quality Control, Prentice Hall
5. Thomason,An Introduction to reliability & control, Machinery Publishing.

6. A.V. Taylor, Total Quality Control, McGraw-Hill
7. K.S.Krishnamoorthi, V. Ram Krishnamoorthi,A First Course in Quality Engineering: Integrating Statistical and Management Methods of Quality, Second Edition, CRC Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weight of 12 marks*.

The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTIP–116A	RELIABILITY ENGINEERING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	The main objective of the course is to impart the students with the knowledge of reliability analysis in industrial system. Students can get acquainted with different reliability calculation models.						
Course Outcomes							
CO1	To understand the concepts of reliability in industrial systems.						
CO2	To study the reliability determination methods and advanced evaluation techniques.						
CO3	To understand various reliability prediction and evolution methods.						
CO4	To acquaint the fundamentals of reliability management and risk assessment.						

UNIT-I

Reliability Engineering: Reliability function,failure rate, Mean time between failures (MTBF), Mean time to failure (MTTF), mortality curve, useful life availability, maintainability, system effectiveness. Introduction to probability distributions.

Time to failure distributions: Exponential, normal, Gamma, Weibull; ranking of data, probability plotting techniques, Hazard plotting Concept of Bathtub Hazard Rate curve, Reliability evaluation of two-state device networks-series, parallel, k-out-of-m systems; Standby redundant systems, Reliability evaluation of three-state device networks-series and parallel.

UNIT-II

Reliability Determination and Prediction: Reliability Determination Methods: Network reduction technique, Path tracing technique, Decomposition technique, Delta-Star method.

Advanced Reliability Evaluation Concepts: Supplementary variables technique, Interference theory, Human reliability, Common cause failures, Fault trees, Failure mode and effect analysis

UNIT-III

Reliability Prediction Models: Series and parallel systems - RBD approach - Standby systems - m/n configuration - Application of Baye's theorem - cut and tie set method - Markov analysis - FTA - Limitations.

UNIT-IV

Reliability testing: Time acceleration factor, influence of acceleration factor in test planning, application to acceleration test, high temperature operating life acceleration model, temperature humidity bias acceleration model, temperature cycle acceleration model, vibration accelerator model, failure free accelerated test planning. Accelerated reliability growth.

Risk Assessment: Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.

RECOMMENDED BOOKS:

1. Charles E. Ebeling, “An introduction to Reliability and Maintainability engineering”, TMH, 2000.
2. Roy Billington and Ronald N. Allan, “Reliability Evaluation of Engineering Systems”, Springer, 2007.
3. Sharma S C, Inspection Quality Control and Reliability, Khanna Publishers.
4. Connor P.D.T.O. Practical Reliability Engineering”, John Wiley.
5. Naikan V N A Reliability Engineering and Life Testing”, PHI Learning Private Limited.
6. Prabhakar Murthy D N and Marvin R, “Product Reliability”, Springer-Verlag.

7. Dana Crowe and Alec Feinberg, Design for Reliability, CRC Press.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units). All questions will have equal *weight of 12 marks*.

The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTME–106	ADVANCE WELDING LAB							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**40**	**60**	**100**	**3 hrs**
Objective	To familiar about the advance welding techniques.							
Course Outcomes								
CO1	To study various property of metals under different weldings.							
CO2	To acquaint students various welding tests.							
CO3	Various solid state weldings.							
CO4	To get familiar with different types of electrodes used in welding.							

1) To study Heat Flow in welding by using Gas Welding Equipment

2) To study tensile property, bead geometry, hardness of bead, microstructure of welding bead in case of:

a) MIG Welding
b) TIG Welding
c) SAW Welding
d) Arc Welding

3) Use different destructive testing methods (Impact test- Charpy and Izod impact tests, Hardness test- Brinell, Vickers, Rockwell hardness tests) for quality control of welds.

4) Use different non destructive testing (Dye Penetrant Testing and Magnetic Particle Testing, Visual inspection; Radiography Testing) for quality control of welds.

5) To study mechanical behavior (tensile strength hardness of bead, micro structure of welding bead, impact strength, corrosion and wear, fatigue behavior) in case of
a) Frictions stir welding
b) Frictions stir processing

6) To study welding thermal cycles, weld metal solidification process and welding metallurgy during the welding of ferrous and non ferrous metals.

7) To study the different codes and symbols use in welding to differentiate electrodes and consumables according to ASME standard.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTME-108	REFRIGERATION AND CRYOGENICS LAB							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical Marks	Total	Time (Hrs.)
-	-	4	2	-	40	60	100	3
Objective	To make students understand the applications of refrigeration and cryogenics.							
Course Outcomes								
CO 1	Students will understand about the basics and working of refrigeration and cryogenics systems.							
CO 2	Students will be able to identify the different cycle of operation in refrigeration.							
CO 3	Students will know the working principle to achieve very low temperature and its importance in air-conditioning.							
CO 4	Student will learn about the various working and design of different types of refrigeration systems.							

List of Experiments

1. To study and perform experiment on compound vapour compression Refrigeration Cycle.
2. To study and perform experiment on Solar Air-conditioner based on vapour absorption cycle.
3. To study and perform experiments on multi-load systems.
4. To study and perform experiment on vapour absorption apparatus.
5. To find the performance parameter of cooling tower.
6. To study various components in room air conditioner.
7. To find performance of a refrigeration test rig system by using different expansion devices.
8. To study and perform experiments on cascade system.
9. To study and perform experiments on dry ice machine.
10. To study and perform experiments on gas liquefaction system.

Note: Total eight experiments are to be performed selecting at least six from the above list

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTME-110	MINI PROJECT							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**4**	**2**	**-**	**-**	**100**	**100**	**3 hrs**
Objective	In case of mini project, they will solve a live problem using software/analytical/computational tools							
Course Outcomes								
CO 1	Students will learn to write technical reports.							
CO 2	Students will develop skills to present and defend their work in front of technically qualified audience.							

Students can take up small problems in the field of mechanicalengineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Students will be required to submit a brief synopsis of 3-4 pages related to the topic by the first week of September.

w.e.f. 2018-19

Audit Course-II

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTAD- 102A	CONSTITUTION OF INDIA						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The main objective of the course is to impart the students with the knowledge of informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.						
Course Outcomes							
CO1	To discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.						
CO2	To discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.						
CO3	To discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.						
CO4	To discuss the passage of the Hindu Code Bill of 1956.						

Unit-I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features

Unit-II

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality, Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit-III

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit-IV

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

RECOMMENDED BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "framing of Indian Constitution", 1st Edition, 2015.
3. M. P. Jain, "Indian Constitution Law", 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTAD-104A	PEDAGOGY STUDIES						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	The main objective of the course is to review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers and Identify critical evidence gaps to guide the development.						
Course Outcomes							
CO1	Understand the pedagogical practices being used by teachers in formal and informal classrooms in developing countries.						
CO2	Become aware of the evidence on the effectiveness of these pedagogical practices, in different conditions and with different population of learners.						
CO3	Understand the significance of teacher education (curriculum and practicum) and the school curriculum and guidance materials for effective pedagogy.						

Unit-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions. Overview of methodology and Searching.

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

Unit-II

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit-III

Professional development: alignment with classroom practices and follow-up support, Peer support Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Unit-IV

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

RECOMMENDED BOOKS:

1. Ackers J, Hardman F, "Classroom interaction in Kenyan primary schools", Compare, 31 (2): 245-261.
2. Agrawal M, "Curricular reform in schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K, "Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?" International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ, "Culture and pedagogy: International comparisons in primary education". Oxford and Boston: Blackwell.
6. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign"

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTAD-106A	STRESS MANAGEMENT BY YOGA						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
2	0	0	-	-	100	100	3
Objective	The main objective of the course is to achieve overall health of body and mind and to overcome stress						
Course Outcomes							
CO1	Develop healthy mind in a healthy body thus improving social health.						
CO2	Improve efficiency						
CO3	Learn the Yogasan						
CO4	Learn the Pranayam						

Unit-I

Definitions of Eight parts of yog. (Ashtanga)

Unit-II

Yam and Niyam. Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit-III

Asan and Pranayam

i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam

RECOMMENDED BOOKS:

1. Janardan Swami Yogabhyasi Mandal, "Yogic Asanas for Group Tarining-Part-I" : Nagpur
2. Swami Vivekananda, "Rajayoga or conquering the Internal Nature" AdvaitaAshrama (Publication Department), Kolkata

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (2nd Sem.)
(Credit based)

MTAD-108A	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**-**	**-**	**100**	**100**	**3**
Objective	To learn how to achieve the highest goal happily. To become a person with stable mind, pleasing personality and determination. To awaken wisdom in students.						
Course Outcomes							
CO1	Students become aware about leadership.						
CO2	Students will learn how to improve communication skills						
CO3	Understand the team building and conflict						
CO4	Student will learn how to manage the time.						

Neetisatakam-Holistic development of personality

i) Verses- 19,20,21,22 (wisdom)
ii) Verses- 29,31,32 (pride & heroism)
iii) Verses- 26,28,63,65 (virtue)
iv) Verses- 52,53,59 (dont's)
v) Verses- 71,73,75,78 (do's)

Approach to day to day work and duties.

Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47, 48,
Chapter 3-Verses 13, 21, 27, 35,
Chapter 6-Verses 5, 13, 17, 23, 35,
Chapter 18-Verses 45, 46, 48.

Statements of basic knowledge.

Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16, 17, 18

Personality of Role model. Shrimad BhagwadGeeta:

Chapter 2-Verses 17,

Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

RECOMMENDED BOOKS:

1. Swami Swarupananda, "Srimad Bhagavad Gita" Advaita Ashram (PublicationDepartment), Kolkata
2. P.Gopinath, "Bhartrihari's Three Satakam (Niti-sringar-vairagya) by, Rashtriya Sanskrit Sansthanam, New Delhi.

Third Semester (Programme Elective-V)

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd.Sem.)
(Credit based)

MTIP–201A	ENTERPRISE RESOURCE PLANNING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of the course is to impart the students with the knowledge of integrated applications to manage the business and automate many back office functions related to technology, services and human resources.						
Course Outcomes							
CO1	To study the basic principles and models of an enterprise.						
CO2	To understand the concepts of technology and architecture in ERP.						
CO3	To study ERP system packages.						
CO4	To study the ERP procurement issues.						

UNIT I

ENTERPRISE RESOURCE PLANNING:
Introduction, Evolution of ERP, Principle of ERP, Enabling Technologies, ERP Characteristics, Features of ERP, The advantages of ERP, Reasons for the Failure of ERP Implementation, Risk and governance issues in an ERP, ERP Framework, Business Blueprint, Business Engineering Vs. Business Process Re-Engineering, ERP Tools and Software, Demand Chain, Value Chain, and Supply Chain.

UNIT-II

ERP ARCHITECTURE: Need to Study ERP Architecture**,** Layered Architecture,Types of ERP Architecture:Two-tier Implementations,Three-tier Client/Server Implementations, Web-based architecture, Service-Oriented Architectures,Logical Architecture of an ERP System,Physical Architecture of an ERP System, Evaluation Framework for ERP Acquisition.

UNIT III

ERP PACKAGE INTEGRATION AND IMPLEMENTATION: ERP market, SAP, Peoplesoft, BAAN company, ORACLE corporation, A comparative assessment and selection of ERP packages and modules, Sales Force Automation, Integration of ERP, Integration of ERP and the Internet, ERP implementation strategies,Comparison of Big Bang vs. Phased Approach,Implementation Strategy in Small and Medium Enterprise, Post Implementation Issues.

UNIT IV

OVERVIEW OF ARCHITECTURE OF DIFFERENT ERP SOFTWARES:
Oracle overview, Architecture, A.I.M. and applications, SAP Software architecture overview, ERP before and after Y2K, Impact of Y2K on ERP Development, Risk and Governance Issues in an ERP

ERP MODULES: *Finance module, Sales & Distribution module, Human Resources module, Plant Maintenance module, Quality Management module, Material management module, manufacturing management module.*

RECOMMENDED BOOKS:

1. Sadagopan. S, ERP-A Managerial Perspective, Tata Mcgraw Hill,1999.
2. Jose Antonio Fernandez, the SAP R/3 Handbook, Tata Mcgraw Hill,1998.
3. Vinod Kumar Crag and N.K. Venkitakrishnan, Enterprise Resource Planning- Concepts and Practice, Prentice Hall of India,1998.
4. Garg &Venkitakrishnan,ERPWARE, ERP Implementation Framework, Prentice Hall,1999.
5. Thomas E Vollmann and BeryWhybark, Manufacturing and Control Systems, Galgothia Publications,1998.
6. Alexis Leon,Enterprise resource planning, Tata Mcgraw-Hill

Note: ThepaperwillhaveatotalofNINEquestions.QuestionNo.1,whichiscompulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all FourUnits).
All questions will have equal *weight of 12 marks*.The student will attempt a total of *FIVE questions*, each of

12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rd Sem.)

(Credit based)

MTIP-203A	**DESIGN OF EXPERIMENTS**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To understand the various design of experiments techniques for optimization of problems						
Course Outcomes							
CO1	To understand the concepts of Design of Experiment and statistical Methods.						
CO2	To understand the ANOVA and factorial design and fitting response curves and surfaces.						
CO3	To study the application of Taguchi Method and testing of hypothesis						
CO4	To study and implement the Response Surface Methodology.						

UNIT-I

Introduction to Designed Experiments: Introduction:Strategyofexperimentation,Sometypicalapplicationsofexperimentaldesign, Basic principles, Guidelines for designing experiments, Using statistical design in experimentation, A Checklist for Planning experiments,*Introduction to Minitab, Interface of Minitab, Customizing Minitab, Entering Data, Graphing Data, Printing Data and Graphs, Saving and Retrieving information.*

Basic Statistical Methods: Introduction, Basic statistical concepts, Types of Data, Graphical Presentation of Data.

Descriptive Statistics: Measure of Location, Measure of Variation, The Normal Distribution, Counting, Minitab Commands to Calculate Descriptive Statistics.

Inferential Statistics: The Distribution of Sample Means (R Known), Confidence Interval for the Population Mean (σ Known), Hypothesis testing for one sample mean (σ Known), Hypothesis test for two sample means, Testing for Normality, *Hypothesis test and Confidence Intervals with Minitab.*

UNIT-II

Analysis of Variance: Introduction to Analysis of Variance, ANOVA assumptions and Validation, ANOVA Table, The sum of square approach to ANOVA calculations, Analysis of the fixed Effect model, Decomposition of the Total sum of squares. Statistical analysis, Estimation of the Model Parameters, Unbalanced Data, Model Accuracy Check, Practical interpretation of results. *ANOVA with Minitab*

Factorial Experiments: Basic definition and principles, Advantages of factorials, Two level factorial design, The 2^1 Factorial Experiment, The 2^2 Factorial Experiment, The 2^3 Factorial Design, Addition of Centre Cells to 2^k Designs. General Procedure for Analysis of 2^k designs. 2^k Factorial Designs in Minitab.

UNIT-III

Introduction to Taguchi Method: Introduction, Taguchi Quality loss function, Orthogonal Array, Properties of Orthogonal Array, Minimum number of experiments to be conducted, Static Problems, Dynamic Problems,Assumptions of the Taguchi method, Steps in Taguchi Method, Assessment of Factors and Interactions, Selection and Application of Orthogonal arrays, Data Analysis from Taguchi Experiments, Variable Data with main factors only, Variable Data with Interactions, Attribute Data Analysis, Confirmation Experiment, Confidence Intervals, Robust Design Approach. *Applications of Taguchi Method using Minitab*.

UNIT-IV

Introduction to Response Surface Methodology: Introduction, Terms in Quadratic Models, The method of steepest ascent, Analysis of Second order response surfaces, Experimental design for fitting response surfaces, 2k Designs with Centers, 3^k Factorial Designs, Box-Behnken Designs, Central Composite Designs, Analysis of Data from RSM Designs, Design Considerations for Response Surface Experiments. *Response Surface Designs in Minitab.*

RECOMMENDED BOOKS:

1. Douglas C Montgomery,Design and Analysis of Experiments, John Wiley
2. Paul G. Mathews,Design of Experiments with MINITAB, New Age International Publishers.
3. K. Krishnaiah, P. Shahabudeen,Applied Design of Experiments and Taguchi Methods,PHI.
4. Angela Dean and Daniel Voss,Design and Analysis of Experiments, Springer.
5. John P.W.M., Statistical Design and Analysis of Experiments, John Wiley
6. Montgomery D.C., Runger G. C., Introduction to Linear Regression Analysis, John Wiley
7. Myres R.H. and Montgomery D.C.,Response Surface Methodology Process and Product Optimization Using Designed Experiments, Wiley
8. G UNIPUB, White Plains,Introduction to Quality Engineering Taguchi, New York.
9. https://www.ee.iitb.ac.in/~apte/CV_PRA_TAGUCHI_INTRO.htm
10. www.ecs.umass.edu/mie/labs/mda/fea/sankar/chap2.html

Note: Thepaperwillhaveatotalof*NINEquestions.*QuestionNo.1,whichiscompulsory, shall be Objective Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from eachunit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(Credit based)

MTIP–205A	STRATEGIC ENTREPRENEURSHIP						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 hrs**
Objective	To provide knowledge to the students about entrepreneurship concepts and various development programmes and policies.						
Course Outcomes							
CO1	To know about the small scale industries, scopes and the causes of their sickness.						
CO2	To know about the EDP and different government policies.						
CO3	To learn about business incubations and its future perspectives.						
CO4	To learn E-business marketing and developments.						

UNIT-I

Small Scale Industries: Definition and types of SSI's; Role, scope and performance in national economy; Problems of small scale industries.

Industrial Sickness: Definition; Causes of sickness; Indian scenario, Government help; Management strategies; Need for trained entrepreneurs

UNIT-II

Entrepreneurship Development Programmes: Introduction, Origin of EDP's , Organizations involved in EDP's, Objectives of EDPs, Implementation of EDP's, Short comings of EDP's, Role in entrepreneurship development.

Step: Introduction, Origin, Status in India, Success and failure factors, Govt. polices and incentives, future prospects in India.

UNIT-III

Business Incubation: Introduction, Origin and development of business incubators in India and other countries, types of incubators, success parameters for a business incubator, Benefits to industries, institutes, government and society; future prospects. A few case studies (at least 2).

Project Management: Concept, Characteristics and Significance of Project Management. Components of Project Management. Project Life Cycle. Project Identification and Selection. Project Formulation and Appraisal.

UNIT-IV

Special Aspects of Entrepreneurship: Entrepreneurship, Social entrepreneurship, International entrepreneurship, Rural entrepreneurship, Community Development, Women entrepreneurship.

Network Marketing: Introduction, E-business, E-commerce, E-auction, A basic internet e-business architecture, A multi-tier e-business architecture.

RECOMMENDED BOOKS:

1. P.K. Gupta,Strategic Entrepreneurship, Everest Publishing House.
2. David Cleland,Project Management –Strategic Design and Implementation, McGraw Hill.
3. David H Holl,Entrepreneurship-New Venture Creation, Prentice Hall of India.
4. Steed & Steed,Sustainable Strategic Management, Prentice Hall of India.
5. Kotler,Marketing Management by Prentice Hall of India.
6. Tarek Khalil,Management of Technology, McGraw Hill.
7. Henry Steiner,Engineering Economic Principles, McGraw Hill.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weight of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

Open Elective

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(Credit based)

MTOE-201A	BUSINESS ANALYTICS						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes							
CO1	Able to have knowledge of various business analysis techniques.						
CO2	Learn the requirement specification and transforming the requirement into different models.						
CO3	Learn the requirement representation and managing requirement assets.						
CO4	Learn the Recent Trends in Embedded and collaborative business						

Unit-I

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst. Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.
Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit-II

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.
Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit-III

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements.
Managing Requirements Assets: Change Control, Requirements Tools

Unit-IV

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

RECOMMENDED BOOKS:

1. James Cadle, "Business Analysis", BCS, The Chartered Institute for IT.
2. Erik Larson and, Clifford Gray, "Project Management: The Managerial Process", McGraw-Hill Education.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(Credit based)

MTOE-203A	**INDUSTRIAL SAFETY**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is toaware students about the industrial safety maintenance and fault findings.						
Course Outcomes							
CO1	Understand the industrial safety.						
CO2	Analyze fundamentals of maintenance engineering.						
CO3	Understand the wear and corrosion and fault tracing.						
CO4	Understanding when to do periodic inceptions and apply the preventing maintenance.						

Unit-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-II

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-III

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-IV

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of

preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

RECOMMENDED BOOKS:

1. Higgins & Morrow, "Maintenance Engineering Handbook", Da Information Services.
2. H. P. Garg, "Maintenance Engineering", S. Chand and Company.
3. Audels, "Pump-hydraulic Compressors", Mcgraw Hill Publication.
4. Winterkorn, Hans, "Foundation Engineering Handbook", Chapman & Hall London.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(Credit based)

MTOE-205A	OPERATIONS RESEARCH						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to aware students about the dynamic programming to solve problems of discrete and continuous variables and model the real world problem and simulate it.						
Course Outcomes							
CO1	Students should be able to apply the dynamic programming to solve problems of discreet and continuous variables.						
CO2	Students should be able to apply the concept of non-linear programming						
CO3	Students should be able to carry out sensitivity analysis						
CO4	Student should be able to model the real world problem and simulate it.						

Unit-I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit-II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit-III

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit-IV

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

RECOMMENDED BOOKS:

1. H.A. Taha, “Operations Research, An Introduction”, PHI, 2008
2. H.M. Wagner, “Principles of Operations Research”, PHI, Delhi, 1982.
3. J.C. Pant, “Introduction to Optimization: Operations Research”, Jain Brothers, Delhi, 2008
4. Hitler Libermann, “Operations Research”, McGraw Hill Pub. 2009
5. Pannerselvam, “Operations Research”, Prentice Hall of India 2010
6. Harvey M Wagner, “Principles of Operations Research”, Prentice Hall of India 2010

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(Credit based)

MTOE-207A	**COST MANAGEMENT OF ENGINEERING PROJECTS**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to impart the studentswith the knowledge of cost management for the engineering project and apply cost models to the real world projects.						
CourseOutcomes							
CO1	Students should be able to learn the strategic cost management process.						
CO2	Students should be able to types of project and project team types						
CO3	Students should be able to carry out Cost Behavior and Profit Planning analysis.						
CO4	Student should be able to learn the quantitative techniques for cost management.						

Unit-I

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-II

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit-III

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-IV

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

RECOMMENDED BOOKS:

1. Charles Thomas Horngren, "Cost Accounting a Managerial Emphasis", Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, "Advanced Management Accounting"
3. Robert S Kaplan Anthony A. Alkinson, "Management & Cost Accounting"

4. Ashish K. Bhattacharya, "Principles & Practices of Cost Accounting", A. H. Wheeler publisher
5. N.D. Vohra, "Quantitative Techniques in Management", Tata McGraw Hill Book Co. Ltd.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(Credit based)

MTOE-209A	**COMPOSITE MATERIALS**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Objective	The main objective of this course is to impart the studentswith the knowledge of composites, its materials, analysis, fabrication, and performance analysis.						
Course Outcomes							
CO1	Students should be able to learn the classification and characteristics of composite materials.						
CO2	Students should be able to understand about different fabrication techniques related to metal matrix composites.						
CO3	Students should be able to understand about different fabrication techniques related to polymer matrix composites.						
CO4	Student should be able to do the analyses of the composite materials under different loading conditions.						

UNIT–I

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures,Iso-strain and Iso-stress conditions.

UNIT – II

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications.

Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–III

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – IV

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

RECOMMENDED BOOKS:

1. R.W.Cahn, "Material Science and Technology" VCH, West Germany.

2. WD Callister, Jr, "Materials Science and Engineering, An introduction"
3. Balasubramaniam, "John Wiley & Sons", NY, Indian edition, 2007.

4. Lubin, "Hand Book of Composite Materials"
5. K.K.Chawla, "Composite Materials"
6. Deborah D.L. Chung, "Composite Materials Science and Applications"
7. Danial Gay, Suong V. Hoa, and Stephen W. Tasi, "Composite Materials Design and Applications"

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(Credit based)

MTOE-211A	WASTE TO ENERGY						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	60	40	100	3
Objective	The main objective of this course is to impart the studentswith the knowledge of generation of energy from the waste.						
Course Outcomes							
CO1	Students should be able to learn the classification of waste as a fuel and biomass pyrolysis.						
CO2	Students should be able to learn gasification process and different types of gasifiers.						
CO3	Students should be able to learn different combustors for biomass.						
CO4	Student should be able to learn the Biogas plant technology different biomass conversions processes for different applications.						

Unit-I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-II

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-III

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-IV

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

RECOMMENDED BOOKS:

1. Desai, Ashok V, “Non-Conventional Energy”, Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. and Mahdi, S. S., “Biogas Technology - A Practical Hand Book - Vol. I & II”, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Challal, D. S, “Food, Feed and Fuel from Biomass”, IBH Publishing Co. Pvt. Ltd., 1991.

4. C. Y. WereKo-Brobby and E. B. Hagan, "Biomass Conversion and Technology", John Wiley & Sons, 1996.

Note: The paper will have a total of *NINE questions.* Question No. 1, which is compulsory, shall be OBJECTIVE Type and have contents from the entire syllabus (all Four Units).

All questions will have equal *weightage of 12 marks*. The student will attempt a total of *FIVE questions*, each of 12 marks. Q. No. 1 is compulsory. *The student shall attempt remaining four questions by selecting only one question from each unit.*

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (3rdSem.)
(Credit based)

MTME-201	**DISSERTATION PHASE - I**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical Marks**	**Total**	**Time (Hrs.)**
0	**0**	**20**	**10**	**-**	**100**	**-**	**100**	**-**
Objective	The main objective of this course is to plan a research work (which includes the problem formulation/literature review, proposed objectives, proposed methodologies and references) in the field of Industrial and Production Engineering or interrelated fields of applications.							
Course Outcomes								
CO 1	Students will be exposed to various self-learning topics.							
CO 2	Students will be exposed toan exhaustive survey of the literature such as books, national/international refereed journals, resource persons andindustrialsurveysfor the selection/ identification of engineering/research problem.							
CO 3	Students will be able to set the research objectives of the identified engineering/research problem.							
CO 4	Students will learn modern tools/techniques related to the identified engineering/researchproblem for the solution and able to learn technical report writing skills.							
CO 5	Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.							

The students will start their research workin third semester with a research problem having research potential involving scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.

The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his/her supervisor and the topic of dissertation must be mutually decided by the supervisor and student.

The students will be required to submit a progress report related to their dissertation work by the end of September. The progress report will cover the following:

- The goal set for the period.
- Research papers studied.
- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.

The progress report must be at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The students will be required to appear for comprehensive Seminar & Viva-voce and submit a synopsis report based on their progress related to the dissertation as per the presentation date mentioned in the academic calendar for the session. The synopsis report will be submitted in the same format as that of the thesis and will contain the following:

1. Introduction
2. Literature Survey
3. Gaps in Literature
4. Objectives of the Proposed Work
5. Methodology
6. References

*** Student will choose his/her guide in the end of second semester.**

w.e.f. 2018-19

Fourth Semester

MASTER OF TECHNOLOGY IN MECHANICAL ENGINEERING (4th Sem.)
(Credit based)

MTME-202	DISSERTATION PHASE -II							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical	Total	Time (Hrs.)
0	0	32	16	-	100	200	300	-
Objective	The main objective of the course is to make the students able to do some good research in the field of their interests related to Industrial and Production Engineering or interrelated fields of applications.							
Course Outcomes								
CO 1	Students will be able to design solutions for engineering problems that meet the specified needs with appropriate considerations.							
CO 2	Students will be able to conduct investigations of engineering problems using research-basedknowledge and experimental/researchmethods including design of experiments, analysis and interpretation of data, and synthesisof the information to provide valid conclusions.							
CO 3	Students will be able to apply resources and modernengineering tools and techniques with an understanding of thelimitations.							
CO 4	Students will be able to either work in a research environment or in an industrial environment.							
CO 5	Students will be conversant with technical report writing, professional ethics, responsibilities and norms of the engineering practice.							
CO 6	Students will be able to present and convince their topic of study to the engineering community.							

The students are required to continue Analytical/Experimental/Computational/Industrial Problems or Case studies investigations in the field of Industrial and Production Engineering or other related fields which have been finalized in the third semester. They would be working under the supervision of a faculty member.

The students will be required to submit a progress report duly signed by their respective supervisors to the department, related to their dissertation work in the last week of March. The progress report will cover the following:

- The goal set for the period.
- Research papers studied.

- Methodology used in achieving the goal.
- The extent of fulfillment of the goal.
- References

The progress report must be of at least of 3-4 pages and the cover page should include the tentative topic, name of the candidate, name of the supervisor, period of progress report, signature of candidate and supervisor.

The candidate has to prepare a detailed dissertation report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up/numerical details/industrial case study etc. as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study.

The final dissertation will be submitted in the end of semester as per academic calendar for the session, which will be evaluated by internal as well as external examiners based upon his/her research work. At least one publication is expected before final submission of the dissertation from every student in peer reviewed referred journals or reputed conference from the work done by them in their dissertation. The dissertation should be presented in standard format as provided by the department.

The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a supervisor, co-supervisor etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his supervisor.

KURUKSHETRA UNIVERSITY, KURUKSHETRA

('A+' Grade, NAAC Accredited)

SCHEME OF EXAMINATIONS FOR MASTER OF TECHNOLOGY IN ELECTRICAL ENGINEERING (w. e. f. 2018-19)

SEMESTER-I

Sr. No.	Course Code	SUBJECT	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTEL-101A	Advanced Power System Analysis	3	-	-	3	40	60	3	3
2	MTEL-103A	Advanced Instrumentation & Control	3	-	-	3	40	60	3	3
3	*	Program Elective-I	3	-	-	3	40	60	3	3
4	**	Program Elective-II	3	-	-	3	40	60	3	3
5	MTEL-117A	Instrumentation & Control Lab	-	-	4	4	40	60	2	3
6	MTEL-119A	Advanced Power System Lab-I	-	-	4	4	40	60	2	3
7	MTRM-111A	Research Methodology and IPR	2	-	-	2	40	60	2	3
8	***	Audit Course-I	2	-	-	2	-	-	-	-
		Total	**16**		**8**	**24**	**280**	**420**	**18**	

*** PROGRAM ELECTIVE – I**		
1.	MTEL-105A	Renewable Energy Resources
2.	MTEL-107A	Power Electronics Applications in Renewable Energy
3.	MTEL-109A	Smart Grid

**** PROGRAM ELECTIVE - II**		
1.	MTEL-111A	Bio-Medical Signal & Image Processing
2.	MTEL-113A	Advanced Digital Signal Processing
3.	MTEL-115A	Bio-Medical Instrumentation

***** AUDIT COURSE – I**		
1.	MTAD-101A	English for Research Paper Writing
2.	MTAD-103A	Disaster Management
3.	MTAD-105A	Sanskrit for Technical Knowledge
4.	MTAD-107A	Value Education

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2. *** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

SEMESTER-II

Sr. No.	Course Code	Subject	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTEL-102A	Advanced Power System Protection	3	-	-	3	40	60	3	3
2	MTEL-104A	Intelligent Control	3	-	-	3	40	60	3	3
3	*	Program Elective-III	3	-	-	3	40	60	3	3
4	**	Program Elective-IV	3	-	-	3	40	60	3	3
5	MTEL-118A	Modeling & Simulation Lab	-	-	4	4	40	60	2	3
6	MTEL-120A	Advanced Power System Lab-II	-	-	4	4	40	60	2	3
7	#MTEL-122A	Mini Project	-	-	4	4	100	-	2	3
8	***	Audit Course-II	2	-	-	-	-	-	-	-
		Total	**14**		**12**	**26**	**340**	**360**	**18**	

***PROGRAM ELECTIVES - III**		
1.	MTEL-106A	HVDC Transmission & FACTS Devices
2.	MTEL-108A	Transients in Power System
3.	MTEL-110A	Advanced Power Distribution & Automation

****PROGRAM ELECTIVE – IV**		
1.	MTEL-112A	Digital Control System
2.	MTEL-114A	Advanced Microprocessors
3.	MTEL-116A	Reliability Engineering

***** AUDIT COURSE–II**		
1.	MTAD-102A	Constitution of India
2.	MTAD-104A	Pedagogy Studies
3.	MTAD-106A	Stress Management by Yoga
4.	MTAD-108A	Personality Development through Life Enlightenment Skills

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

Note 2. *** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

#Note3: Mini project: During this course the student will be able to understand the contemporary/emerging technologies for various processes and systems. During the semester, the students are required to search/gather the material/information on a specific topic, comprehend it and present/discuss the same in the class. He/she will be acquainted to share knowledge effectively in oral (seminar) and written form (formulate documents) in the form of report. The student will be evaluated on the basis of viva/ seminar (40 marks) and report (60 marks).

SEMESTER-III

Sr. No.	Course Code	Subject	L	T	P	Total	Minor* Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	*	Program Elective-V	3	-	-	3	40	60	3	3
2	**	Open Elective	3	-	-	3	40	60	3	3
3	MTEL-207A	Dissertation Phase-I	-	-	20	20	100	-	10	--
		Total	**6**		**20**	**26**	**180**	**120**	**16**	

** OPEN ELECTIVE		
1.	MTOE-201A	Business Analytics
2.	MTOE-203A	Industrial Safety
3.	MTOE-205A	Operation Research
4.	MTOE-207A	Cost Management of Engineering Projects
5.	MTOE-209A	Composite Materials
6.	MTOE-211A	Waste to Energy

* PROGRAM ELECTIVE - V		
1.	MTEL-201A	Distributed Generation
2.	MTEL-203A	Electric Drives & Control
3.	MTEL-205A	Power System Restructuring & Deregulation

SEMESTER-IV

Sr. No.	Course Code		L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTEL-202A	Dissertation Phase-II	-	-	32	-	100	200	16	--
						Total	**100**	**200**	**16**	

Total Credits – 68

Note 1: At the end of the second semester each student is required to do his/her Dissertation work in the identified area in consent of the Guide/Supervisor. Synopsis for the Dissertation Part-I is to be submitted within three weeks of the beginning of the Third Semester.

Note 2: Each admitted student is required to submit the report of his/her Dissertation Part-I as per the schedule mentioned in Academic calendar for the corresponding academic session otherwise the Dissertation Part-II cannot be continued at any level.

Note 3: Each admitted student is required to submit his/her final Dissertation Part-II as per the schedule mentioned in Academic calendar for the corresponding academic session only after the publication of two papers in a journal/International/National conference of repute like IEEE, Springer, Elsevier, ACM etc.

Note 4: The course of program/open elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

MTEL-101A	Advanced Power System Analysis						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	To enable students to analyse power system networks, various faults, load flow study, security and contingency analysis.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand matrices related to power system and its formation with different methods.						
CO2	Understand how to analyze various types of faults in power system						
CO3	Study various methods of load flow and their advantages and disadvantages						
CO4	Understand need of power system security, state estimation and contingency analysis						

UNIT1

Network Modelling: System graph, loop, cut set and Incidence matrices, Primitive network and matrix, Formation of various network matrices by singular transformation.

Bus Impedance Algorithm: Singular transformation, direct inspection, Building Block algorithm for bus impedance matrix, Addition of links, addition of branches, (considering mutual coupling).

UNIT2

Balanced and unbalanced network elements: Representation of three phase network elements, representation under balanced and unbalanced excitation, transformation matrices, symmetrical components, sequence impedances, unbalanced elements and three phase power invariance.

Short circuit studies: Network representations for single line to ground fault, line to line fault, LL-G fault, and 3-phase faults, Short circuit calculations for various types of faults in matrix form.

UNIT3

Load flow studies: Load flow and its importance. Classification of buses, load flow techniques, Iterative solutions and computer flow charts using Gauss-Seidel and Newton-Raphson methods, Decoupled and fast decoupled methods, Representation of regulating and off nominal ratio transformers and modification of Y_{bus}.

UNIT4

Power system security: Introduction to Power system security, Addition and removal of multiple lines, network reduction for contingency analysis, current injection, shift destitution factor, single outage contingency analysis.

State estimation in power systems: data acquisition system, Method of least-squares, State estimation by weighted least square technique.

Suggested Books:

1. Stagg G W, El-Abaid A H, "Computer methods in Power system analysis", McGraw Hill.
2. Singh L P, "Advanced Power System Analysis and Dynamics", New Age, Int. Publication.
3. Ramana N V, "Power System Analysis", Pearson Education.
4. Nagsarkar T K, Sukhija M S, "Power System Analysis", Oxford University Press.
5. Uma Rao K, "Computer Techniques and Models in Power System", IK Publications.
6. Grainger J J, Stevenson W D, "Power System Analysis", McGraw Hill.
7. Allen Wood, Bruce Wollenberg, "Power Generation operation & control", John Wiley & Sons.
8. Nagrath I J, Kothari D P, "Power System Engineering" McGraw Hill, New York.
9. Pai M A, "Computer Techniques in Power System Analysis", 2nd Edition, TMH-New Delhi.

MTEL-103A	Advanced Instrumentation & Control						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	This course will look at different types of Instruments with their controls.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand different types of **Instruments** with their applications.						
CO2	Understand basics of smart Sensor with their advantages ,disadvantages and applications						
CO3	To emphasize and analysis of Virtual Instruments.						
CO4	To study different types of VI structures						

Unit 1

Transducers: Introduction, Characteristics and Classifications of electrical transducers, measurement of displacement, Force, pressure, speed, temperature and intensity of light using different electrical transducers, advantages, disadvantages and applications of transducers

. **Unit 2**

Smart Sensors: Introduction, architecture of smart sensor, optical sensor, microelectronic sensor, chemical, Bio Sensor and Physical Sensor, piezo-resistive pressure sensor, fibre optic temperature sensor, light sensor, advantages, disadvantages and applications of smart sensors.

Unit 3

Virtual Instrumentation: Introduction, architecture of VI, Evaluation and architecture of VI, conventional Virtual Instrumentation, Advantage of Lab View, Software Environment, Creating and Saving VI, front Panel and block diagram Tool Bar, Palettes, front panel control and indicators, block diagram: Terminals, Nodes, Functions, Sub VI, Data Flow Program.

Unit 4

VI Structures: Control structures, selection structures, case structures, Sequence structures, formula node, array, single and multi-dimensional array, auto indexing, clusters, creating clusters control and indicators, data plotting.

Suggested Books:

1. Johnson G W, “Lab VIEW Graphical Programming”, Second edition, McGraw Hill.

2. Kring J & Travis J, “LabVIEW for everyone”, Prentice Hall, New Jersey.

3. James K, “PC Interfacing and Data Acquisition”, Elsevier.

4. Jerome J, “Virtual Instrumentation using Lab View”, Prentice Hall, India.

MTEL-105A	Renewable Energy Resources						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of renewable energy resources and different factors related to them.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about renewable energy resources and solar power system.						
CO2	To acquaint students with the phenomenon of wind power system and its applications with grid.						
CO3	To impart knowledge to students about geothermal and ocean power system.						
CO4	To let student understand fuel cell, hydrogen and hybrid energy system.						

Unit 1

ENERGY RESOURCES: Renewable energy sources, distributed energy systems and dispersed generation, atmospheric aspects of electric energy generation, Impact of renewable energy generation on environment

SOLAR ENERGY: Solar Radiation and its Measurement, Solar Thermal Energy Collectors: different types of collectors and their performance analysis, Solar Thermal Energy Conversion System: solar water heater, solar distillation, slat thermal power plant and various applications of solar system, Solar Photovoltaic System: solar cell, VI characteristics, solar electricity and grid and off-grid solar system.

Unit 2

WIND ENERGY: Wind turbines and rotors, Wind Energy Extraction, Wind Characteristics, Power Density Duration Curve, Design of Wind Turbine Rotor, Design of Regulating System for Rotor, Wind Power Generation Curve, Sub-systems of a Horizontal Axis Wind Turbine Generator, Modes of Wind Power Generation, Estimation of Wind Energy Potential, Selection of Optimum Wind Energy Generator (WEG), Grid Interfacing of a Wind Farm, Methods of Grid Connection, Grid System and Properties, Capacity of Wind Farms for Penetration into Grid, Control System for Wind Farms, Economics of Wind Farms

Unit 3

GEOTHERMAL ENERGY: Structure of the Earth's Interior, Plate Tectonic Major Test, Geothermal Sites, Geothermal Field, Geothermal Gradients, Geothermal Resources, Geothermal Power Generation, Geothermal Electric Power Plant, Geothermal-Preheat Hybrid with Conventional Plant

OCEAN ENERGY: Development of a Tidal Power Scheme, Grid Interfacing of Tidal Power, Wave Energy, Mathematical Analysis of Wave Energy, Empirical Formulae on Wave Energy, Wave Energy Conversion, Principle of Wave Energy plant, Wave Energy Conversion Machines.

Unit 4

FUEL CELLS: Principle of Operation of Fuel Cell, Fuel Processor, Fuel Cell Types, Energy Output of a Fuel Cell, Efficiency, and EMF of a Fuel Cell, Operating Characteristics of Fuel Cells, Thermal Efficiency of Fuel Cell

HYDROGEN ENERGY SYSTEM: Hydrogen Production, Hydrogen Storage, Development of Hydrogen Cartridge, Gas Hydrate

HYBRID ENERGY SYSTEMS: Hybrid Systems AND ITS Types, Electric and Hybrid Electric Vehicles, Hydrogen-Powered-Electric Vehicles.

Suggested Books:

1. Kothari DP, Singal KC, Ranjan Rakesh, "Renewable energy sources and emerging technologies, 2nd ed, Prentice Hall (India)
2. Rai G D, "Non-Conventional Sources of Energy, Khanna Publishers.
3. Bansal N K, Kleemann M, Heliss M, "Renewable energy sources and conversion technology", McGraw Hill Education.
4. Abbasi S A, Abbasi N, "Renewable energy sources and their environmental impact", PHI.
5. Mittal KM, "Renewable energy Systems", Wheelar Publishing.
6. Mukherjee D, "Renewable energy Systems", New Age International.

MTEL-107A	Power Electronics Applications in Renewable Energy						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the application of power system in renewable energy resources.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about power electronics devices and DC-DC converters.						
CO2	To acquaint students with the modern power electronics converters.						
CO3	To impart knowledge to students about power electronics interface devices for solar energy.						
CO4	To let student understand wind energy interfacing devices.						

Unit1

Review of Power Devices: SCR, BJT, MOSFET, IGBT, GTO, Safe operating Limits, Selection of devices for various applications.

Phase controlled Converters: **(**1-φ&3-φ) thyristor fed half controlled, fully controlled and Dual converters with inductive and motor load.

DC to DC converters: Analysis of various conduction modes of Buck, Boost, Buck-Boost.

Unit2

Modern Power Electronic Converters: Basic concepts of VSI, single phase half bridge, full bridge and three phase bridge inverters, PWM modulation strategies, Sinusoidal PWM, Space vector modulation, Selective Harmonic Elimination method, other inverter switching schemes, blanking time, Current source inverters.

Unit3

Design of Power Electronics Interfaces for Solar PV: Solar PV technologies, MPPT, Design of DC-DC converters for MPPT, MPPT algorithms, Implementation of MPPT control through DSP controllers. Topologies for grid connected and standalone applications: single phase and three phase systems, Single stage and multistage, isolated and non-isolated.

Unit4

Power Electronics Interfaces for WES: Topologies of WES, design considerations for wind energy Switch rectifier/inverter system, Power Converters for Doubly Fed Induction Generators (DFIG) in Wind Turbines.

Power Electronics Interfaces for Fuel Cells: Types of fuel cells, Proton Exchange Membrane (PEM) fuel cell: features and operational characteristics, Design of DC-DC converters for PEM fuel cell, MPPT in Fuel Cell.

Suggested Books:

1. Mohan N, Undel and T M, Robbins W P, "Power Electronics, Converters, Applications & Design", Wiley India Pvt. Ltd.
2. Bose B K, "Modern Power Electronics and AC Drives", Pearson Education.
3. Joseph Vithayathil,"Power Electronics", Tata McGraw Hil.
4. Amirnaser Yezdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modelling, Control and Applications", IEEE John Wiley Publications.
5. Solanki C S, "Solar Photo Voltaic", PHI learning Pvt Ltd.

MTEL-109A	Smart Grid						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of smart Grid and its advantages over conventional grid						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about Smart Grids and Appreciate the difference between smart grid & conventional grid						
CO2	To acquaint students with the phenomenon of smart metering concepts to industrial and commercial installations						
CO3	To impart knowledge to students about Formulate solutions in the areas of smart substations, distributed generation and wide area measurements						
CO4	To let student understand microgrid and related issues..						

UNIT-1

Introduction to Smart Grid, Evolution of Electric Grid Concept of Smart Grid, Definitions Need of Smart Grid, Concept of Robust & Self-Healing Grid, Present development & International policies in Smart Grid. Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources Power Quality Conditioners for Smart Grid

UNIT-2

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS) Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation. Cyber Security for Smart Grid

UNIT-3

Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU)

UNIT-4

Concept of micro-grid, need & applications of micro-grid, formation of micro-grid, Issues of interconnection, protection & control of Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines Captive power plants, Integration of renewable energy sources

Suggested Books:

1. Keyhani A, “Design of smart power grid renewable energy systems”, Wiley IEEE.
2. Berger L T, Iniewski K, “Smart Grid: Applications, Communications and Security”, Wiley.
3. Gellings C W., “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press.
4. Ekanayake J B, Jenkins N, Liyanage K, Yokoyama A, “Smart Grid: Technology and Applications”, Wiley.
5. Borlase S, “Smart Grid: Infrastructure, Technology and solutions”, CRC Press.
6. Phadke A G, “Synchronized Phasor Measurement and their Applications”, Springer.

MTEL-111A	Bio-Medical Signal & Image Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	This course will look at Biomedical signal and Image for understanding and their processing assessing						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand different types of biomedical signal and Identify and analyse different biomedical signals.						
CO2	Understand basics of Image processing and its methods						
CO3	To emphasize and analysis of Clustering and Classification						
CO4	To study different types of bio signals and their processing						

Unit-1

Signals and Biomedical Signal Processing: Introduction and overview, Analog, discrete and digital signals, Processing and transformation of signals, Signal processing for feature extraction, Characteristics of digital Images, Fourier transform: Properties of One-Dimensional Fourier Transform, Discrete Fourier Transform.

. **Unit-2**

Image Processing: Image filtering Enhancement and Restoration, Point processing, Mask processing: linear filtering in Space domain, Frequency-domain filtering, Smoothing and sharping filters in frequency domain, Wavelet transform, FFT to STFT, One-Dimensional Continuous and discrete Wavelet Transform, Image processing methods.

Unit-3

Clustering and Classification: Clustering versus Classification, Feature extraction, Biomedical and. Biological features, Signal and Image processing features, K-means: A Simple Clustering Method, study of different types of Classifiers for signal processing.

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Unit-4

Processing of Biomedical Signals: Electric activities of Cell, Electric data acquisition, Electrocardiogram: Signal of Cardiovascular system, Processing and feature extraction of ECG, Electroencephalogram, Signal of the brain, Processing and feature extraction of EEG, Electromyogram: Signal of muscles, Processing and feature extraction of EMG. Frequency and wavelet-domain analysis.

Suggested Books:

1.KayvanNajarian& Robert Splinter, "Introduction to Biomedical signal and Image Processing", CRC Press
2.MetinAkay "Time Frequency & Wavelets in Biomedical Signal Processing", Wiley-IEEE Press.
3. Amine Nait-Ali, "Advanced Biomedical Signal Processing", Springer.

MTEL-113A	Advanced Digital Signal Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of LTI system and designing of different types of Filters**.**						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about LTI system and DFT.						
CO2	To acquaint students with the study and design of FIR filters.						
CO3	To impart knowledge to students about study and design of IIR filters.						
CO4	To let student understand the concept and design of adaptive digital filters and power spectrum estimation.						

UNIT-1

Introduction of DSP: Introduction to Signal Processing, Discrete Linear Systems, superposition Principle, UNIT-Sample response, stability & causality Criterion.

Fourier Transform & inverse Fourier transform: Frequency domain design of digital filters, Fourier transform, use of Fourier transform in Signal processing. The inverse fourier transform, sampling continuous function to generate a sequence, Reconstruction of continuous -time signals from Discrete-time sequences.

UNIT-2

Digital Filter Structure & Implementation: Linearity, time invariance & causality, the discrete convolution, the transfer function, stability tests, steady state response, Amplitude & Phase Characteristics, stabilization procedure, Ideal LP Filter, Physical reliability & specifications. FIR Filters, Truncation windowing & Delays, design example, IIR Filters: Review of design of analog filters & analog frequency transformation. Digital frequency transformation. Design of LP filters using impulse invariance method, bilinear transformation, Phase equalizer, digital all pass filters.

UNIT-3

Implementation of Filters: Realization block diagrams, Cascade & parallel realization, effect of infinite-word length, transfer function of degree 1&2, Sensitivity comparisons, effects of finite precision arithmetic on Digital filters.

UNIT-4

DFT & FFT & Z transform with Applications: Discrete Fourier transform, properties of DFT, Circular Convolution, Fast Fourier Transform, Realizations of DFT. The Z-transform, the system function of a digital filter, Digital Filter implementation from the system function, the inverse Z- transform, properties & applications, Special computation of finite sequences, sequence of infinite length & continuous time signals, computation of Fourier series & time sequences from spectra.

Suggested Books:

1. J G Proakis, “Digital Signal Processing using Matlab”, Pearson Education.
2. Alam V. Oppenheim and Ronald W. Schafer, “Digital Signal Processing” Pearson Education.
3. Rabiner & Gold, “Major Test& application of digital Signal Processing”, Pearson Education
4. Roman kuc, “Introduction to Digital Signal Processing,” Tata McGraw Hill Edition.
5. Richard G. Lyons, “Understanding Digital Signal Processing”, Pearson Education.
6. Paulo S. R. Diniz, Eduardo A. B. da Silva, Sergio L. Netto, “Digital Signal Processing: System Analysis and Design”, Springer.
7. Manolakis G Demitries, “Applied Digital Signal Processing”, Cambridge Univ. Press.

MTEL-115A	Bio-Medical Instrumentation						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of different types of Biomedical Instruments with their controls.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand the different types of biomedical transducer for signal measurement and recording.						
CO2	Understand basics of blood pressure, blood flow and respiratory system measurements.						
CO3	Understand the muscoskeletal and nervous system and their measurement.						
CO4	To emphasize and analysis of recent trends in biomedical Engg and safety measurement.						

Unit-1

Characteristics of Transducers and Electrodes for Biological Measurement: Introduction to human body, block diagram, classification, various physiological events and suitable transducer for their recording, bioelectric potentials.

Cardiac system: Cardiac musculature, Electro cardiography, ECG recording, phonocardiography, holter recording ECG lead system, Heart rate meter, vector cardiography, pacemakers,

Unit-2

Blood pressure and Blood flow measurement; Invasive and non-invasive methods of blood pressure, characteristics of blood flow and heart sound, Cardiac output measurement, Plethysmography.

Respiratory system: Mechanics or breathing, parameters of respiration, Respiratory system measurements, respiratory therapy instruments.

Unit-3

Muscoskeletal Systems; EMG, Clinical applications, Muscles stimulator, Instrumentation for measuring Nervous function; EEG signal, frequency band classification, Lead systems, EEG recording, Clinical applications of EEG signal, X-ray CT scan, MRI, PET.

Clinical Laboratory Instrumentation; Test on blood cell, Blood cell counter, Blood glucose monitors, auto analyzer, pulse-oximeter.

Unit-4

Recent Trends in Biomedical Engg: Patient care and monitoring, Non-invasive diagnostic instrumentation, biotelemetry, telemedicine, prosthetic devices, lie detector test, Application of lasers and ultrasonic in biomedical field.

Troubleshooting and Electrical safety of Biomedical instruments; Physiological effect of current and safety measurement.

Suggested Books:

1.W T Wester, J G Tompkins, “Design of Microprocessor based Medical Instrumentation”, Englewood cliffs

2.Tatsuo, Togato & Toshiya, “Biomedical transducers and instruments”, CRC Press

3. Joseph P Bronzino, “The Biomedical engineering handbook”, CRC Press

MTEL-117A	Instrumentation &Control Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of how to create, simulate and measure the different applications in VI.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about mathematical, Boolean operations, half adder.						
CO2	Understand how to create the VI for decimal to binary conversion, array function, sequence structure. Also studying the properties and options of graphs/charts.						
CO3	To impart knowledge about measurement of temperature, strain and power using VI.						
CO4	Understand to create model for speed control of DC motor, analysis of PID controller.						

Following experiments (at least 10) are required to be performed in MATLAB/ETAP/LabView or equivalent:

1. Find addition, subtraction, multiplication and division of two numeric inputs
2. Perform various Boolean operations (AND, OR, NAND, NOR, XOR).
3. Add two binary bits and find the sum and carry (half adder).
4. Create a Vito find the decimal equivalent of a binary number using sub VI.
5. Create VI for studying array functions.
6. Create VI for studying sequence structure.
7. Create VI for studying properties and options of graphs/charts.
8. Measurement of Temperature using Virtual instrumentation.
9. Measurement of Strain using Virtual instrumentation.
10. ImplementationofVI to control the speed of a DC motor.
11. RealTime Power measurement and analysis using Virtual instrumentation.
12. Creating Models, Simulation and Analysis of PID Controller.
13. Study and Implementation of Displacement Transducers.

MTEL-119A	Advanced Power System Lab-I						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of programing for various types of power system appliances.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about a program to develop Bus Admittance Matrix, power flow studies using Newton-Raphson and Gauss-Siedel method.						
CO2	Understand how to determine the generalized constants A, B, C, D of a long transmission line and voltage & current for three phase faults ona2-buspowersystem						
CO3	To impart knowledge about simulation and analysis of a single phase & three phase power system and generation, transmission & distribution in power system.						
CO4	To impart knowledge about simulation and analysis of different fault condition and contingency concept in a power system.						

Following experiments are required to be performed in MATLAB/ETAP/LabView or equivalent.

1. Write a program to develop Bus Admittance Matrix Y_{BUS}.
2. Write a program for the Power Flow Studies using N-R(Newton-Raphson) method.
3. Write a program for the power flow analysis of system using Gauss-Siedel Technique.
4. Determination of the generalized constants A, B, C, D of a long transmission line.
5. Determination of the voltage and current for three phase faults on a 2-bus power system.
6. Simulation and Analysis of a single phase & three phase power system.
7. Simulation & Analysis of generation, transmission & distribution in power system.
8. Simulation & Analysis of different fault condition in power system.
9. Simulation and Analysis of 9-bus power system.
10. Simulation and Analysis of contingency concept in a power system.

MTRM-111A	Research Methodology and IPR						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to Research Methodology and IPR for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.*						
Course Outcomes (CO)							
CO1	Understand research problem formulation.						
CO2	Analyze research related information						
CO3	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.						
CO4	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.						

Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2

Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper.Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 3

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 4

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.
2. C.R. Kothari, "Research Methodology: Methods & Techniques, 2nd edition or above, New Age Publishers.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

MTEL-102A	Advanced Power System Protection						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of advanced protection system in modern power system.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about need of protection system and various issues of CT and PT						
CO2	To acquaint students with the comparators and relays.						
CO3	To impart knowledge to students about distance protection and protection of feeders, generators and motors.						
CO4	To let student understand protection of transformers, buses and modern protection system.						

Unit1

Introduction: Need for protective systems, Zones of protection, classification of protective relays, electromechanical, solid state and digital relays, comparisons between different types of relays.

Current transformers and potential transformers: construction, operating principle and their performance

Unit2

Comparators: general equation of comparators, Analysis for amplitude comparator, analysis for phase comparator, duality between amplitude and phase comparators.

Over current relays, differential relays, operating and restraining characteristics, distance relays, impedance relays, reactance relays, and mho relay quadrilateral relays, elliptical relays, comparison with conventional relays.

Unit3

Distance protection: Principle of distance relaying, time grading of distance relays, schemes of distance protection, distance protection by impedance, reactance and mho relays, Effect of power swings on the performance of distance relays.

Pilot relaying schemes: Pilot wire protection, carrier current protection.

Protection of Generators and Motors: Types of faults, Stator and rotor protection against various types of faults.

Unit4

Protection of Transformers: Types of faults, differential protection schemes, harmonic restraint relay, over flux protection, Earthing transformer protection.

Bus Zone Protection: Types of Bus-bar faults, differential current protection frame leakage protection. Microprocessor based protective relays: Overcurrent relay, impedance relay, reactance relay, mho relay, microprocessor based distance relaying.

Application of artificial intelligence and wavelet transform in protective relays

Suggested Books:

1. TSM Rao, “Power System Protection–Static Relays”, Tata McGraw Hill Education Pvt. Ltd.
2. B. Bhalja, R P Maheshwari and N G Chothani, “Protection and Switchgear”, Oxford University Press.
3. Ravinder Nath & Chander, “Power System Protection and Switchgear”, New Age International Publishers.
4. Badri Ram & Vishwakarma, “Power system protection and switch gear” McGraw Hill Education(India)
5. C L Wadhwa, “Electrical Power Systems”, New Age International Publishers.
6. Protective Relays –Their Major Test and Practice Vol. I & II by W. Van Warrington.
7. Advanced power system analysis and dynamics by L P Singh: Wiley Eastern N. Delhi.
8. Digital Protection: Protective relay from Electro Mechanical to Microprocessor, L P Singh: Wiley Eastern.
9. Switchgear and protection by S S Rao: Khanna Pub

MTEL-104A	Intelligent Control						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	This course will look at different types of Intelligent controls.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand reasoning and apply the ANN models to different problems.						
CO2	Understand reasoning and apply the learning scheme to different problems.						
CO3	Understand reasoning and apply the Fuzzy system to different problems.						
CO4	Understand reasoning and apply the Genetic & PSO algorithm to different problems.						

Unit-1

ANN Models & Architecture:

Biological foundations, ANN models, Types of activation function, introduction to network architecture, multilayer feed forward network (MLFFN), Kohonen self-organizing map, radial basis Function network (RBFN), recurring neural network.

Unit-2

Learning Processes:

Supervised and unsupervised learning, error-correction learning, Hebbian learning, Boltzman learning, single layer and multilayer perception model, least mean square algorithm, back propagation algorithm, Application in forecasting and pattern recognition and other engineering problems.

Unit-3

Fuzzy Control System:

Fuzzy sets, fuzzy set operations, properties, membership functions, fuzzy to crisp conversion, measures of fuzziness, fuzzification and defuzzification methods, application in engineering problems. Simple fuzzy logic controllers with examples, special forms of fuzzy logic models, classical fuzzy control problems.

Unit-4

Genetic & PSO Algorithm:

Genetic Algorithm: Types of reproduction operators, crossover & mutation Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO) - Graph Grammer Approach - Example Problems

Suggested Books:

1. M. T. Hagon, Howard B. Demuth and Mark Beale, “Neural Network Design”, PWS Publishing.

2. Jacek M Zurada, “Introduction to Artificial Neural Systems”, Jaico Publishing House, Bombay.

3. Wasserman, “Neural Computing: Major Test and Practice”, Van Nastr and Reinhold.

4. Freeman “Neural Networks-Algorithms, application and programming techniques”, Pearson Education.

MTEL-106A	HVDC Transmission & FACTS Devices						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of HVDC and FACTS devices.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about HVDC transmission system.						
CO2	To acquaint students with the interaction of AC and DC system and various links.						
CO3	To impart knowledge to students about facts devices.						
CO4	To let student understand compensation system and control techniques.						

Unit 1

HVDC Transmission: Development of HVDC Technology, Selection of converter configuration. Rectifier and Inverter operation. Control of HVDC converters and Systems.

Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters.

Unit 2

Interaction between HVAC and DC systems – Voltage interaction, over voltages on AC/DC side, Harmonic instability problems and DC power modulation.

Multi-terminal DC links and systems; series, parallel and series parallel systems, their operation and control.

Unit 3

Introduction of Facts Concepts: Basic of flexible alternating current transmission system (FACTS) controllers, shunt, series, combined and other controllers, HVDC or FACTS, static VAR compensator (SVC) and static synchronous compensator (STATCOM), Static Synchronous Series Compensator (SSSC), Thyristor Controlled Series, Capacitor (TCSC). Solid State Contactors (SSC) and TSSC.

Unit 4

Combined Compensators: Introduction, Unified power flow controller (UPFC), conventional power control capabilities, real and reactive power flow control, comparison of UPFC to series compensators, control structure, dynamic performance. Interline power flow controller (IPFC) basic operating principles, control structure, application considerations.

Suggested Books:

1. Hingorani N.G, "Understanding FACTS (Concepts and Technology of Flexible AC Transmission System)", Standard Publishers.
2. Song Y.H. and Johns A.T., "Flexible AC Transmission Systems", IEEE Press.
3. Ghosh A. and Ledwich G., "Power Quality Enhancement using Custom Power Devices", Kluwer Academic Publishers.
4. Mathur R.M. and Verma R.K., "Thyristor based FACTS controllers for Electrical Transmission Systems", IEEE Press.
5. Bollen M.H.J., "Understanding Power Quality and Voltage Sag", IEEE Press.
6. Padiyar K.R., "FACTS Controllers in Power Transmission and Distribution", New Age International Publisher.
7. Miller T.J.E., "Reactive Power Control in Electric Systems", John Wiley.
8. Kamakshaiah S, Kamaraju V, "HVDC Transmission", McGraw Hill Education.

MTEL-108A	Transients in Power System						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of transients in power system.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about different types of factors effecting power quality.						
CO2	To acquaint students with the transients and lightning.						
CO3	To impart knowledge to harmonics.						
CO4	To let student understand about distributed generation and various issues related to power quality.						

UNIT-1

What is Power Quality, Power Quality is Equal to Voltage Quality, Why are we concerned about Power Quality, Voltage Imbalance, Waveform Distortion, Voltage Fluctuation, Power Frequency Variations, Power Quality Terms, Sources of Sags and Interruption, Estimating Voltage Sag Performance, Area of Vulnerability, Equipment Sensitivity of Voltage Sags, Transmission Systems Sag Performance Evaluation, Utility Distribution System Sag Performance Evaluation.

UNIT-2

Sources of Transient Overvoltage's: Capacitor Switching, Restrike during Capacitor De-energizing, Lightning, Ferro - resonance, Other Switching Transients. Principles of Overvoltage Protection.
Devices for Overvoltage Protection: Surge Arresters and Transient Voltage Surge Suppressor, Isolation Transformers, Utility System Lightning Protection, Shielding, Line Arresters, Low Side Surges, Cable Protection, Scout Arrester Scheme, Computer Tools for Transient Analysis.

UNIT-3

Fundamentals of Harmonics: Harmonic Distortion, Voltage vs Current Distortion, Harmonics vs Transients, Power System Quantities Under Non Sinusoidal Conditions, Active, Reactive and Apparent Power, Power Factor: Displacement and True, Harmonic Phase Sequences, Triplen Harmonics.
Harmonic Sources from Commercial Loads: Single Phase Power Supplies, Fluorescent Lighting, Adjustable Speed Drives for HVAC and Elevators.
Effects of Harmonic Distortion: Impact on Capacitors, Impact on Transformers, Impact on Motors, Impact on Telecommunications, Impact on Energy and Demand Metering.

UNIT-4

Distributed Generation and Power Quality: Resurgence of DG, Perspectives on DG Benefits, Perspectives on Interconnection, DG Technologies, Fuel Cells, Wind Turbines, Photovoltaic Systems, Interface to the Utility System, Synchronous Machines, Asynchronous Machines, Electronic Power Inverters, Power Quality Issues, Voltage Regulation, Harmonics, Voltage Sags, Operating Conflicts, Voltage Regulation Issues, Islanding, Transformer Connections.

Suggested Books:

1. R C Dugan, M F McGranaghan, S Santoso, H. Wayne Beaty, "Electrical Power System Quality", McGraw Hill.
2. Akihiro Ametani, Naoto Nagaoka, Yoshihiro Baba, Teruo Ohno, "Power System Transients: Theory and Applications", CRC Press.
3. L.V. Bewley, "Traveling waves in Transmission Systems", Dover.
4. R. Rudenberg, "Electric Stroke waves in Power Systems", Harvard University Press, Cambridge, Massachusetts.
5. Allan Greenwood, "Electric Transients in Power Systems", Wiley Interscience.
6. CS Indulkar and DP Kothari, "Power System Transients, Statistical Approach", PHI Pvt Ltd., New Delhi.
7. VA Venikov, "Transient phenomena in Electrical Power Systems", Pergamon Press, London.
8. Klaus Ragaller, "Surges in High Voltage Networks", Plenum Press, New York.
9. Pritindra Chowdhari, "Electromagnetic transients in Po r System", John Wiley and Sons Inc.
10. Naidu M S and Kamaraju V, "High Voltage Engineering", TMH Publishing Company Ltd., New Delhi.

MTEL-110A	Advanced Power Distribution & Automation						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of electricity distribution and automation.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about distribution automation.						
CO2	To acquaint students with the control and intelligent system in distribution automation.						
CO3	To impart knowledge to students about renewable energy resources and distribution management.						
CO4	To let student understand communication system implementation in distribution system.						

UNIT-1

Introduction: General Concept, Distribution of Power, Power Loads, Connected Loads.
Load Forecasting: Concept of Statistics, Regression Analysis, Correlation Theory, Factor in Power System Loading, Unloading the System, Forecast of System peak.

UNIT-2

System Planning: Planning Process, Basic Principle in system planning, System Development, Overview of Distributed generation, Different types of mapping: Global positioning System GPS, Automated mapping AM/Facility Management FM.
Introductory Methods in Power System Planning: Per Unit Calculation, Matrix Algebra, Symmetrical Components, Overview of Load Flow, Automated Planning: software needs, Data, solution techniques (Gauss Iterative method, Gauss seidel iterative method, Newton Raphson iterative method, Improved newton Raphson method) Effect of Abnormal Loads.

UNIT-3

Brief introduction of Distribution Automation, Role of PLC & SCADA in substation and distribution automation, Consumer information Service (CIS), Geographical information system GIS, Automatic meter Reading (AMR), Automation System.

UNIT-4

Metering System: Different types of Meter, Metering system component, Ferraris Meters, Solid state meters, Advance meter Infrastructure Systems (AMI).
Overview of Net metering, Meter current Rating, Prepaid Electricity meters, Meter selection and Location, testing methods.

Suggested Books:

1. A. S Pabla, “Electric Power Distribution”, McGraw Hill Education.
2. James A. Momoh, “Electric Power Distribution Automation Protection and Control”, CRC Press.
3. James N-Green and R Wilson, “Control and Automation of electric Power Distribution Systems”, CRC Press.
4. Turan Gonen,“Electric Power Distribution System Engineering”, CRC Press.
5. Abdelhay A. Sallam, “Electric Distribution Systems”,Wiley-IEEEPress.

MTEL-112A	Digital Control System						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of digital control system.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about signal processing in digital control system.						
CO2	To acquaint students with the control devices and systems.						
CO3	To impart knowledge to students about state variables, controllability and observability.						
CO4	To let student understand the various concepts of digital observers.						

Unit-1

Signal Processing in Digital Control: Basic digital control scheme, principle of signal conversion, basic discrete-time signal, time-domain model for discrete-time systems, z-transform, transfer function models, jury stability criterion, sample and hold systems, sample spectra and aliasing

Unit-2

Models of Digital Control Devices and Systems: Introduction, z-domain description of sampled continuous-time plants, z-domain description of systems with dead-time, implementation of digital controllers, digital PID controllers, digital temperature control system, stepping motors and their control, PLC

Unit-3.

Analysis using State Variable Methods: State variable representation-concepts, modeling, transformation, state diagrams, Jordan canonical form, Eigen values and Eigenvectors,

Solution of state equations, concepts of controllability and Observability,

Unit-4

Digital Observers: State regulator design-full order and reduced order state observer, design of state observers, compensator design by separation principle, state feedback with integral control , deadbeat control by state feedback and deadbeat observers

Suggested Books:

1. Ogata K," Discrete time Control Systems", Pearson Education.

2. Nagrath and Gopal, "Control System Engineering", New Age International.

3. Kuo B C, "Digital Control Systems", Oxford University Press.

4. Goapl, "Digital Control & State Variable Method", McGraw Hill Education.

MTEL-114A	Advanced Microprocessors						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of advanced microprocessor.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about 8086 microprocessors.						
CO2	To acquaint students with the interfacing converters etc.						
CO3	To impart knowledge to students about microcontrollers.						
CO4	To let student about application of microprocessor and various controllers related to it.						

UNIT-1

Architecture of 8086 microprocessor, Memory Addressing, Bus Timings for MN/MX mode, interrupt structure. Memory Interfacing and Addressed encoding techniques for 8086 microprocessor

UNIT-2

Addressing modes, Instruction set and application programs, Assembler Directives, Programming Techniques using TASM, Interfacing D/A and A/D converters using programmable I/O devices, Interfacing Stepper motor. Architecture of INTEL X86 Family: CPU block diagrams, Pin diagrams and internal descriptions of 80286, 386, 486 and Pentium Processor, Instruction formats.

UNIT-3

Introduction to micro controllers, Architecture of 8051microcontroller, basic Instruction set, programming, serial data communication, inter facing with D/A and A/D converters.

UNIT-4

Application of Microprocessors, A Microcomputer-based Industrial Process-control System, Hardware for Control Systems and Temperature Controller, Overview of Smart-Scale Operation.

Suggested Books:

1. Hall D V, “Microprocessors & Interfacing”, McGraw Hill Education.
2. Brey B, “The Intel Processors”, Pearson Education.
3.Gibson, “Microprocessors”,, Prentice Hall of India.
4. Jean Loup Baer, “Microprocessor Architecture”, Cambridge University Press.
5. Ayala K J, “Micro Controller”, Penram International

MTEL-116A	Reliability Engineering						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the concept of Reliability Engineering and its application in Engineering**.**						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To emphasize and analysis of basic of reliability engineering.						
CO2	To understand the concept of Fault tree analysis in reliability.						
CO3	To understand the concept of Maintainability Analysis in reliability.						
CO4	To study the concept of Artificial Intelligence in reliability engineering.						

Unit-1

Review of basic concepts in Reliability Engg., Reliability function, different reliability models, etc. Reliability evaluation techniques for complex systems; Tie set and cut set approaches, different reliability measures, Reliability allocation/apportionment, reliability improvement, redundancy optimization techniques.

Unit-2

Fault tree analysis: fault tree construction, simplification and evaluation, importance measures, modularization, applications, advantages and disadvantages of fault tree techniques.

Unit-3

Maintainability Analysis: measures of system performance, types of maintenance, reliability centred maintenance, reliability and availability, evaluation of engine ring systems using Markov models.

Unit-4

Applications of fuzzy Major Test and neural networks to Reliability Engineering. Reliability testing, design for reliability and maintainability. Typical reliability case studies.

Suggested Books:

1. R. Rama Kumar, “Engineering Reliability”, Prentice Hall.
2. K B Mishra, “Reliability Analysis & Prediction”.
3. K B Mishra, “New trends in System Reliability Evaluation”.
4. M L Shooman, “Probabilistic reliability–an engineering approach”, R E Krieger Pub.
5. K K Aggarwal, “Reliability Engineering”.
6. Roy & Billington, “Reliability Engineering”.
7. Balagurswami, “Reliability Engineering”, McGraw Hill Education.

MTEL-118A	Modelling & Simulation Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of modelling and simulation of different types of applications.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about to preform Thevenin's ,Norton's,& Superposition theorem and Avg. & R. M. S. value of R L C different R, L and C circuit.						
CO2	To impart knowledge about to preform half and full wave rectifier with different R, L and C load for both single and three phase.						
CO3	To impart knowledge about to preform different types of power electronics component mainly inverter and chopper.						
CO4	To impart knowledge about to preform speed and torque control of DC and AC motors.						

Following experiments (at least 10) are required to be performed in MATLAB/ETAP/LabView or equivalent.

1. To verify Thevenin's, Norton's & Superposition theorem.
2. To find Average & RMS value of (V-I) of RLC series & parallel; series parallel RC-RL circuit.
3. To perform1-ϕ (half & full) wave rectifier with (R, R-L & R-C) load.
4. To perform 3-ϕ (half & full) wave rectifier with (R, R-L & R-C) load.
5. To find Average RMS.&T.H.D. of 1-ϕ (half & full) wave inverter with (R & R-L) load.
6. To find Avg., R.M.S.&T.H.D. of 3-ϕ (half & full) wave inverter with (R & R-L) load.
7. To perform current source inverter (C.S.I.) & PWM inverter.
8. To perform step down (BUCK)& step up (BOOST) chopper.
9. To perform Type (A, B, C & D) chopper.
10. To perform Field & Armature control of separately excited DC motor.
11. To perform Field & Armature control of DC series & DC shunt motor.
12. To perform 3-ϕ Induction Motor with constant & variable torque.
13. To perform speed control of 3-ϕ Synchronous motor with constant & variable torque.

MTEL-120A	Advanced Power System Lab-II						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of programing for various types of power system appliances.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge the simulation& analysis of the generator and transformer protection.						
CO2	To impart knowledge the simulation& analysis of power quality improvement, different types of load.						
CO3	To impart knowledge the simulation& analysis of PV cell.						
CO4	To impart knowledge the simulation& analysis of different non-conventional plant biomass gasifier and wind turbine.						

Following experiments are required to be performed in MATLAB/ETAP/LabView or equivalent.

1. Simulation & Analysis of the generator protection.
2. Simulation & Analysis of the transformer protection.
3. Simulation & Analysis of power quality improvement.
4. Simulation & Analysis of different types of relays in power system.
5. To perform the simulation of Photo-Electric Effect.
6. To perform the simulation to construct the PV cell to show the V-I & P-V characteristics curve of it.
7. ToperformthesimulationofPhotovoltaicpowerconversionforsingleand3-phase load on account with MPPT.
8. To perform the construction of a Simulink model of Biomass Gasifier.
9. To study mathematical modelling of DFIG based Wind Turbine and its impact on connection with grid.
10. To perform the simulation of Permanent Magnet Synchronous Generator (PMSG) based wind energy conversion system.
11. To perform the simulation of PV-Grid inter connection using MPPT technique with the partial shading effect.

MTEL-201A	Distributed Generation						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	To understand renewable energy sources. To gain understanding of the working of off-grid and grid-connected renewable energy generation schemes.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To understand the planning and operational issues related to Distributed Generation.						
CO2	Acquire Knowledge about Distributed Generation Learn Micro-Grids						
CO3	understand renewable energy sources						
CO4	Understanding of the working of off-grid and grid-connected renewable energy generation schemes.						

UNIT-1

Need for Distributed generation. Renewable sources in distributed generation and current scenario in Distributed Generation. Introduction to micro-grids. Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids. Modelling & analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units.

UNIT-2

Planning of DGs. Sitting and sizing of DGs optimal placement of DG sources in distribution systems. Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine based interfaces. Aggregation of multiple DG units.

UNIT-3

Technical impacts of DGs. Transmission systems Distribution Systems De-Regulation Impact of DGs upon protective relaying. Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis...

UNIT-4

Economic and control aspects of DGs Market facts. Issues and challenges Limitations of DGs, Voltage control techniques. Reactive power control, Harmonics Power quality issues, Reliability of DG based systems.

Suggested reading:

1. H. Lee Willis, Walter G. Scott, “Distributed Power Generation – Planning and Evaluation”, Marcel Decker Press.
2. M Godoy Simoes, Felix A. Farret, “Renewable Energy Systems – Design and Analysis with Induction Generators”, CRC press.
3. Stuart Borlase. “Smart Grid: Infrastructure Technology Solutions” CRC Press

MTEL-203A	ELECTRIC DRIVES & CONTROL						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of electric drives & control in electric system.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To study basic electric drives, types of loads, classes of motor duty.						
CO2	To study different types of DC drives, stability analysis, modern control techniques.						
CO3	To study mathematical modelling of induction motor drives, introduction to Cyclo-converter fed induction motor drive.						
CO4	To study different types of synchronous motor drives used in mills.						

UNIT 1

Introduction: Definition, Part of the electric drive, Types of loads, steady state & transient stability of Drive, state of art of power electronics and drives, thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating.

UNIT 2

D.C. Drives: Review of braking and speed control of D.C. motors, multi-quadrant operation, loss minimization in adjustable speed drives. Mathematical modelling of dc drives, stability analysis, modern control techniques: variable structure, adaptive control, Chopper-Controlled DC Drives.

UNIT 3

Induction motor drives: Review of braking and speed control of induction motors, constant V/F, constant air gap flux, controlled voltage, controlled current and controlled slip operation. Mathematical modelling of induction motor drives, transient response and stability analysis Introduction to Cyclo-converter fed induction motor drive. Pulse Width Modulation for Electric Power Converters

UNIT 4

Synchronous motor drives: Adjustable frequency operation, voltage fed drive, current fed self-controlled drive. Application of electric drives in steel mills, paper mills, textile mills and machine tools etc. A. C. motor drives in transportation system and traction.

Suggested Books:

1. Dubey G K, “Fundamentals of Electrical Drives”, Narosa Publishing House, New Delhi.

2. S K Pillai, “A First Course on Electrical Drives”, New Age International (P) Ltd., New Delhi.

3. Krishan R, “Electric Motor Drives: Modeling Analysis and Control”, PHI Pvt Ltd. New Delhi-2001.

4. Bose B K, “Power Electronics and Variable Frequency Drives: Technology and Applications”, IEEE Press, 1997.

5. Bose B K , “Modern Power Electronics and AC Drives”, Pearson Educational, Delhi,

MTEL-205A	Power System Restructuring & Deregulation						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of restructuring and deregulation.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about restructuring and its various issues related to it.						
CO2	To acquaint students with the deregulation and market models.						
CO3	To impart knowledge to students about transmission pricing.						
CO4	To let student understand in detail about congestion management and experiences of various nations.						

Unit-1

Introduction: Basic concept and definitions, privatization, restructuring, transmission open access, wheeling, deregulation, components of deregulated system, advantages of competitive system.

Power System Restructuring: An overview of the restructured power system, Difference between integrated power system and restructured power system, Explanation with suitable practical examples.

Unit-2

Deregulation of Power Sector: Separation of owner ship and operation, Deregulated models, pool model, pool and bilateral trades model, multilateral trade model.

Competitive electricity market: Independent System Operator activities in pool market, Wholesale electricity market characteristics, central auction, single auction power pool, double auction power pool, market clearing and pricing, Market Power and its Mitigation Techniques, Bilateral trading, Ancillary services.

Unit-3

Transmission Pricing: Marginal pricing of Electricity, nodal pricing, zonal pricing, embedded cost, Postage stamp method, Contract Path method, Boundary flow method, MW-mile method, MVA-mile method, Comparison of different methods.

Unit-4

Congestion Management: Congestion management in normal operation, explanation with suitable example, total transfer capability (TTC), Available transfer capability (ATC), Different Experiences in deregulation: England and Wales, Norway, China, California, New Zealand and Indian power system.

Suggested Books:

1.LoiLei Lai, "Power System Restructuring and Deregulation", John Wiley & Sons Ltd.

2.K Bhattacharya, M H T Bollen and J C Doolder, " Operation of Restructured Power Systems", Kluwer Academic Publishers.

3.Lorrin Philipson and H Lee Willis, "Understanding Electric Utilities and Deregulation", Marcel Dekker Inc, New York.

4.Yong-Hua Song, Xi-Fan Wang, "Operation of market-oriented power systems" ,Springer, Germany.

MTOE-201A	Business Analytics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes (CO)							
CO1	*Able to have knowledge of various business analysis techniques.*						
CO2	*Learn the requirement specification and transforming the requirement into different models.*						
CO3	*Learn the requirement representation and managing requirement assests.*						
CO4	*Learn the Recent Trends in Embedded and collaborative business*						

Unit 1

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.

Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit 2

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.

Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit 3

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements.

Managing Requirements Assets: Change Control, Requirements Tools

Unit 4

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

References:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

MTOE-203A	Industrial Safety						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the industrial safety.*						
Course Outcomes (CO)							
CO1	*Understand the industrial safety.*						
CO2	*Analyze fundamental of maintenance engineering.*						
CO3	*Understand the wear and corrosion and fault tracing.*						
CO4	*Understanding that when to do periodic inceptions and apply the preventing maintenance.*						

Unit-1

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-2

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-3

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-4

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

MTOE-205A	Operations Research						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enable students to aware about the dynamic programming to solve problems of discreet and continuous variables and model the real world problem and simulate it.						
Course Outcomes (CO)							
CO1	*Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.*						
CO2	*Students should able to apply the concept of non-linear programming*						
CO3	*Students should able to carry out sensitivity analysis*						
CO4	*Student should able to model the real world problem and simulate it.*						

Unit -1

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit -2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit- 3

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit -4

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

MTOE-207A	Cost Management of Engineering Projects						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to make aware about the cost management for the engineering project and apply cost models the real world projects.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the strategic cost management process.*						
CO2	*Students should able to types of project and project team types*						
CO3	*Students should able to carry out Cost Behavior and Profit Planning analysis.*						
CO4	*Student should able to learn the quantitative techniques for cost management.*						

Unit-1

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-2

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit-3

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-4

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

MTOE-209A	Composite Materials						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the composite materials and their properties.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification and characteristics of Composite materials.*						
CO2	*Students should able reinforcements Composite materials.*						
CO3	*Students should able to carry out the preparation of compounds.*						
CO4	*Student should able to do the analysis of the composite materials.*						

UNIT–1:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Iso-strain and Iso-stress conditions.

UNIT – 2

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–3

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – 4

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

MTOE-211A	Waste to Energy						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the generation of energy from the waste.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification of waste as a fuel.*						
CO2	*Students should able to learn the Manufacture of charcoal.*						
CO3	*Students should able to carry out the designing of gasifiers and biomass stoves.*						
CO4	*Student should able to learn the Biogas plant technology.*						

Unit-1

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-2

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-3

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-4

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

MTAD-101A	English For Research Paper Writing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Student will able to understand the basic rules of research paper writing.*						
Course Outcomes (CO)							
CO1	*Understand that how to improve your writing skills and level of readability*						
CO2	*Learn about what to write in each section*						
CO3	*Understand the skills needed when writing a Title*						
CO4	*Ensure the good quality of paper at very first-time submission*						

Unit 1

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit 2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit 3

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit 4

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

MTAD-103A	Disaster Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Develop an understanding of disaster risk reduction and management*						
Course Outcomes (CO)							
CO1	*Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.*						
CO2	*Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.*						
CO3	*Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.*						
CO4	*critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in*						

Unit 1

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit 2

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit 3

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit 4

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

References:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

MTAD-105A	Sanskrit for Technical Knowledge						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Students will be able to Understanding basic Sanskrit language and Ancient Sanskrit literature about science & technology can be understood and Being a logical language will help to develop logic in students*						
Course Outcomes (CO)							
CO1	*To get a working knowledge in illustrious Sanskrit, the scientific language in the world*						
CO2	*Learning of Sanskrit to improve brain functioning*						
CO3	*Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power*						
CO4	*The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature*						

Unit –1

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit – 2

Order, Introduction of roots,Technical information about Sanskrit Literature

Unit –3

Technical concepts of Engineering: Electrical, Mechanical

Unit –4

Technical concepts of Engineering: Architecture, Mathematics

References

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

MTAD-107A	Value Education						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand value of education and self- development, Imbibe good values in students and Let the should know about the importance of character*						
Course Outcomes (CO)							
CO1	*Knowledge of self-development*						
CO2	*Learn the importance of Human values*						
CO3	*Developing the overall personality*						
CO4	*Know about the importance of character*						

Unit 1

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.

Unit 2

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature,Discipline

Unit 3

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

Unit 4

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

References

1.Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

MTAD-102A	Constitution of India						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.*						
Course Outcomes (CO)							
CO1	*Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*						
CO2	*Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*						
CO3	*Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.*						
CO4	*Discuss the passage of the Hindu Code Bill of 1956.*						

Unit I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features

Unit 2

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality , Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive , President, Governor , Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit 3

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit 4

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

MTAD-104A	Pedagogy Studies						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers and Identify critical evidence gaps to guide the development*.						
Course Outcomes (CO)							
CO1	*What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?*						
CO2	*What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?*						
CO3	*How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?*						
CO4	*What is the importance of identifying research gaps?*						

Unit 1

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology , Theories of learning, Curriculum, Teacher education., Conceptual framework, Research questions. Overview of methodology and Searching. Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. , Curriculum, Teacher education.

Unit 2

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 3

Professional development: alignment with classroom practices and follow-up support, Peer support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes,

Unit 4

Research gaps and future directions: Research design, Contexts , Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

References

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

MTAD-106A	Stress Management by Yoga						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To achieve overall health of body and mind and to overcome stress						
Course Outcomes (CO)							
CO1	*Develop healthy mind in a healthy body thus improving social health.*						
CO2	*Improve efficiency*						
CO3	*Learn the Yog asan*						
CO4	*Learn the pranayama*						

Unit – 1

Definitions of Eight parts of yog (Ashtanga).

Unit- 2

Yam and Niyam, Do`s and Don't's in life; Ahinsa, satya, astheya, bramhacharya and aparigraha; Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit- 3

Asan and Pranayam, Various yog poses and their benefits for mind & body,

Unit- 4

Regularization of breathing techniques and its effects-Types of pranayam.

References

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

MTAD-108A	Personality Development through Life Enlightenment Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To learn to achieve the highest goal happily To become a person with stable mind, pleasing personality and determination To awaken wisdom in students						
Course Outcomes (CO)							
CO1	*Students become aware about leadership.*						
CO2	*Students will learn how to perform his/her duties in day to day work.*						
CO3	*Understand the team building and conflict*						
CO4	*Student will learn how to become role model for the society.*						

Unit – 1

Neetisatakam-Holistic development of personality: Verses: 19, 20, 21, 22 (wisdom); Verses: 29, 31, 32 (pride & heroism); Verses: 26, 28, 63, 65 (virtue); Verses: 52, 53, 59 (don's); Verses: 71, 73, 75, 78 (do's).

Unit – 2

Approach to day to day work and duties; Shrimad Bhagwad Geeta: Chapter-2: Verses: 41, 47, 48; Chapter-3: Verses: 13, 21, 27, 35; Chapter-6: Verses: 5, 13, 17, 23, 35; Chapter-18: Verses: 45, 46, 48.

Unit - 3

Statements of basic knowledge; Shrimad Bhagwad Geeta: Chapter-2: Verses: 56, 62, 68; Chapter-12: Verses: 13, 14, 15, 16, 17, 18.

Unit – 4

Personality of Role model; Shrimad Bhagwad Geeta: Chapter-2: Verses: 17; Chapter-3: Verses: 36, 37, 42: Chapter-4: Verses: 18, 38, 39; Chapter-18: Verses: 37, 38, 63.

References:

1. Srimad Bhagavad Gita, Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya), P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Dissertation Phase – I and Dissertation Phase - II

Teaching Scheme

Lab work : 20 and 32 hrs/week for Dissertation Phase- I (MTEL-207A)and Phase- II (MTEL-202A) respectively

Course Outcomes:
At the end of this course, students will be able to

a. Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
b. Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
c. Ability to present the findings of their technical solution in a written report. Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:
The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

1. Relevance to social needs of society
    - Relevance to value addition to existing facilities in the
    - Relevance to industry need
2. Problems of national importance
3. Research and development in various domain
4. The student should complete the following:
    - Literature survey Problem
    - D efinition Motivation for study and Objectives
    - Preliminary design / feasibility / modular approaches
    - Implementation and Verification
5. Report and presentation

The dissertation phase- II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

Experimental verification / Proof of concept.

Design, fabrication, testing of Communication System.

The viva-voce examination will be based on the above report and work.

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Guidelines for Dissertation Phase – I and Phase-II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referredliterature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

KURUKSHETRA UNIVERSITY, KURUKSHETRA

('A+' Grade, NAAC Accredited)

SCHEME OF EXAMINATIONS FOR
MASTER OF TECHNOLOGY IN
ELECTRICAL POWER SYSTEM (w. e. f. 2018-19)

SEMESTER-I										
Sr. No.	**Course Code**	**SUBJECT**	L	T	P	**Total**	**Minor Test**	**Major Test**	**Cr.**	**Duration of Exam (Hrs.)**
1	MTEL-101A	Advanced Power System Analysis	3	-	-	3	40	60	3	3
2	MTPS-103A	EHV-AC Transmission System	3	-	-	3	40	60	3	3
3	*	Program Elective-I	3	-	-	3	40	60	3	3
4	**	Program Elective-II	3	-	-	3	40	60	3	3
5	MTPS-117A	Power Electronics and Drives Lab	-	-	4	4	40	60	2	3
6	MTEL-119A	Advanced Power System Lab-I	-	-	4	4	40	60	2	3
7	MTRM-111A	Research Methodology and IPR	2	-	-	2	40	60	2	3
8	***	Audit Course-I	2	-	-	2	-	-	-	-
		Total	**16**		**8**	**24**	**280**	**420**	**18**	

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2. *** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

SEMESTER-II

Sr. No.	Course Code	Subject	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTPS-102A	Power system operation & control	3	-	-	3	40	60	3	3
2	MTPS-104A	Power System Protection & Relaying	3	-	-	3	40	60	3	3
3	*	Program Elective-III	3	-	-	3	40	60	3	3
4	**	Program Elective-IV	3	-	-	3	40	60	3	3
5	MTPS-118A	Power System Protection Lab	-	-	4	4	40	60	2	3
6	MTEL-120A	Advanced Power System Lab-II	-	-	4	4	40	60	2	3
7	#MTEL-122A	Mini Project	-	-	4	4	100	-	2	3
8	***	Audit Course-II	2	-	-	-	-	-	-	-
		Total	**14**		**12**	**26**	**340**	**360**	**18**	

*PROGRAM ELECTIVES - III		
1.	MTEL-106A	HVDC Transmission & FACTS Devices
2.	MTEL-108A	Transients in Power System
3.	MTEL-110A	Advanced Power Distribution & Automation

**PROGRAM ELECTIVE – IV		
1.	MTEL-112A	Digital Control System
2.	MTEL-114A	Advanced Microprocessors
3.	MTEL-116A	Reliability Engineering

*** AUDIT COURSE–II		
1.	MTAD-102A	Constitution of India
2.	MTAD-104A	Pedagogy Studies
3.	MTAD-106A	Stress Management by Yoga
4.	MTAD-108A	Personality Development through Life Enlightenment Skills

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

Note 2. *** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

#Note3: Mini project: During this course the student will be able to understand the contemporary/emerging technologies for various processes and systems. During the semester, the students are required to search/gather the material/information on a specific topic, comprehend it and present/discuss the same in the class. He/she will be acquainted to share knowledge effectively in oral

SEMESTER-III										
Sr. No.	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Minor* Test**	**Major Test**	**Cr.**	**Duration of Exam (Hrs.)**
1	*	Program Elective-V	3	-	-	3	40	60	3	3
2	**	Open Elective	3	-	-	3	40	60	3	3
3	MTPS-207A	Dissertation Phase-I	-	-	20	20	100	-	10	--
		Total	**6**		**20**	**26**	**180**	**120**	**16**	

(seminar) and written form (formulate documents) in the form of report. The student will be evaluated on the basis of viva/ seminar (40 marks) and report (60 marks).

*** PROGRAM ELECTIVE - V**		
1.	MTEL-201A	Distributed Generation
2.	MTEL-203A	Electric Drives & Control
3.	MTEL-205A	Power System Restructuring & Deregulation

**** OPEN ELECTIVE**		
1.	MTOE-201A	Business Analytics
2.	MTOE-203A	Industrial Safety
3.	MTOE-205A	Operation Research
4.	MTOE-207A	Cost Management of Engineering Projects
5.	MTOE-209A	Composite Materials
6.	MTOE-211A	Waste to Energy

SEMESTER-IV

Sr. No.	**Course Code**		**L**	**T**	**P**	**Total**	**Minor Test**	**Major Test**	**Cr.**	**Duration of Exam (Hrs.)**
1	MTPS-202A	Dissertation Phase-II	-	-	32	-	100	200	16	--
						Total	**100**	**200**	**16**	

Total Credits – 68

Note 1: At the end of the second semester each student is required to do his/her Dissertation work in the identified area in consent of the Guide/Supervisor. Synopsis for the Dissertation Part-I is to be submitted within three weeks of the beginning of the Third Semester.

Note 2: Each admitted student is required to submit the report of his/her Dissertation Part-I as per the schedule mentioned in Academic calendar for the corresponding academic session otherwise the Dissertation Part-II cannot be continued at any level.

Note 3: Each admitted student is required to submit his/her final Dissertation Part-II as per the schedule mentioned in Academic calendar for the corresponding academic session only after the publication of two papers in a journal/International/National conference of repute like IEEE, Springer, Elsevier, ACM and UGC Approved Journals etc.

Note 4: The course of program/open elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

MTEL-101A	Advanced Power System Analysis						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	To enable students to analyse power system networks, various faults, load flow study, security and contingency analysis.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand matrices related to power system and its formation with different methods.						
CO2	Understand how to analyze various types of faults in power system						
CO3	Study various methods of load flow and their advantages and disadvantages						
CO4	Understand need of power system security, state estimation and contingency analysis						

UNIT1

Network Modelling: System graph, loop, cut set and Incidence matrices, Primitive network and matrix, Formation of various network matrices by singular transformation.

Bus Impedance Algorithm: Singular transformation, direct inspection, Building Block algorithm for bus impedance matrix, Addition of links, addition of branches, (considering mutual coupling).

UNIT2

Balanced and unbalanced network elements: Representation of three phase network elements, representation under balanced and unbalanced excitation, transformation matrices, symmetrical components, sequence impedances, unbalanced elements and three phase power invariance.

Short circuit studies: Network representations for single line to ground fault, line to line fault, LL-G fault, and 3-phase faults, Short circuit calculations for various types of faults in matrix form.

UNIT3

Load flow studies: Load flow and its importance. Classification of buses, load flow techniques, Iterative solutions and computer flow charts using Gauss-Seidel and Newton-Raphson methods, Decoupled and fast decoupled methods, Representation of regulating and off nominal ratio transformers and modification of Y_{bus}.

UNIT4

Power system security: Introduction to Power system security, Addition and removal of multiple lines, network reduction for contingency analysis, current injection, shift destitution factor, single outage contingency analysis.

State estimation in power systems: data acquisition system, Method of least-squares, State estimation by weighted least square technique.

Suggested Books:

1. Stagg G W, EI-Abaid A H, "Computer methods in Power system analysis", McGraw Hill.
2. Singh L P, "Advanced Power System Analysis and Dynamics", New Age, Int. Publication.
3. Ramana N V, "Power System Analysis", Pearson Education.
4. Nagsarkar T K, Sukhija M S, "Power System Analysis", Oxford University Press.
5. Uma Rao K, "Computer Techniques and Models in Power System", IK Publications.
6. Grainger J J, Stevenson W D, "Power System Analysis", McGraw Hill.
7. Allen Wood, Bruce Wollenberg, "Power Generation operation & control", John Wiley & Sons.
8. Nagrath I J, Kothari D P, "Power System Engineering" McGraw Hill, New York.
9. Pai M A, "Computer Techniques in Power System Analysis", 2nd Edition, TMH-New Delhi.

MTPS-103A	EHV- AC TRANSMISSION SYSTEM						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	This course will look at Transmission of power at extra high level of voltage						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand Role of EHV AC Transmission.						
CO2	Understand concept of corona, its causes , effects and remedies						
CO3	To study Origin of over voltages and their types						
CO4	To study Power frequency over voltages						

Unit 1

Introduction: Role of EHV AC Transmission, standard transmission voltages, average value of line parameters, power handling capacity. Line parameters, Properties of bundled conductors, Resistance, Inductance and Capacitance of bundled conductor lines. Temperature rise of conductors and current carrying capacity.

.

. **Unit 2**

Voltage gradients on conductors: Charge potential relations for multi-conductor lines, surface voltage gradient on conductors, distribution of voltage gradient on sub conductors of bundle. Corona Effects, Corona loss, attenuation of traveling waves, audible noise, limits for audible noise, AN measurement and meters, Day night equivalent noise level.

Unit 3

Limits for radio interference fields: RI excitation function, measurements of RI, RIV, Excitation function. Switching Over voltages: Origin of over voltages and their types, over voltages due to interruption of low inductive current and interruption of capacitive currents, Reduction of switching surges on EHV systems.

Unit 4

Power frequency over voltages: Problems at power frequency, no-load voltage conditions and charging current, voltage control using synchronous condensers, sub synchronous resonance in series-capacitor compensated lines, state reactive compensating schemes.

Operational aspects of Power flow: Line load ability, effects of over load, reactive power limitations and over voltage problem.

Suggested Books:

1. Begamudre, "EHV AC Transmission engineering", Wiley Easter Ltd. 2nd Ed.

2. Edison Electric Institute, "EHV transmission reference book", GE Co.

3. EPRI, Palo Alto, "Transmission line reference book 345 KV".

4. Rudenberg, "Transient performance of electric power systems" McGraw Hill

MTEL-105A	Renewable Energy Resources						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of renewable energy resources and different factors related to them.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about renewable energy resources and solar power system.						
CO2	To acquaint students with the phenomenon of wind power system and its applications with grid.						
CO3	To impart knowledge to students about geothermal and ocean power system.						
CO4	To let student understand fuel cell, hydrogen and hybrid energy system.						

Unit 1

ENERGY RESOURCES: Renewable energy sources, distributed energy systems and dispersed generation, atmospheric aspects of electric energy generation, Impact of renewable energy generation on environment

SOLAR ENERGY: Solar Radiation and its Measurement, Solar Thermal Energy Collectors: different types of collectors and their performance analysis, Solar Thermal Energy Conversion System: solar water heater, solar distillation, slat thermal power plant and various applications of solar system, Solar Photovoltaic System: solar cell, VI characteristics, solar electricity and grid and off-grid solar system.

Unit 2

WIND ENERGY: Wind turbines and rotors, Wind Energy Extraction, Wind Characteristics, Power Density Duration Curve, Design of Wind Turbine Rotor, Design of Regulating System for Rotor, Wind Power Generation Curve, Sub-systems of a Horizontal Axis Wind Turbine Generator, Modes of Wind Power Generation, Estimation of Wind Energy Potential, Selection of Optimum Wind Energy Generator (WEG), Grid Interfacing of a Wind Farm, Methods of Grid Connection, Grid System and Properties, Capacity of Wind Farms for Penetration into Grid, Control System for Wind Farms, Economics of Wind Farms

Unit 3

GEOTHERMAL ENERGY: Structure of the Earth's Interior, Plate Tectonic Major Test, Geothermal Sites, Geothermal Field, Geothermal Gradients, Geothermal Resources, Geothermal Power Generation, Geothermal Electric Power Plant, Geothermal-Preheat Hybrid with Conventional Plant

OCEAN ENERGY: Development of a Tidal Power Scheme, Grid Interfacing of Tidal Power, Wave Energy, Mathematical Analysis of Wave Energy, Empirical Formulae on Wave Energy, Wave Energy Conversion, Principle of Wave Energy plant, Wave Energy Conversion Machines.

Unit 4

FUEL CELLS: Principle of Operation of Fuel Cell, Fuel Processor, Fuel Cell Types, Energy Output of a Fuel Cell, Efficiency, and EMF of a Fuel Cell, Operating Characteristics of Fuel Cells, Thermal Efficiency of Fuel Cell

HYDROGEN ENERGY SYSTEM: Hydrogen Production, Hydrogen Storage, Development of Hydrogen Cartridge, Gas Hydrate

HYBRID ENERGY SYSTEMS: Hybrid Systems AND ITS Types, Electric and Hybrid Electric Vehicles, Hydrogen-Powered-Electric Vehicles.

Suggested Books:

1. Kothari DP, Singal KC, Ranjan Rakesh, "Renewable energy sources and emerging technologies, 2nd ed, Prentice Hall (India)
2. Rai G D, "Non-Conventional Sources of Energy, Khanna Publishers.
3. Bansal, Kleemann, Heliss, "Renewable energy sources and conversion technology", McGraw Hill Education.
4. Abbasi S A, Abbasi N, "Renewable energy sources and their environmental impact", PHI.
5. Mittal KM, "Renewable energy Systems", Wheelar Publishing.
6. Mukherjee D, "Renewable energy Systems", New Age International.

MTEL-107A	Power Electronics Applications in Renewable Energy						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the application of power system in renewable energy resources.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about power electronics devices and DC-DC converters.						
CO2	To acquaint students with the modern power electronics converters.						
CO3	To impart knowledge to students about power electronics interface devices for solar energy.						
CO4	To let student understand wind energy interfacing devices.						

Unit1

Review of Power Devices: SCR, BJT, MOSFET, IGBT, GTO, Safe operating Limits, Selection of devices for various applications.

Phase controlled Converters: **(**1-φ&3-φ) thyristor fed half controlled, fully controlled and Dual converters with inductive and motor load.

DC to DC converters: Analysis of various conduction modes of Buck, Boost, Buck-Boost.

Unit2

Modern Power Electronic Converters: Basic concepts of VSI, single phase half bridge, full bridge and three phase bridge inverters, PWM modulation strategies, Sinusoidal PWM, Space vector modulation, Selective Harmonic Elimination method, other inverter switching schemes, blanking time, Current source inverters.

Unit3

Design of Power Electronics Interfaces for Solar PV: Solar PV technologies, MPPT, Design of DC-DC converters for MPPT, MPPT algorithms, Implementation of MPPT control through DSP controllers. Topologies for grid connected and standalone applications: single phase and three phase systems, Single stage and multistage, isolated and non-isolated.

Unit4

Power Electronics Interfaces for WES: Topologies of WES, design considerations for wind energy Switch rectifier/inverter system, Power Converters for Doubly Fed Induction Generators (DFIG) in Wind Turbines.

Power Electronics Interfaces for Fuel Cells: Types of fuel cells, Proton Exchange Membrane (PEM) fuel cell: features and operational characteristics, Design of DC-DC converters for PEM fuel cell, MPPT in Fuel Cell.

Suggested Books:

1. Mohan N, Undel and T M, Robbins W P, "Power Electronics, Converters, Applications & Design", Wiley India Pvt. Ltd.
2. Bose B K, "Modern Power Electronics and AC Drives", Pearson Education.
3. Joseph Vithayathil,"Power Electronics", Tata McGraw Hil.
4. Amirnaser Yezdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modelling, Control and Applications", IEEE John Wiley Publications.
5. Solanki C S, "Solar Photo Voltaic", PHI learning Pvt Ltd.

MTEL-109A	SMART GRID						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of smart Grid and its advantages over conventional grid						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about Smart Grids and Appreciate the difference between smart grid & conventional grid						
CO2	To acquaint students with the phenomenon of smart metering concepts to industrial and commercial installations						
CO3	To impart knowledge to students about Formulate solutions in the areas of smart substations, distributed generation and wide area measurements						
CO4	To let student understand microgrid and related issues..						

UNIT-1

Introduction to Smart Grid, Evolution of Electric Grid Concept of Smart Grid, Definitions Need of Smart Grid, Concept of Robust & Self-Healing Grid, Present development & International policies in Smart Grid. Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources Power Quality Conditioners for Smart Grid

UNIT-2

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS) Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation. Cyber Security for Smart Grid

UNIT-3

Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU)

UNIT-4

Concept of micro-grid, need & applications of micro-grid, formation of micro-grid, Issues of interconnection, protection & control of Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines Captive power plants, Integration of renewable energy sources

Suggested Books:

1. Keyhani A, “Design of smart power grid renewable energy systems”, Wiley IEEE.
2. Berger L T, Iniewski K, “Smart Grid: Applications, Communications and Security”, Wiley.
3. Gellings C W., “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press.
4. Ekanayake J B, Jenkins N, Liyanage K, Yokoyama A, “Smart Grid: Technology and Applications”, Wiley.
5. Borlase S, “Smart Grid: Infrastructure, Technology and solutions”, CRC Press.
6. Phadke A G, “Synchronized Phasor Measurement and their Applications”, Springer.

MTEL-111A	Bio-Medical Signal & Image Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	This course will look at Biomedical signal and Image for understanding and their processing assessing						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand different types of biomedical signal and Identify and analyse different biomedical signals.						
CO2	Understand basics of Image processing and its methods						
CO3	To emphasize and analysis of Clustering and Classification						
CO4	To study different types of bio signals and their processing						

Unit-1

Signals and Biomedical Signal Processing: Introduction and overview, Analog, discrete and digital signals, Processing and transformation of signals, Signal processing for feature extraction, Characteristics of digital Images, Fourier transform: Properties of One-Dimensional Fourier Transform, Discrete Fourier Transform.

. **Unit-2**

Image Processing: Image filtering Enhancement and Restoration, Point processing, Mask processing: linear filtering in Space domain, Frequency-domain filtering, Smoothing and sharping filters in frequency domain, Wavelet transform, FFT to STFT, One-Dimensional Continuous and discrete Wavelet Transform, Image processing methods.

Unit-3

Clustering and Classification: Clustering versus Classification, Feature extraction, Biomedical and. Biological features, Signal and Image processing features, K-means: A Simple Clustering Method, study of different types of Classifiers for signal processing.

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Unit-4

Processing of Biomedical Signals: Electric activities of Cell, Electric data acquisition, Electrocardiogram: Signal of Cardiovascular system, Processing and feature extraction of ECG, Electroencephalogram, Signal of the brain, Processing and feature extraction of EEG, Electromyogram: Signal of muscles, Processing and feature extraction of EMG. Frequency and wavelet-domain analysis.

Suggested Books:

1.KayvanNajarian& Robert Splinter, "Introduction to Biomedical signal and Image Processing", CRC Press
2.MetinAkay "Time Frequency & Wavelets in Biomedical Signal Processing", Wiley-IEEE Press.
3. Amine Nait-Ali, "Advanced Biomedical Signal Processing", Springer.

MTEL-113A	Advanced Digital Signal Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of LTI system and designing of different types of Filters**.**						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about LTI system and DFT.						
CO2	To acquaint students with the study and design of FIR filters.						
CO3	To impart knowledge to students about study and design of IIR filters.						
CO4	To let student understand the concept and design of adaptive digital filters and power spectrum estimation.						

UNIT-1

Introduction of DSP: Introduction to Signal Processing, Discrete Linear Systems, superposition Principle, UNIT-Sample response, stability & causality Criterion.

Fourier Transform & inverse Fourier transform: Frequency domain design of digital filters, Fourier transform, use of Fourier transform in Signal processing. The inverse fourier transform, sampling continuous function to generate a sequence, Reconstruction of continuous -time signals from Discrete-time sequences.

UNIT-2

Digital Filter Structure & Implementation: Linearity, time invariance & causality, the discrete convolution, the transfer function, stability tests, steady state response, Amplitude & Phase Characteristics, stabilization procedure, Ideal LP Filter, Physical reliability & specifications. FIR Filters, Truncation windowing & Delays, design example, IIR Filters: Review of design of analog filters & analog frequency transformation. Digital frequency transformation. Design of LP filters using impulse invariance method, bilinear transformation, Phase equalizer, digital all pass filters.

UNIT-3

Implementation of Filters: Realization block diagrams, Cascade & parallel realization, effect of infinite-word length, transfer function of degree 1&2, Sensitivity comparisons, effects of finite precision arithmetic on Digital filters.

UNIT-4

DFT & FFT & Z transform with Applications: Discrete Fourier transform, properties of DFT, Circular Convolution, Fast Fourier Transform, Realizations of DFT. The Z-transform, the system function of a digital filter, Digital Filter implementation from the system function, the inverse Z- transform, properties & applications, Special computation of finite sequences, sequence of infinite length & continuous time signals, computation of Fourier series & time sequences from spectra.

Suggested Books:

1. J G Proakis, "Digital Signal Processing using Matlab", Pearson Education.
2. Alam V. Oppenheim and Ronald W. Schafer, "Digital Signal Processing" Pearson Education.
3. Rabiner & Gold, "Major Test& application of digital Signal Processing", Pearson Education
4. Roman kuc, "Introduction to Digital Signal Processing," Tata McGraw Hill Edition.
5. Richard G. Lyons, "Understanding Digital Signal Processing", Pearson Education.
6. Paulo S. R. Diniz, Eduardo A. B. da Silva, Sergio L. Netto, "Digital Signal Processing: System Analysis and Design", Springer.
7. Manolakis G Demitries, "Applied Digital Signal Processing", Cambridge Univ. Press.

MTEL-115A	Bio-Medical Instrumentation						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of different types of Biomedical Instruments with their controls.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand the different types of biomedical transducer for signal measurement and recording.						
CO2	Understand basics of blood pressure, blood flow and respiratory system measurements.						
CO3	Understand the muscoskeletal and nervous system and their measurement.						
CO4	To emphasize and analysis of recent trends in biomedical Engg and safety measurement.						

Unit-1

Characteristics of Transducers and Electrodes for Biological Measurement: Introduction to human body, block diagram, classification, various physiological events and suitable transducer for their recording, bioelectric potentials.

Cardiac system: Cardiac musculature, Electro cardiography, ECG recording, phonocardiography, holter recording ECG lead system, Heart rate meter, vector cardiography, pacemakers,

Unit-2

Blood pressure and Blood flow measurement; Invasive and non-invasive methods of blood pressure, characteristics of blood flow and heart sound, Cardiac output measurement, Plethysmography.

Respiratory system: Mechanics or breathing, parameters of respiration, Respiratory system measurements, respiratory therapy instruments.

Unit-3

Muscoskeletal Systems; EMG, Clinical applications, Muscles stimulator, Instrumentation for measuring Nervous function; EEG signal, frequency band classification, Lead systems, EEG recording, Clinical applications of EEG signal, X-ray CT scan, MRI, PET.

Clinical Laboratory Instrumentation; Test on blood cell, Blood cell counter, Blood glucose monitors, auto analyzer, pulse-oximeter.

Unit-4

Recent Trends in Biomedical Engg: Patient care and monitoring, Non-invasive diagnostic instrumentation, biotelemetry, telemedicine, prosthetic devices, lie detector test, Application of lasers and ultrasonic in biomedical field.

Troubleshooting and Electrical safety of Biomedical instruments; Physiological effect of current and safety measurement.

Suggested Books:

1.W T Wester, J G Tompkins, “Design of Microprocessor based Medical Instrumentation”, Englewood cliffs

2.Tatsuo, Togato & Toshiya, “Biomedical transducers and instruments”, CRC Press

3. Joseph P Bronzino, “The Biomedical engineering handbook”, CRC Press.

MTPS-117A	Power Electronics & Drives Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of power electronics devices and their applications						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about Power Electronic Devices						
CO2	Understand how to create the VI Characteristics of Various Devices and Their Analysis.						
CO3	To impart knowledge about chopper, bridge invertor and Cycloconverter						
CO4	Understand to create model for speed control of AC motor using TRIAC.						

Following experiments (at least 08) are required to be performed:

1. Experiment to study characteristics of Diode, Thyristor and TRIAC.
2. Experiment to study characteristics of transistor and MOSFET.
3. Experiment to study R and R-C firing circuits
4. Experiment to study UJT firing circuit.
5. Study of A.C single phase motor speed control using TRIAC.
6. Experiment to study Thyristorised D.C circuit breaker.
7. Experiment to study Thyristorised A.C phase control.
8. Experiment to study full wave converter.
9. Experiment to study series inverter.
10. Experiment to study DC chopper.
11. Experiment to study of bridge inverter.
12. Experiment to study of single phase Cycloconvertor

MTEL-119A	Advanced Power System Lab-I						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of programing for various types of power system appliances.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about a program to develop Bus Admittance Matrix, power flow studies using Newton-Raphson and Gauss-Siedel method.						
CO2	Understand how to determine the generalized constants A, B, C, D of a long transmission line and voltage & current for three phase faults ona2-buspowersystem						
CO3	To impart knowledge about simulation and analysis of a single phase & three phase power system and generation, transmission & distribution in power system.						
CO4	To impart knowledge about simulation and analysis of different fault condition and contingency concept in a power system.						

Following experiments (at least 8) are required to be performed in MATLAB/ETAP/LabView or equivalent:

1. Write a program to develop Bus Admittance Matrix YBUS.
2. Write a program for the Power Flow Studies using N-R(Newton-Raphson) method.
3. Write a program for the power flow analysis of system using Gauss-Siedel Technique.
4. Determination of the generalized constants , A, B, C, D of a long transmission line.
5. Determination of the voltage and current for three phase faults on a 2-bus power system.
6. Simulation and Analysis of a single phase & three phase power system.
7. Simulation & Analysis of generation, transmission & distribution in power system.
8. Simulation & Analysis of different fault condition in power system.
9. Simulation and Analysis of 9-bus power system.
10. Simulation and Analysis of contingency concept in a power system.

MTRM-111A	Research Methodology and IPR						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to Research Methodology and IPR for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.*						
Course Outcomes (CO)							
CO1	Understand research problem formulation.						
CO2	Analyze research related information						
CO3	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.						
CO4	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.						

Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2

Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper.Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 3

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 4

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.
2. C.R. Kothari, "Research Methodology: Methods & Techniques, 2nd edition or above, New Age Publishers.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

MTPS-102A	POWER SYSTEM OPERATION & CONTROL						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of power system operation , load forecasting and load frequency control						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about Load Characteristics and modelling						
CO2	To acquaint students with the Hydroelectric plant model, Energy scheduling						
CO3	To impart knowledge to students about Load forecasting, Power Systems interconnection						
CO4	To let student understand Load frequency control problem.						

Unit1

Load Characteristics and modeling: Thermal UNITs cost models, Formulation and solution of optimum dispatch without considering transmission losses using Lagrange's methods, General transmission loss formula and B-Coefficients, Incremental transmission loss formula, Optimum dispatch considering transmission losses, Penalty factor technique, Iterative computational procedure for dispatch problem.

Unit2

Hydroelectric plant model: Energy scheduling, Incremental water rate, Coordination equations for short-range hydrothermal scheduling with fixed head hydro plant, Computational flow-chart, Optimal scheduling of hydrothermal system using discretization and gradient vector approach.

Unit3

Load forecasting: Power Systems interconnection, Un-integrated and integrated operation, UNIT commitment problem, Solution of the problem by priority list scheduling and using dynamic programming principle and Lagrangian relaxation technique, Economics of inter-change of energy, Effects of transmission losses, SCADA systems.

Unit4

Load frequency control problem: Models of various subsystems of a generating UNIT, Governor Characteristics, Steady-state and dynamic analysis, Control area concept, Incorporating proportional and integral type controllers. Area control error, LFC and economic dispatch, Two-area LFC, Tie-line Control, Control of active and reactive power, Shunt and series compensation and associated analysis

Suggested Books:

1. Allen J. Wood, and Bruce F. Wollenberg, "Power Generation, Operation and Control", John Wiley & Sons, Inc., New York.
2. Olle I. Elgerd, "Electric Energy Systems Theory – An Introduction", Mc Graw-Hill Book Company, New York.
3. John J. Grainger and William D. Stevenson, Jr, "Power System Analysis", Mc Graw Hill Book Company, Inc., New York.
4. P S R Murty, "Power System Operation and Control", Tata McGraw-Hill Publishing Company Ltd., New Delhi.
5. I J Nagrath and DP Kothari, "Power System Engineering", Tata McGraw Hill Publishing Co., Ltd. New Delhi.

6. B R Gupta, "Generation of Electrical Energy", S. Chand & Co. Ltd. N. Delhi.

MTPS-104A	Power System Protection & Relaying						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	This course will look at different types of Power System Protection schemes.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	Understand Protective Relaying Fundamental.						
CO2	Understand Static relays and their operation						
CO3	Understand Distance protection Principle						
CO4	Understand Protection of Generators and Motors						

Unit-1

Protective Relaying Fundamental: Need for protective systems, Zones of protection, classification of protective relays and protective schemes, Advantages and disadvantages of different relays.
Current transformers and potential transformers: Operating principle, construction, characteristics, performance and specifications.
Comparators: general equation of comparators, Analysis for amplitude comparator, analysis for phase comparator, duality between amplitude and phase comparators, different types of amplitude and phase comparators.

.**Unit-2**

Static relays: Over current relays- Instantaneous over current relays, definite time over current relays, directional over current relay, comparison with conventional relays, differential relays, operating and restraining characteristics, types of differential relays, comparison with conventional relays, distance relays, impedance relays, reactance relays, mho relay quadrilateral relays, elliptical relays, comparison with conventional relays.

Unit-3

Distance protection: Principle of distance relaying, time grading of distance relays, schemes of distance protection, distance protection by impedance, reactance and mho relays, Effect of power swings on the performance of distance relays.
Pilot relaying schemes: Pilot wire protection, carrier current protection.

Unit-4

Protection of Generators and Motors: Types of faults, Stator and rotor protection against various types of faults. Protection of Transformers: Types of faults, differential protection schemes, harmonic restraint relay, over flux protection, earthing transformer protection.
Bus Zone Protection: Types of Bus-bar faults, differential current protection frame leakage protection.
Microprocessor based Protective relays: Over current relay, impedance relay, reactance relay, mho relay, distance relaying.

Suggested Books:

1. TSM Rao, "Power System Protection – Static Relays", Tata McGraw Hill.
2. B Bhalja, R P Maheshwari and N G Chothani, "Protection and Switchgear", Oxford University Press, New Delhi, 2011.
3. Badri Ram and Vishwakarma, "Power System protection and Switchgear", Tata McGraw Hill.
4. B. Ravindernath and M. Chander, "Power System Protection and Switchgear", New Age Publication, New Delhi, 2012.
5. S. P Patra, S.K Basu and S. Choudhary, "Power System Protection", Oxford IBH Pub.
6. C L Wadhwa, "Electrical Power Systems", New Age Publication, New Delhi, 2012

MTEL-106A	HVDC Transmission & FACTS Devices						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of HVDC and FACTS devices.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about HVDC transmission system.						
CO2	To acquaint students with the interaction of AC and DC system and various links.						
CO3	To impart knowledge to students about facts devices.						
CO4	To let student understand compensation system and control techniques.						

Unit 1

HVDC Transmission: Development of HVDC Technology, Selection of converter configuration. Rectifier and Inverter operation. Control of HVDC converters and Systems.

Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters.

Unit 2

Interaction between HVAC and DC systems – Voltage interaction, over voltages on AC/DC side, Harmonic instability problems and DC power modulation.

Multi-terminal DC links and systems; series, parallel and series parallel systems, their operation and control.

Unit 3

Introduction of Facts Concepts: Basic of flexible alternating current transmission system (FACTS) controllers, shunt, series, combined and other controllers, HVDC or FACTS, static VAR compensator (SVC) and static synchronous compensator (STATCOM), Static Synchronous Series Compensator (SSSC), Thyristor Controlled Series, Capacitor (TCSC). Solid State Contactors (SSC) and TSSC.

Unit 4

Combined Compensators: Introduction, Unified power flow controller (UPFC), conventional power control capabilities, real and reactive power flow control, comparison of UPFC to series compensators, control structure, dynamic performance. Interline power flow controller (IPFC) basic operating principles, control structure, application considerations.

Suggested Books:

1. Hingorani N.G, "Understanding FACTS (Concepts and Technology of Flexible AC Transmission System)", Standard Publishers.
2. Song Y.H. and Johns A.T., "Flexible AC Transmission Systems", IEEE Press.
3. Ghosh A. and Ledwich G., "Power Quality Enhancement using Custom Power Devices", Kluwer Academic Publishers.
4. Mathur R.M. and Verma R.K., "Thyristor based FACTS controllers for Electrical Transmission Systems", IEEE Press.
5. Bollen M.H.J., "Understanding Power Quality and Voltage Sag", IEEE Press.
6. Padiyar K.R., "FACTS Controllers in Power Transmission and Distribution", New Age International Publisher.
7. Miller T.J.E., "Reactive Power Control in Electric Systems", John Wiley.
8. Kamakshaiah S, Kamaraju V, "HVDC Transmission", McGraw Hill Education.

MTEL-108A	TRANSIENTS IN POWER SYSTEM						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of transients in power system.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about different types of factors effecting power quality.						
CO2	To acquaint students with the transients and lightning.						
CO3	To impart knowledge to harmonics.						
CO4	To let student understand about distributed generation and various issues related to power quality.						

UNIT-1

What is Power Quality, Power Quality is Equal to Voltage Quality, Why are we concerned about Power Quality, Voltage Imbalance, Waveform Distortion, Voltage Fluctuation, Power Frequency Variations, Power Quality Terms, Sources of Sags and Interruption, Estimating Voltage Sag Performance, Area of Vulnerability, Equipment Sensitivity of Voltage Sags, Transmission Systems Sag Performance Evaluation, Utility Distribution System Sag Performance Evaluation.

UNIT-2

Sources of Transient Overvoltage's: Capacitor Switching, Restrike during Capacitor De-energizing, Lightning, Ferro -resonance, Other Switching Transients. Principles of Overvoltage Protection.

Devices for Overvoltage Protection: Surge Arresters and Transient Voltage Surge Suppressor, Isolation Transformers, Utility System Lightning Protection, Shielding, Line Arresters, Low Side Surges, Cable Protection, Scout Arrester Scheme, Computer Tools for Transient Analysis.

UNIT-3

Fundamentals of Harmonics: Harmonic Distortion, Voltage vs Current Distortion, Harmonics vs Transients, Power System Quantities Under Non Sinusoidal Conditions, Active, Reactive and Apparent Power, Power Factor: Displacement and True, Harmonic Phase Sequences, Triplen Harmonics.

Harmonic Sources from Commercial Loads: Single Phase Power Supplies, Fluorescent Lighting, Adjustable Speed Drives for HVAC and Elevators.

Effects of Harmonic Distortion: Impact on Capacitors, Impact on Transformers, Impact on Motors, Impact on Telecommunications, Impact on Energy and Demand Metering.

UNIT-4

Distributed Generation and Power Quality: Resurgence of DG, Perspectives on DG Benefits, Perspectives on Interconnection, DG Technologies, Fuel Cells, Wind Turbines, Photovoltaic Systems, Interface to the Utility System, Synchronous Machines, Asynchronous Machines, Electronic Power Inverters, Power Quality Issues, Voltage Regulation, Harmonics, Voltage Sags, Operating Conflicts, Voltage Regulation Issues, Islanding, Transformer Connections.

Suggested Books:

1. Dugan, McGranaghan, Santoso, H. Wayne Beaty, "Electrical Power System Quality", McGraw Hill.
2. Akihiro Ametani, Naoto Nagaoka, Yoshihiro Baba, Teruo Ohno, "Power System Transients: Theory and Applications", CRC Press.
3. L.V. Bewley, "Traveling waves in Transmission Systems", Dover.
4. R. Rudenberg, "Electric Stroke waves in Power Systems", Harvard University Press, Cambridge.
5. Allan Greenwood, "Electric Transients in Power Systems", Wiley Interscience.
6. CS Indulkar and DP Kothari, "Power System Transients, Statistical Approach", PHI Pvt Ltd., New Delhi.
7. VA Venikov, "Transient phenomena in Electrical Power Systems", Pergamon Press, London.
8. Klaus Ragaller, "Surges in High Voltage Networks", Plenum Press, New York.
9. Pritindra Chowdhari, "Electromagnetic transients in Po r System", John Wiley and Sons Inc.

10. Naidu M S and Kamaraju V, "High Voltage Engineering", TMH Publishing Company Ltd., New Delhi.

MTEL-110A	Advanced Power Distribution & Automation						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of electricity distribution and automation.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about distribution automation.						
CO2	To acquaint students with the control and intelligent system in distribution automation.						
CO3	To impart knowledge to students about renewable energy resources and distribution management.						
CO4	To let student understand communication system implementation in distribution system.						

UNIT-1

Introduction: General Concept, Distribution of Power, Power Loads, Connected Loads.

Load Forecasting: Concept of Statistics, Regression Analysis, Correlation Theory, Factor in Power System Loading, Unloading the System, Forecast of System peak.

UNIT-2

System Planning: Planning Process, Basic Principle in system planning, System Development, Overview of Distributed generation, Different types of mapping: Global positioning System GPS, Automated mapping AM/Facility Management FM.

Introductory Methods in Power System Planning: Per Unit Calculation, Matrix Algebra, Symmetrical Components, Overview of Load Flow, Automated Planning: software needs, Data, solution techniques (Gauss Iterative method, Gauss seidel iterative method, Newton Raphson iterative method, Improved newton Raphson method) Effect of Abnormal Loads.

UNIT-3

Brief introduction of Distribution Automation, Role of PLC & SCADA in substation and distribution automation, Consumer information Service (CIS), Geographical information system GIS, Automatic meter Reading (AMR), Automation System.

UNIT-4

Metering System: Different types of Meter, Metering system component, Ferraris Meters, Solid state meters, Advance meter Infrastructure Systems (AMI).

Overview of Net metering, Meter current Rating, Prepaid Electricity meters, Meter selection and Location, testing methods.

Suggested Books:

1. A. S Pabla, "Electric Power Distribution", McGraw Hill Education.
2. James A. Momoh, "Electric Power Distribution Automation Protection and Control", CRC Press.
3. James N-Green and R Wilson, "Control and Automation of electric Power Distribution Systems", CRC Press.
4. Turan Gonen,"Electric Power Distribution System Engineering", CRC Press.
5. Abdelhay A. Sallam, "Electric Distribution Systems",Wiley-IEEEPress.

MTEL-112A	Digital Control System						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of digital control system.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about signal processing in digital control system.						
CO2	To acquaint students with the control devices and systems.						
CO3	To impart knowledge to students about state variables, controllability and observability.						
CO4	To let student understand the various concepts of digital observers.						

Unit-1

Signal Processing in Digital Control: Basic digital control scheme, principle of signal conversion, basic discrete-time signal, time-domain model for discrete-time systems, z-transform, transfer function models, jury stability criterion, sample and hold systems, sample spectra and aliasing

Unit-2

Models of Digital Control Devices and Systems: Introduction, z-domain description of sampled continuous-time plants, z-domain description of systems with dead-time, implementation of digital controllers, digital PID controllers, digital temperature control system, stepping motors and their control, PLC

Unit-3.

Analysis using State Variable Methods: State variable representation-concepts, modeling, transformation, state diagrams, Jordan canonical form, Eigen values and Eigenvectors,

Solution of state equations, concepts of controllability and Observability,

Unit-4

Digital Observers: State regulator design-full order and reduced order state observer, design of state observers, compensator design by separation principle, state feedback with integral control , deadbeat control by state feedback and deadbeat observers

Suggested Books:

1. Ogata K," Discrete time Control Systems", Pearson Education.

2. Nagrath and Gopal, "Control System Engineering", New Age International.

3. Kuo B C, "Digital Control Systems", Oxford University Press.

4. Goapl, "Digital Control & State Variable Method", McGraw Hill Education.

MTEL-114A	Advanced Microprocessors						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of advanced microprocessor.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about 8086 microprocessors.						
CO2	To acquaint students with the interfacing converters etc.						
CO3	To impart knowledge to students about microcontrollers.						
CO4	To let student about application of microprocessor and various controllers related to it.						

UNIT-1

Architecture of 8086 microprocessor, Memory Addressing, Bus Timings for MN/MX mode, interrupt structure. Memory Interfacing and Addressed encoding techniques for 8086 microprocessor

UNIT-2

Addressing modes, Instruction set and application programs, Assembler Directives, Programming Techniques using TASM, Interfacing D/A and A/D converters using programmable I/O devices, Interfacing Stepper motor. Architecture of INTEL X86 Family: CPU block diagrams, Pin diagrams and internal descriptions of 80286, 386, 486 and Pentium Processor, Instruction formats.

UNIT-3

Introduction to micro controllers, Architecture of 8051microcontroller, basic Instruction set, programming, serial data communication, inter facing with D/A and A/D converters.

UNIT-4

Application of Microprocessors, A Microcomputer-based Industrial Process-control System, Hardware for Control Systems and Temperature Controller, Overview of Smart-Scale Operation.

Suggested Books:

1. Hall D V, “Microprocessors & Interfacing”, McGraw Hill Education.
2. Brey B, “The Intel Processors”, Pearson Education.
3.Gibson, “Microprocessors”,, Prentice Hall of India.
4. Jean Loup Baer, “Microprocessor Architecture”, Cambridge University Press.
5. Ayala K J, “Micro Controller”, Penram International

MTEL-116A	Reliability Engineering						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the concept of Reliability Engineering and its application in Engineering**.**						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To emphasize and analysis of basic of reliability engineering.						
CO2	To understand the concept of Fault tree analysis in reliability.						
CO3	To understand the concept of Maintainability Analysis in reliability.						
CO4	To study the concept of Artificial Intelligence in reliability engineering.						

Unit-1

Review of basic concepts in Reliability Engg., Reliability function, different reliability models, etc. Reliability evaluation techniques for complex systems; Tie set and cut set approaches, different reliability measures, Reliability allocation/apportionment, reliability improvement, redundancy optimization techniques.

Unit-2

Fault tree analysis: fault tree construction, simplification and evaluation, importance measures, modularization, applications, advantages and disadvantages of fault tree techniques.

Unit-3

Maintainability Analysis: measures of system performance, types of maintenance, reliability centred maintenance, reliability and availability, evaluation of engine ring systems using Markov models.

Unit-4

Applications of fuzzy Major Test and neural networks to Reliability Engineering. Reliability testing, design for reliability and maintainability. Typical reliability case studies.

Suggested Books:

1. R. Rama Kumar, "Engineering Reliability", Prentice Hall.
2. K B Mishra, "Reliability Analysis & Prediction".
3. K B Mishra, "New trends in System Reliability Evaluation".
4. M L Shooman, "Probabilistic reliability–an engineering approach", R E Krieger Pub.
5. K K Aggarwal, "Reliability Engineering".
6. Roy & Billington, "Reliability Engineering".
7. Balagurswami, "Reliability Engineering", McGraw Hill Education.

MTPS-118A	Power System Protection Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of Power System Protection						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about to preform test for dielectric strength of transformer oil, zero sequence.						
CO2	To impart knowledge about to preform test on relays						
CO3	To impart knowledge about to preform different types of test on transmission lines						
CO4	To impart knowledge about to preform test on current transformer						

Following experiments (at least 08) are required to be performed:

1. To find out the dielectric strength of transformer oil.
2. To find zero sequence component of three phase line.
3. To draw the characteristics of thermal overload relay.
4. To study an IDMT over current relay to obtain and plot its characteristic curves i.e. the graph between current and time
5. To measure the ABCD parameters of a given transmission line.
6. To plot the power angle characteristics of given transmission lines.
7. To find the string efficiency of a string insulator with/without guard rings.
8. To study the characteristics of transmission line for t-network & pie- network.
9. To study and testing of a current transformer.
10. To study various types of distance relay.

MTEL-120A	Advanced Power System Lab-II						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of programing for various types of power system appliances.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge the simulation& analysis of the generator and transformer protection.						
CO2	To impart knowledge the simulation& analysis of power quality improvement, different types of load.						
CO3	To impart knowledge the simulation& analysis of PV cell.						
CO4	To impart knowledge the simulation& analysis of different non-conventional plant biomass gasifier and wind turbine.						

Following experiments are required to be performed in MATLAB/ETAP/LabView or equivalent.

1. Simulation & Analysis of the generator protection.
2. Simulation & Analysis of the transformer protection.
3. Simulation & Analysis of power quality improvement.
4. Simulation & Analysis of different types of relays in power system.
5. To perform the simulation of Photo-Electric Effect.
6. To perform the simulation to construct the PV cell to show the V-I & P-V characteristics curve of it.
7. ToperformthesimulationofPhotovoltaicpowerconversionforsingleand3-phase load on account with MPPT.
8. To perform the construction of a Simulink model of Biomass Gasifier.
9. To study mathematical modelling of DFIG based Wind Turbine and its impact on connection with grid.
10. To perform the simulation of Permanent Magnet Synchronous Generator (PMSG) based wind energy conversion system.
11. To perform the simulation of PV-Grid inter- connection using MPPT technique with the partial shading effect.

MTEL-201A	DISTRIBUTED GENERATION						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	To understand renewable energy sources. To gain understanding of the working of off-grid and grid-connected renewable energy generation schemes.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To understand the planning and operational issues related to Distributed Generation.						
CO2	Acquire Knowledge about Distributed Generation Learn Micro-Grids						
CO3	understand renewable energy sources						
CO4	Understanding of the working of off-grid and grid-connected renewable energy generation schemes.						

UNIT-1

Need for Distributed generation. Renewable sources in distributed generation and current scenario in Distributed Generation. Introduction to micro-grids. Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids. Modelling & analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units.

UNIT-2

Planning of DGs. Sitting and sizing of DGs optimal placement of DG sources in distribution systems. Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine based interfaces. Aggregation of multiple DG units.

UNIT-3

Technical impacts of DGs. Transmission systems Distribution Systems De-Regulation Impact of DGs upon protective relaying. Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis...

UNIT-4

Economic and control aspects of DGs Market facts. Issues and challenges Limitations of DGs, Voltage control techniques. Reactive power control, Harmonics Power quality issues, Reliability of DG based systems.

Suggested reading:

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation – Planning and Evaluation", Marcel Decker Press.
2. M Godoy Simoes, Felix A. Farret, "Renewable Energy Systems – Design and Analysis with Induction Generators", CRC press.
3. Stuart Borlase. "Smart Grid: Infrastructure Technology Solutions" CRC Press.

MTEL-203A	ELECTRIC DRIVES & CONTROL						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of electric drives & control in electric system.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To study basic electric drives, types of loads, classes of motor duty.						
CO2	To study different types of DC drives, stability analysis, modern control techniques.						
CO3	To study mathematical modelling of induction motor drives, introduction to Cyclo-converter fed induction motor drive.						
CO4	To study different types of synchronous motor drives used in mills.						

UNIT 1

Introduction: Definition, Part of the electric drive, Types of loads, steady state & transient stability of Drive, state of art of power electronics and drives, thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating.

UNIT 2

D.C. Drives: Review of braking and speed control of D.C. motors, multi-quadrant operation, loss minimization in adjustable speed drives. Mathematical modelling of dc drives, stability analysis, modern control techniques: variable structure, adaptive control, Chopper-Controlled DC Drives.

UNIT 3

Induction motor drives: Review of braking and speed control of induction motors, constant V/F, constant air gap flux, controlled voltage, controlled current and controlled slip operation. Mathematical modelling of induction motor drives, transient response and stability analysis Introduction to Cyclo-converter fed induction motor drive. Pulse Width Modulation for Electric Power Converters

UNIT 4

Synchronous motor drives: Adjustable frequency operation, voltage fed drive, current fed self-controlled drive. Application of electric drives in steel mills, paper mills, textile mills and machine tools etc. A. C. motor drives in transportation system and traction.

Suggested Books:

1. Dubey G K, “Fundamentals of Electrical Drives”, Narosa Publishing House, New Delhi.

2. S K Pillai, “A First Course on Electrical Drives”, New Age International (P) Ltd., New Delhi.

3. Krishan R, “Electric Motor Drives: Modeling Analysis and Control”, PHI Pvt Ltd. New Delhi-2001.

4. Bose B K, “Power Electronics and Variable Frequency Drives: Technology and Applications”, IEEE Press, 1997.

5. Bose B K , “Modern Power Electronics and AC Drives”, Pearson Educational, Delhi,

MTEL-205A	Power System Restructuring and Deregulation						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of the course is to impart the students with the knowledge of restructuring and deregulation.						
Course Outcomes (CO)							
After completion of course students will be able to							
CO1	To impart knowledge about restructuring and its various issues related to it.						
CO2	To acquaint students with the deregulation and market models.						
CO3	To impart knowledge to students about transmission pricing.						
CO4	To let student understand in detail about congestion management and experiences of various nations.						

Unit-1

Introduction: Basic concept and definitions, privatization, restructuring, transmission open access, wheeling, deregulation, components of deregulated system, advantages of competitive system.
Power System Restructuring: An overview of the restructured power system, Difference between integrated power system and restructured power system, Explanation with suitable practical examples.

Unit-2

Deregulation of Power Sector: Separation of owner ship and operation, Deregulated models, pool model, pool and bilateral trades model, multilateral trade model.
Competitive electricity market: Independent System Operator activities in pool market, Wholesale electricity market characteristics, central auction, single auction power pool, double auction power pool, market clearing and pricing, Market Power and its Mitigation Techniques, Bilateral trading, Ancillary services.

Unit-3

Transmission Pricing: Marginal pricing of Electricity, nodal pricing, zonal pricing, embedded cost, Postage stamp method, Contract Path method, Boundary flow method, MW-mile method, MVA-mile method, Comparison of different methods.

Unit-4

Congestion Management: Congestion management in normal operation, explanation with suitable example, total transfer capability (TTC), Available transfer capability (ATC), Different Experiences in deregulation: England and Wales, Norway, China, California, New Zealand and Indian power system.

Suggested Books:

1.LoiLei Lai, "Power System Restructuring and Deregulation", John Wiley & Sons Ltd.
2.K Bhattacharya, M H T Bollen and J C Doolder, " Operation of Restructured Power Systems", Kluwer Academic Publishers.
3.Lorrin Philipson and H Lee Willis, "Understanding Electric Utilities and Deregulation", Marcel Dekker Inc, New York.
4.Yong-Hua Song, Xi-Fan Wang, "Operation of market-oriented power systems" ,Springer, Germany.

MTOE-201A	Business Analytics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.						
Course Outcomes (CO)							
CO1	*Able to have knowledge of various business analysis techniques.*						
CO2	*Learn the requirement specification and transforming the requirement into different models.*						
CO3	*Learn the requirement representation and managing requirement assests.*						
CO4	*Learn the Recent Trends in Embedded and collaborative business*						

Unit 1

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.

Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Unit 2

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.

Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit 3

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements.

Managing Requirements Assets: Change Control, Requirements Tools

Unit 4

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

References:

1. Business Analysis by James Cadle et al.

2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

MTOE-203A	Industrial Safety						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the industrial safety.*						
Course Outcomes (CO)							
CO1	*Understand the industrial safety.*						
CO2	*Analyze fundamental of maintenance engineering.*						
CO3	*Understand the wear and corrosion and fault tracing.*						
CO4	*Understanding that when to do periodic inceptions and apply the preventing maintenance.*						

Unit-1

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-2

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-3

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-4

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

MTOE-205A	Operations Research						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To enable students to aware about the dynamic programming to solve problems of discreet and continuous variables and model the real world problem and simulate it.						
Course Outcomes (CO)							
CO1	*Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.*						
CO2	*Students should able to apply the concept of non-linear programming*						
CO3	*Students should able to carry out sensitivity analysis*						
CO4	*Student should able to model the real world problem and simulate it.*						

Unit -1

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit -2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit- 3

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit -4

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

MTOE-207A	Cost Management of Engineering Projects						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to make aware about the cost management for the engineering project and apply cost models the real world projects.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the strategic cost management process.*						
CO2	*Students should able to types of project and project team types*						
CO3	*Students should able to carry out Cost Behavior and Profit Planning analysis.*						
CO4	*Student should able to learn the quantitative techniques for cost management.*						

Unit-1

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-2

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit-3

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-4

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

MTOE-209A	Composite Materials						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the composite materials and their properties.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification and characteristics of Composite materials.*						
CO2	*Students should able reinforcements Composite materials.*						
CO3	*Students should able to carry out the preparation of compounds.*						
CO4	*Student should able to do the analysis of the composite materials.*						

UNIT–1:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Iso-strain and Iso-stress conditions.

UNIT – 2

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–3

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – 4

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.

2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

MTOE-211A	Waste to Energy						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to aware about the generation of energy from the waste.*						
Course Outcomes (CO)							
CO1	*Students should able to learn the Classification of waste as a fuel.*						
CO2	*Students should able to learn the Manufacture of charcoal.*						
CO3	*Students should able to carry out the designing of gasifiers and biomass stoves.*						
CO4	*Student should able to learn the Biogas plant technology.*						

Unit-1

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-2

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-3

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-4

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

MTAD-101A	English For Research Paper Writing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Student will able to understand the basic rules of research paper writing.*						
Course Outcomes (CO)							
CO1	*Understand that how to improve your writing skills and level of readability*						
CO2	*Learn about what to write in each section*						
CO3	*Understand the skills needed when writing a Title*						
CO4	*Ensure the good quality of paper at very first-time submission*						

Unit 1

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit 2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit 3

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit 4

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

MTAD-103A	Disaster Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Develop an understanding of disaster risk reduction and management*						
Course Outcomes (CO)							
CO1	*Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.*						
CO2	*Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.*						
CO3	*Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.*						
CO4	*critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in*						

Unit 1

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit 2

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit 3

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit 4

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

References:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

MTAD-105A	Sanskrit for Technical Knowledge						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Students will be able to Understanding basic Sanskrit language and Ancient Sanskrit literature about science & technology can be understood and Being a logical language will help to develop logic in students*						
Course Outcomes (CO)							
CO1	*To get a working knowledge in illustrious Sanskrit, the scientific language in the world*						
CO2	*Learning of Sanskrit to improve brain functioning*						
CO3	*Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power*						
CO4	*The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature*						

Unit –1

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit – 2

Order, Introduction of roots,Technical information about Sanskrit Literature

Unit –3

Technical concepts of Engineering: Electrical, Mechanical

Unit –4

Technical concepts of Engineering: Architecture, Mathematics

References

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

MTAD-107A	Value Education						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand value of education and self- development, Imbibe good values in students and Let the should know about the importance of character*						
Course Outcomes (CO)							
CO1	*Knowledge of self-development*						

CO2	*Learn the importance of Human values*
CO3	*Developing the overall personality*
CO4	*Know about the importance of character*

Unit 1

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Stadards and principles. Value judgements.

Unit 2

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature,Discipline

Unit 3

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

Unit 4

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

References

1.Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

MTAD-102A	**Constitution of India**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.*						
Course Outcomes (CO)							
CO1	*Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*						
CO2	*Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*						
CO3	*Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.*						
CO4	*Discuss the passage of the Hindu Code Bill of 1956.*						

Unit I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features

Unit 2

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality , Right to Freedom , Right against Exploitation , Right to Freedom of Religion, Cultural and Educational Rights , Right to Constitutional Remedies , Directive Principles of State Policy , Fundamental Duties.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive , President, Governor , Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions

Unit 3

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit 4

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

MTAD-104A	**Pedagogy Studies**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers and Identify critical evidence gaps to guide the development*.						
Course Outcomes (CO)							
CO1	*What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?*						
CO2	*What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?*						
CO3	*How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?*						
CO4	*What is the importance of identifying research gaps?*						

Unit 1

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology , Theories of learning, Curriculum, Teacher education., Conceptual framework, Research questions. Overview of methodology and Searching. Thematic overview: Pedagogical practices are being

used by teachers in formal and informal classrooms in developing countries. , Curriculum, Teacher education.

Unit 2

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 3

Professional development: alignment with classroom practices and follow-up support, Peer support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes,

Unit 4

Research gaps and future directions: Research design, Contexts , Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

References

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

MTAD-106A	**Stress Management by Yoga**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To achieve overall health of body and mind and to overcome stress						
Course Outcomes (CO)							
CO1	*Develop healthy mind in a healthy body thus improving social health.*						
CO2	*Improve efficiency*						
CO3	*Learn the Yog asan*						
CO4	*Learn the pranayama*						

Unit – 1

Definitions of Eight parts of yog (Ashtanga).

Unit- 2

Yam and Niyam, Do`s and Don't's in life; Ahinsa, satya, astheya, bramhacharya and aparigraha; Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit- 3

Asan and Pranayam, Various yog poses and their benefits for mind & body,

Unit- 4

Regularization of breathing techniques and its effects-Types of pranayam.

References

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

MTAD-108A	**Personality Development through Life Enlightenment Skills**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	To learn to achieve the highest goal happily To become a person with stable mind, pleasing personality and determination To awaken wisdom in students						
Course Outcomes (CO)							
CO1	*Students become aware about leadership.*						
CO2	*Students will learn how to perform his/her duties in day to day work.*						
CO3	*Understand the team building and conflict*						
CO4	*Student will learn how to become role model for the society.*						

Unit – 1

Neetisatakam-Holistic development of personality: Verses: 19, 20, 21, 22 (wisdom); Verses: 29, 31, 32 (pride & heroism); Verses: 26, 28, 63, 65 (virtue); Verses: 52, 53, 59 (don's); Verses: 71, 73, 75, 78 (do's).

Unit – 2

Approach to day to day work and duties; Shrimad Bhagwad Geeta: Chapter-2: Verses: 41, 47, 48; Chapter-3: Verses: 13, 21, 27, 35; Chapter-6: Verses: 5, 13, 17, 23, 35; Chapter-18: Verses: 45, 46, 48.

Unit - 3

Statements of basic knowledge; Shrimad Bhagwad Geeta: Chapter-2: Verses: 56, 62, 68; Chapter-12: Verses: 13, 14, 15, 16, 17, 18.

Unit – 4

Personality of Role model; Shrimad Bhagwad Geeta: Chapter-2: Verses: 17; Chapter-3: Verses: 36, 37, 42: Chapter-4: Verses: 18, 38, 39; Chapter-18: Verses: 37, 38, 63.

References:

1. Srimad Bhagavad Gita, Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya), P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Dissertation Phase – I and Dissertation Phase - II

Teaching Scheme

Lab work : 20 and 32 hrs/week for Dissertation Phase- I (MTPS-207A)and Phase- II (MTPS-202A) respectively

Course Outcomes:

At the end of this course, students will be able to

a. Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
b. Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
c. Ability to present the findings of their technical solution in a written report. Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

1. Relevance to social needs of society
    - Relevance to value addition to existing facilities in the
    - Relevance to industry need
2. Problems of national importance
3. Research and development in various domain
4. The student should complete the following:
    - Literature survey Problem
    - D efinition Motivation for study and Objectives
    - Preliminary design / feasibility / modular approaches
    - Implementation and Verification
5. Report and presentation

The dissertation phase- II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

Experimental verification / Proof of concept.

Design, fabrication, testing of Communication System.

The viva-voce examination will be based on the above report and work.

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Guidelines for Dissertation Phase – I and Phase-II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referredliterature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

KURUKSHETRA UNIVERSITY, KURUKSHETRA

('A+' Grade, NAAC Accredited)

SCHEME OF EXAMINATIONS FOR

MASTER OF TECHNOLOGY IN

POWER ELECTRONICS AND DRIVES (w. e. f. 2018-19)

SEMESTER-I

Sr. No.	Course Code	SUBJECT	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTPE-101A	PWM converter and Applications	3	-	-	3	40	60	3	3
2	MTPE-103A	Power Quality	3	-	-	3	40	60	3	3
3	*	Program Elective –I	3	-	-	3	40	60	3	3
4	**	Program Elective-II	3	-	-	3	40	60	3	3
5	MTPE - 117A	Electrical Drives Laboratory	-	-	4	4	40	60	2	3
6	MTPE - 119A	Digital Signal Processing Lab	-	-	4	4	40	60	2	3
7	MTRM-111A	Research Methodology and IPR	2	-	-	2	40	60	2	3
8	***	Audit Course-I	2	-	-	2	-	-	-	-
		Total	**16**		**8**	**24**	**280**	**420**	**18**	

*** PROGRAM ELECTIVE – I**		
1.	MTEL-105A	Renewable Energy Resources
2.	MTEL-107A	Power Electronics Applications in Renewable Energy
3.	MTEL-109A	Smart Grid

**** PROGRAM ELECTIVE - II**		
1.	MTEL-111A	Bio-Medical Signal & Image Processing
2.	MTEL-113A	Advanced Digital Signal Processing
3.	MTEL-115A	Bio-Medical Instrumentation

***** AUDIT COURSE – I**		
1.	MTAD-101A	English for Research Paper Writing
2.	MTAD-103A	Disaster Management
3.	MTAD-105A	Sanskrit for Technical Knowledge
4.	MTAD-107A	Value Education

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

2.*** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

SEMESTER-II

Sr. No.	Course Code	Subject	L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTPE-102A	Power Electronic Converters	3	-	-	3	40	60	3	3
2	MTPE-104A	Digital Control of Power Electronic and Drive Systems	3	-	-	3	40	60	3	3
3	*	Program Elective-III	3	-	-	3	40	60	3	3
4	**	Program Elective-IV	3	-	-	3	40	60	3	3
5	MTPE-118A	Power Electronics Laboratory	-	-	4	4	40	60	2	3
6	MTPE-120A	Microcontrollers Lab	-	-	4	4	40	60	2	3
7	MTPE-122A	Mini Project	-	-	4	4	100	-	2	3
8	***	Audit Course-II	2	-	-	-	-	-	-	-
		Total	**14**		**12**	**26**	**340**	**360**	**18**	

***PROGRAM ELECTIVES - III**		
1.	MTEL-106A	HVDC Transmission & FACTS Devices
2.	MTEL-108A	Transients in Power System
3.	MTEL-110A	Advanced Power Distribution &Automation

****PROGRAM ELECTIVE – IV**		
1.	MTEL-112A	Digital Control System
2.	MTEL-114A	Advanced Microprocessors
3.	MTEL-116A	Reliability Engineering

***** AUDIT COURSE–II**		
1.	MTAD-102A	Constitution of India
2.	MTAD-104A	Pedagogy Studies
3.	MTAD-106A	Stress Management by Yoga
4.	MTAD-108A	Personality Development through Life Enlightenment Skills

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.

Note 2.*** Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

#Note3: Mini project: During this course the student will be able to understand the contemporary/emerging technologies for various processes and systems. During the semester, the students are required to search/gather the material/information on a specific topic, comprehend it and

present/discuss the same in the class. He/she will be acquainted to share knowledge effectively in oral (seminar) and written form (formulate documents) in the form of report. The student will be evaluated on the basis of viva/ seminar (40 marks) and report (60 marks).

Sr. No.	Course Code	Subject	L	T	P	Total	Minor* Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	*	Program Elective-V	3	-	-	3	40	60	3	3
2	**	Open Elective	3	-	-	3	40	60	3	3
3	MTPE-207A	Dissertation Phase-I	-	-	20	20	100	-	10	--
		Total	**6**		**20**	**26**	**180**	**120**	**16**	

SEMESTER-III

*** PROGRAM ELECTIVE - V**		
1.	MTEL-201A	Distributed Generation
2.	MTEL-203A	Electric Drives & Control
3.	MTEL-205A	Power System Restructuring & Deregulation

**** OPEN ELECTIVE**		
1.	MTOE-201A	Business Analytics
2.	MTOE-203A	Industrial Safety
3.	MTOE-205A	Operation Research
4.	MTOE-207A	Cost Management of Engineering Projects
5.	MTOE-209A	Composite Materials
6.	MTOE-211A	Waste to Energy

SEMESTER-IV

Sr. No.	Course Code		L	T	P	Total	Minor Test	Major Test	Cr.	Duration of Exam (Hrs.)
1	MTPE-202A	Dissertation Phase-II	-	-	32	-	100	200	16	--
						Total	**100**	**200**	**16**	

Total Credits – 68

Note 1: At the end of the second semester each student is required to do his/her Dissertation work in the identified area in consent of the Guide/Supervisor. Synopsis for the Dissertation Part-I is to be submitted within three weeks of the beginning of the Third Semester.

Note 2: Each admitted student is required to submit the report of his/her Dissertation Part-I as per the schedule mentioned in Academic calendar for the corresponding academic session otherwise the Dissertation Part-II cannot be continued at any level.

Note 3: Each admitted student is required to submit his/her final Dissertation Part-II as per the schedule mentioned in Academic calendar for the corresponding academic session only after the publication of two papers in a journal/International/National conference of repute like IEEE, Springer, Elsevier,

ACM etc.

Note 4: The course of program/open elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength of the class.