KURUKSHETRA UNIVERSITY, KURUKSHETRA

(ESTABLISHED BY THE STATE LEGISLATURE ACT XII OF 1956)

('A++' GRADE NAAC ACCREDITED)

Scheme & Syllabus of
B. Tech. Degree
in
Mechanical & Mechatronics Engineering
(Additive Manufacturing)

(2024-2025)

GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit*:

1Hr.Lecture (L) per week	1Credit
1Hr. Tutorial (T) per week	1Credit
1Hr.Practical (P) per week	0.5Credit
2Hours Practical (P) per week	1Credit

*Except for mandatory and value added courses.

B. Range of Credits: The total number of credits proposed for the four-year B.Tech. Degree in Mechanical & Mechatronics Engineering (Additive Manufacturing) is kept as 174. In addition to this, for B.Tech. with Honors & specialization/minor degree, the student has to acquire additional 18-20 credits through MOOC courses offered at SWAYAM/NPTEL portal.

C. Structure of UG Program in Mechanical & Mechatronics Engineering (Additive Manufacturing) :

The structure of UG program in Mechanical & Mechatronics Engineering (Additive Manufacturing) is having the following categories of courses with the breakup of credits as given:

S. No.	Category	Breakup of Credits (Total 174)
1	Humanities and Social Sciences including Management courses	13.5
2	Basic Science courses	24
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	24.5
4	Professional core courses	76
5	Project work, seminar and internship in industry or elsewhere	11
6	Professional Elective courses relevant to chosen Specialization/branch	12
7	Open subjects–Electives from other technical and /or emerging subjects	6
8	Value Added and Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution , Essence of Indian Knowledge Tradition], [IDEAWorkshop, Personality Development and Soft Skills, National/International languages, NCC/NSS/Yoga/Sports/Technical and cultural activities]	7 (1 for each course)
	Total	**174**

D.Course code and definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
C	Credits
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSC/HSM	Humanities and Social Sciences including Management courses
MMAC	Program core courses
MMAP	Professional Elective courses
MMAO	Open Elective courses
VAC	Value Added Courses
MAC	Mandatory Courses

CATEGORY-WISE COURSES:
HUMANITIES & SOCIAL SCIENCES COURSES [HSC/HSM]

S.No	Code No.	Subject	Semester	Credits
1	B24-HSC-101	English for Technical Writing	I/II	**2:0:2=3**
2	B24-HSC-102	Design Thinking	I/II	**0:0:3=1.5**
3	B24-HSM-101	Universal Human Values- II: Understanding Harmony And Ethical Human Conduct	I/II	**3:0:0=3**
4	B24-HSM-202	Innovation, Start-up and Entrepreneurship	IV	**3:0:0=3**
5	B24-HSM-401	Organizational Behaviour	VII	**3:0:0=3**
			Total	**13.5**

BASIC SCIENCE COURSES [BSC]

S. No	Code No.	Subject	Semester	Credits
1	B24-BSC-104	Engineering Chemistry	I/II	**3:0:2=4**
2	B24-BSC-107	Mathematics-I	I	**3:1:0=4**
3	B24-BSC-106	Biology	I/II	**3:0:0=3**
4	B24-BSC-101	Semiconductor Physics	I/II	**3:1:2=5**
5	B24-BSC-108	Mathematics-II	II	**3:1:0=4**
6.	B24-BSC-201	Mathematics-III	III	**3:1:0=4**
			Total	**24**

ENGINEERING SCIENCE COURSES [ESC]

S. No	Code No.	Subject	Semester	Credits
1	B24-ESC-101	Programming for Problem Solving	I/II	**3:0:2=4**
2	B24-ESC-107	Manufacturing Processes Workshop	I/II	**0:0:3=1.5**
3	B24-ESC-102	Engineering Graphics and Design	I/II	**1:0:4=3**
4	B24-ESC-104	Basic Electrical Engineering	I/II	**3:1:2=5**
5	B24-ESC-201	Engineering Thermodynamics	III	**3:1:0=4**
6.	B24-ESC-203	Measurement and Control	III	**3:0:0=3**
7.	B24-ESC-202	Mechatronics	IV	**3:0:2=4**
Total				**24.5**

PROGRAM CORE COURSES [MMAC]

S. No	Code No.	Subject	Semester	Credits
1	B24-MMAC-201	Theory of Machines	III	**3:1:2=5**
2	B24-MMAC-203	Mechanics of Solids	III	**3:1:2=5**
3	B24-MMAC-205	Digital Electronics	III	**3:0:2=4**
4	B24-MMAC-202	Fluid Mechanics and Machines	IV	**4:1:2=6**
5	B24-MMAC-204	Pneumatic and Hydraulic Systems	IV	**3:0:2=4**
6	B24-MMAC-206	Programmable Logic Controller	IV	**3:0:2=4**
7	B24-MMAC-208	Manufacturing Technology	IV	**3:0:0=3**
8	B24-MMAC-301	Heat Transfer	V	**3:1:2=5**
9	B24-MMAC-303	Production Technology	V	**3:0:2=4**
10	B24-MMAC-305	Data Structure and Algorithms	V	**3:0:2=4**
11	B24-MMAC-307	Design of Machine Elements	V	**2:4:0=6**
12	B24-MMAC-309	Sensors and Actuators	V	**3:0:0=3**
13	B24-MMAC-302	Embedded Systems	VI	**3:0:2=4**
14	B24-MMAC-304	Computer Aided Design and Manufacturing	VI	**3:0:2=4**
15	B24-MMAC-306	Refrigeration and Air-conditioning	VI	**3:1:2=5**
16	B24-MMAC-308	Internal Combustion Engines	VI	**3:0:0=3**
17	B24-MMAC-401	Automobile Engineering	VII	**3:0:0=3**
18	B24-MMAC-403	Python for Mechanical Engineering	VII	**3:0:2=4**
			Total	**76**

SKILL ENHANCEMENT BASED PROJECT WORK, SEMINAR AND INTERNSHIP

S. No	Code No.	Subject	Semester	Credits
1	B24-MMAC-310	Project-I	VI	**0:0:4=2**
2	B24-MMAC-405	Project-II	VII	**0:0:8=4**
3	B24-MMAC-402 /404/406/408	Project-IV/Industrial Training/ Entrepreneurship/Start-up	VIII	**0:0:10=5**
			Total	**11**

PROGRAMME ELECTIVES [MMAP]

Sr. No.	Subject	Semester	Credits
1	PROGRAMMEELECTIVE-I	VI	**3:0:0=3**
2	PROGRAMMEELECTIVE-II	VI	**3:0:0=3**
3	PROGRAMMEELECTIVE-III	VII	**3:0:0=3**
4	PROGRAMMEELECTIVE-IV	VIII	**3:0:0=3**
	Total		**12**

LIST OF PROGRAMME ELECTIVE COURSES [MMAP]

S. No	Code No.	Subject	Semester	Credits
1	B24-MMAP-302	Renewable Energy Resources	VI	**3:0:0=3**
2	B24-MMAP-304	Smart Materials	VI	**3:0:0=3**
3	B24-MMAP-306	Industry4.0	VI	**3:0:0=3**
4	B24-MMAP-308	Welding Technology	VI	**3:0:0=3**
5	B24-MMAP-310	Theory of Elasticity and Plasticity	VI	**3:0:0=3**
6	B24-MMAP-312	Power Plant Engineering	VI	**3:0:0=3**
7	B24-MMAP-314	Optimization Techniques	VI	**3:0:0=3**
8	B24-MMAP-316	Design of Transmission Systems	VI	**3:0:0=3**
9	B24-MMAP-318	Non-Conventional Machining	VI	**3:0:0=3**
10	B24-MMAP-320	Industrial Robotics	VI	**3:0:0=3**
11	B24-MMAP-322	Acoustics and Noise Control	VI	**3:0:0=3**
12	B24-MMAP-324	Product Design and Development	VI	**3:0:0=3**
13	B24-MMAP-401	Manufacturing Automation	VII	**3:0:0=3**
14	B24-MMAP-403	Finite Element Analysis	VII	**3:0:0=3**
15	B24-MMAP-405	Air-conditioning System Design	VII	**3:0:0=3**
16	B24-MMAP-407	Non-destructive Testing	VII	**3:0:0=3**
17	B24-MMAP-409	Computational Fluid Dynamics	VII	**3:0:0=3**
18	B24-MMAP-411	Heating, Ventilation and Air-conditioning systems	VII	**3:0:0=3**
19	B24-MMAP-402	Quality and Reliability Engineering	VIII	**3:0:0=3**
20	B24-MMAP-404	Composite Materials	VIII	**3:0:0=3**
21	B24-MMAP-406	Additive Manufacturing	VIII	**3:0:0=3**
22	B24-MMAP-408	Tool Design	VIII	**3:0:0=3**
23	B24-MMAP-410	Total Quality Management	VIII	**3:0:0=3**
24	B24-MMAP-412	Concurrent Engineering	VIII	**3:0:0=3**
25	B24-MMAP-414	Foundry Engineering	VIII	**3:0:0=3**
26	B24-MMAP-416	Ergonomics	VIII	**3:0:0=3**

OPEN ELECTIVES [MMAO]

Sr. No.	Subject	Semester	Credits
1	**OPENELECTIVE-I**	VII	**3:0:0=3**
2	**OPENELECTIVE-II**	VIII	**3:0:0=3**
		Total	**6**

LIST OF OPEN ELECTIVE COURSES [MMAO]

S. No	Code No.	Subject	Semester	Credits
1	B24-MMAO-401	Internet of Things	VII	**3:0:0=3**
2	B24- MMAO-403	Basics of Electric Vehicle	VII	**3:0:0=3**
3	B24-MMAO-405	Management Information System	VII	**3:0:0=3**
4	B24-MMAO-407	Waste to Energy	VII	**3:0:0=3**
5	B24-MMAO-409	Consumer Electronics	VII	**3:0:0=3**
6	B24-MMAO-411	Bioinformatics	VII	**3:0:0=3**
7	B24-MMAO-402	Intellectual Property Rights(IPR) and Regulatory Framework	VIII	**3:0:0=3**
8	B24-MMAO-404	Digital Marketing	VIII	**3:0:0=3**
9	B24-MMAO-406	Supply Chain Management	VIII	**3:0:0=3**
10	B24-MMAO-408	Biomechanics	VIII	**3:0:0=3**
11	B24-MMAO-410	Artificial Intelligence	VIII	**3:0:0=3**
12	B24-MMAO-412	Industrial Engineering	VIII	**3:0:0=3**
13	B24-MMAO-414	Block Chain Technology	VIII	**3:0:0=3**
14	B24-MMAO-416	Gender Sensitivity	VIII	**3:0:0=3**

VALUE ADDED AND MANDATORY COURSES [VAC/MAC]

S. No.	Course No./Code	Subject	Semester	Hrs/Week L:T:P	Credits
1	B24-VAC-101	Personality Development and Soft Skills	I/II	2:0:0	1
2	B24-VAC-102	IDEA Workshop	I/II	0:0:3	1
3	B24-VAC-302/304/	Hindi Language Skills/Sanskrit Language	VI	2:0:0	1
4	306/308/310 B24-VAC-401/403	Skills/German Language Skills/Japanese Language Skills/French Language Skills NCC/NSS/Sports/Yoga/Technical or	VII	0:0:2	1
5	/405/407/409/411 B24-MAC-201	Cultural Club/Society activities Environmental Studies	III	3:0:0	1
6	B24-MAC-202	Essence of Indian Traditional Knowledge	IV	3:0:0	1
7	B24-MAC-301	Constitution of India	V	3:0:0	1
Total					7

SEMESTER WISE STRUCTURE

Bachelor of Technology [Mechanical & Mechatronics Engineering (Additive Manufacturing)]
KUK Credit-Based (2025-26 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)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1	B24-BSC-201	Mathematics-III	3:1:0	4	4	70	30	--	100	3
2	B24-MMAC-201	Theory of Machines	3:1:0	4	4	70	30	--	100	3
3	B24-MMAC-203	Mechanics of Solids	3:1:0	4	4	70	30	--	100	3
4	B24- MMAC-205	Digital Electronics	3:0:0	3	3	70	30	--	100	3
5	B24-ESC-201	Engineering Thermodynamics	3:1:0	4	4	70	30	--	100	3
6	B24-ESC-203	Measurement and Control	3:0:0	3	3	70	30	--	100	3
7	B24-MMAC-207	Theory of Machines Lab	0:0:2	2	1	--	40	60	100	3
8	B24-MMAC-209	Mechanics of Solids Lab	0:0:2	2	1	--	40	60	100	3
9	B24-MMAC-211	Digital Electronics Lab	0:0:2	2	1	--	40	60	100	3
10	B24-MAC-201	Environmental Studies	3:0:0	3	1	70	30	--	100	3
Total				**31**	**26**	**490**	**330**	**180**	**1000**	

Bachelor of Technology [Mechanical & Mechatronics Engineering (Additive Manufacturing)]
KUK Credit-Based (2025-26 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)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1	B24-ESC-202	Mechatronics	3:0:0	3	3	70	30	--	100	3
2	B24-MMAC-202	Fluid Mechanics and Machines	4:1:0	5	5	70	30	--	100	3
3	B24-MMAC-204	Pneumatic and Hydraulic Systems	3:0:0	3	3	70	30	--	100	3
4	B24-MMAC-206	Programmable Logic Controller	3:0:0	3	3	70	30	--	100	3
5	B24-MMAC-208	Manufacturing Technology	3:0:0	3	3	70	30	--	100	3
6	B24-HSM-202	Innovation, Start-up and Entrepreneurship	3:0:0	3	3	70	30	--	100	3
7	B24-ESC-204	Mechatronics Lab	0:0:2	2	1	--	40	60	100	3
8	B24-MMAC-210	Fluid Mechanics and Machines Lab	0:0:2	2	1	--	40	60	100	3
9	B24-MMAC-212	Pneumatic and Hydraulic Systems Lab	0:0:2	2	1	--	40	60	100	3
10	B24-MMAC-214	Programmable Logic Controller Lab	0:0:2	2	1	--	40	60	100	3
11	B24-MAC-202	Essence of Indian Traditional Knowledge	3:0:0	3	1	--	100	--	100	3
Total				**31**	**25**	**420**	**440**	**240**	**1100**	

Note:

- **All students have to undertake the industrial training for 4 to 6weeks after 4th semester which will be evaluated in 5thsemester.**

Bachelor of Technology [Mechanical & Mechatronics Engineering (Additive Manufacturing)]
KUK Credit-Based (2026-27 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)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1	B24-MMAC-301	Heat Transfer	3:1:0	4	4	70	30	--	100	3
2	B24-MMAC-303	Production Technology	3:0:0	3	3	70	30	--	100	3
3	B24-MMAC-305	Data Structures & Algorithms	3:0:0	3	3	70	30	--	100	3
4	B24-MMAC-307	Design of Machine Elements	2:4:0	6	6	70	30	--	100	3
5	B24-MMAC-309	Sensors & Actuators	3:0:0	3	3	70	30	--	100	3
6	B24-MMAC-311	Heat Transfer Lab	0:0:2	2	1	--	40	60	100	3
7	B24-MMAC-313	Production Technology Lab	0:0:2	2	1	--	40	60	100	3
8	B24-MMAC-315	Data Structures & Algorithms Lab	0:0:2	2	1	--	40	60	100	3
9	*B24-MMAC-317	*Industrial Training-I	2:0:0	2	--	--	100	--	100*	--
10	B24-MAC-301	Constitution of India	2:0:0	2	1	--	100	--	100	3
Total				**29**	**23**	**350**	**470**	**180**	**1000**	

Note:

- ***B24-MMAC-317 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 in Internal Assessment to qualify.**

Bachelor of Technology [Mechanical & Mechatronics Engineering (Additive Manufacturing)]
KUK Credit-Based (2026-27 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)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1	B24-MMAC-302	Embedded Systems	3:0:0	3	3	70	30	--	100	3
2	B24-MMAC-304	Computer Aided Design and Manufacturing	3:0:0	3	3	70	30	--	100	3
3	B24-MMAC-306	Refrigeration and Air-conditioning	3:1:0	4	4	70	30	--	100	3
4	B24-MMAC-308	Internal Combustion Engines	3:0:0	3	3	70	30	--	100	3
5		*Program Elective-I	3:0:0	3	3	70	30	--	100	3
6		*Program Elective-II	3:0:0	3	3	70	30	--	100	3
7	B24-MMAC-310	Project-I	0:0:4	4	2	--	--	100	100	3
	B24-MMAC-312	Embedded Systems Lab	0:0:2	2	1	--	40	60	100	3
8	B24-MMAC-314	Computer Aided Design and Manufacturing Lab	0:0:2	2	1	--	40	60	100	3
9	B24-MMAC-316	Refrigeration and Air-conditioning Lab	0:0:2	2	1	--	40	60	100	3
10	B24-VAC-302/304/306/308/310	Hindi Language Skills/ Sanskrit Language Skills/German Language Skills/Japanese Language Skills/French Language Skills	2:0:0	2	1	--	100	--	100	3
		Total		**31**	**25**	**420**	**400**	**280**	**1100**	

*Program Elective-I			*Program Elective-II	
Course No.	**Course Name**		**Course No.**	**Course Name**
B24-MMAP-302	Renewable Energy Resources		B24-MMAP-314	Optimization Techniques
B24-MMAP-304	Smart Materials		B24-MMAP-316	Design of Transmission Systems
B24-MMAP-306	Industry4.0		B24-MMAP-318	Non-Conventional Machining
B24-MMAP-308	Welding Technology		B24-MMAP-320	Industrial Robotics
B24-MMAP-310	Theory of Elasticity and Plasticity		B24-MMAP-322	Acoustics and Noise Control
B24-MMAP-312	Power Plant Engineering		B24-MMAP-324	Product Design and Development

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

- **All students have to undertake the industrial training for 4 to 6 weeks after 6th semester which will be evaluated in 7th semester.**

Bachelor of Technology [Mechanical & Mechatronics Engineering (Additive Manufacturing)]
KUKCredit-Based (2027-28 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)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1		*Program Elective-III	3:0:0	3	3	70	30	--	100	3
2		**Open Elective-I	3:0:0	3	3	70	30	--	100	3
	B24-HSM-401	Organizational Behaviour	3:0:0	3	3	70	30	--	100	3
3	B24-MMAC-401	Automobile Engineering	3:0:0	3	3	70	30	--	100	3
4	B24-MMAC-403	Python for Mechanical Engineering	3:0:0	3	3	70	30	--	100	3
5	B24-MMAC-405	Project-II	0:0:8	8	4	--	100	100	200	3
6	B24-MMAC-407	Python for Mechanical Engineering Lab	0:0:2	2	1	--	40	60	100	3
7	#B24-MMAC-409	Industrial Training-II	2:0:0	2	--	--	100	--	100#	
8	#B24-MMAC-411	Seminar	0:0:2	2	--		100		100#	
9	##B24-VAC-401/403/405/407/409/411	NCC/NSS/Sports/Yoga/ Technical or Cultural Club/Society activities	2:0:0	2	1	--	100	--	100	3
		Total		**31**	**21**	**350**	**590**	**160**	**1100**	

*Program Elective-III					**Open Elective-I	
Course No.	**Course Name**				**Course No.**	**Course Name**
B24-MMAP-401	Manufacturing Automation				B24-MMAO-401	Internet of Things
B24-MMAP-403	Finite Element Analysis				B24-MMAO-403	Basics of Electric Vehicle
B24-MMAP-405	Air-conditioning System Design				B24-MMAO-405	Management Information System
B24-MMAP-407	Non-destructive Testing				B24-MMAO-407	Waste to Energy
B24-MMAP-409	Computational Fluid Dynamics				B24-MMAO-409	Consumer Electronics
B24-MMAP-411	Heating, Ventilation and Air-conditioning systems				B24-MMAO-411	Bioinformatics

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

- **#B24-MMAC-409 and #B24-MMAC-411 are mandatory credit-less courses in which the students will be evaluated for the industrial training undergone after 6th semester and Seminar on the thrust of the discipline. Students will be required to get passing marks to qualify.**
- **##B24-VAC-401/403/405/407/409/411 are single credit value added courses in which NCC/NSS/Sports/Yoga/Technical or Cultural Club/Society activities will be joined by students in first year and will be evaluated in 7th semester by the institute based upon continuous evaluation model as per guidelines.**

Bachelor of Technology [Mechanical & Mechatronics Engineering (Additive Manufacturing)]
KUKCredit-Based (2027-28 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)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1		*Program Elective-IV	3:0:0	3	3	70	30	--	100	3
2		**Open Elective-II	3:0:0	3	3	70	30	--	100	3
3.	B24-MMAC-402/404/406/408	Project-III/ Industrial Training/Entrepreneurship/ Start-up	0:0:10	10	5		100	100	200	3
			Total	**16**	**11**	**140**	**160**	**100**	**400**	

*Program Elective-IV		**Open Elective-II	
Course No.	**Course Name**	**Course No.**	**Course Name**
B24-MMAP-402	Quality and Reliability Engineering	B24-MMAO-402	Intellectual Property Rights(IPR) and Regulatory Framework
B24-MMAP-404	Composite Materials	B24-MMAO-404	Digital Marketing
B24-MMAP-406	Additive Manufacturing	B24-MMAO-406	Supply Chain Management
B24-MMAP-408	Tool Design	B24-MMAO-408	Biomechanics
B24-MMAP-410	Total Quality Management	B24-MMAO-410	Artificial Intelligence
B24-MMAP-412	Concurrent Engineering	B24-MMAO-412	Industrial Engineering
B24-MMAP-414	Foundry Engineering	B24-MMAO-414	Block Chain Technology
B24-MMAP-416	Ergonomics	B24-MMAO-416	Gender Sensitivity

Note:

- **The *Program Elective-IV and **Open Elective-II will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**
- **In case of semester-long project work/training done in industry, the *Program Elective- IV and **Open Elective-II may be offered in online mode through MOOC courses from SWAYAM/NPTEL.**

B24-BSC-201	Mathematics-III						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Exam Time**
3	**1**	**0**	**4**	**70**	**30**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	Introduction about the concept of Laplace transform and how it is useful in solving the definite integrals and initial value problems.
CO 2	To introduce the fundamental concepts of probability to analyze and predict outcomes in real-life situations.
CO 3	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.
CO 4	To make the students familiar about basic statistics including measures of central tendency, measures of dispersion, correlation, and regression.

UNIT-I

Laplace Transform: Introduction, Laplace Transform of Elementary Functions, Basic properties of Laplace Transform, Laplace transform of periodic functions, finding inverse Laplace transform by different methods, Convolution theorem, solving ordinary differential equations by Laplace Transform method.

UNIT-II

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-III

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-IV

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.

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

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 Manish Goyal, A textbook 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.

B24-MMAC-201	Theory of Machines						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Exam Time**
3	**1**	**0**	**4**	**70**	**30**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	To understand the kinematics of simple mechanisms and their applications.
CO 2	To comprehend the process of profile generation in cams and followers.
CO 3	To gain an understanding of turning moment diagrams with flywheels and the mechanisms employed in automobiles.
CO 4	To acquire knowledge of belts and chain drives.

UNIT-I

Simple Mechanisms: Introduction, kinematic link or element, types of links, structure, difference between a machine and a structure, kinematic pair, types of constrained motions, classification of kinematic pairs, kinematic chain, types of joint in a chain, mechanism, number of degrees of freedom for a plane mechanism, application of Kutchbach criterion for plane mechanism, Grubler's criterion for plane mechanism, inversion of mechanism, types of kinematic chain, four bar chain or quadric cycle chain, inversion of four bar chain, single slider crank chain and its inversions, double slider crank chain and its inversions.

UNIT-II

Cams and Followers: Introduction, classification of followers, classification of cam, terms used in radial cams, Motion of the follower: cam profile by graphical methods with knife edge and radial roller follower for uniform velocity, simple harmonic motion, uniform acceleration and retardation and cycloidal motion of followers, Problems.

UNIT-III

Turning Moment Diagrams and Flywheel: Turning moment diagram for a four stroke cycle internal combustion engine, turning moment diagram for a multi-cylinder engine, fluctuation of energy, flywheel, energy stored in a flywheel, Problems.

Automobile steering gear mechanisms: Fundamental equation for correct steering, Davis and Ackerman steering gear, Hooke's joint (universal coupling), Double hooke's joint.

UNIT-IV

Belt and Chain drives: Introduction,types of flat belt drives, velocity ratio of belt drive, velocity ratio of compound belt drive, slip of belt, creep of belt, length of an open belt drive, length of crossed belt drive, power transmitted by a belt, ratio of driving tensions for flat belt drive, determination of angle of contact, centrifugal tension, maximum tension in the belt, condition for the transmission of maximum power, initial tension in the belt, chain drives, terms used in chain drive, classification of chains, relation between pitch and pitch circle diameter, length of a chain, Problems.

Gears and Gear Trains: Classification & terminology, length of path of contact, length of arc of contact, contact ratio, Interference & undercutting in involute gear teeth, Minimum number of teeth on gear and pinion to avoid interference. Gear Trains**:**simple, compound and reverted gear trains, Problems.

Suggested Books:

1. Theory of machines: S. S. Rattan, Tata McGraw HillPublications
2. Theory of machines : R S Khurmi, S Chand Publications
3. Theory of Mechanism and Machines: JagdishLal, Metropolitan BookCo.
4. Mechanism synthesis and analysis: A.H. Soni, McGraw HillPublications.
5. Theory of Machines: P.L.Ballaney, KhannaPublisher.
6. Mechanism and Machine Theory: J.S. Rao and R.V. Dukkipati Second Edition New age International.
7. Kinematics of Machines-Dr. Sadhu Singh, Pearson Education.
8. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition, MGH, New York.
9. Theory of Mechanisms and Machines: AmitabhaGhosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press.

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

B24-MMAC-203	Mechanics of Solids						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Exam Time**
3	**1**	**0**	**4**	**70**	**30**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	Apply fundamental principles of mechanics & principles of equilibrium to simple and practical problems of engineering, determine centroid and moment of inertia of a different geometrical shape and able to understand its importance.
CO 2	Explain the basic concepts of stress and strain and solve the problems, Determine and calculate the values of principal stresses.
CO 3	Express the concept of torsion of circular shaft and able to solve the problems on torsion of circular shaft. Illustrate and solve the problems on bending stresses in beams
CO 4	Differentiate different types of stresses induced in thin pressure vessel and solve the problems. Use of Lame's equation to calculate the stresses induced in thick pressure vessel.

UNIT-I

Introduction: Force, types of forces, Characteristics of a force, System of forces, Composition and resolution of forces, forces in equilibrium, principle and laws of equilibrium, Free body diagrams, Lami's Theorem, equations of equilibrium

Concept of Centre of gravity and centroid: Centroid of various shapes: Triangle, circle, semicircle, trapezium, I, T, L Sections etc., theorem of parallel and perpendicular axes, moment of inertia of simple geometrical figures, Numerical Problems

UNIT-II

Simple Stresses & Strains: Concept & types of Stresses and Strains, Poisson's ratio, Stresses and Strain in simple and compound bars under axial loading, Stress Strain Diagram, Hook's law, elastic constants, Young's modulus (E), Modulus of rigidity (G or C), Numerical problems.

Principle Stresses: Two dimensional systems, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stresses, Numerical Problems.

UNIT-III

Torsion of Circular Members: Derivation of equation of torsion, Solid and hollow circular shafts, Simple Numerical problems.

Bending Stresses in Beams: Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I, T, Angle, channel sections, Numerical problems.

UNIT-IV

Thin-Walled Vessels: Hoop & Longitudinal stresses & strains in cylindrical vessels & their derivations under internal pressure, Numerical Problems.

Thick Cylinders & Spheres: Derivation of Lame's equations, radial & hoop stresses in thick cylinders subjected to internal fluid pressure only, Simple Numerical Problems

Suggested Books:

1. Strength of Materials – R.K. Rajput, Dhanpat Rai & Sons.
2. Strength of Materials – Sadhu Singh, Khanna Publications.
3. Strength of Materials – R.K. Bansal, Laxmi Publications.
4. Strength of Material – Rider – ELBS

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

B24-MMAC-205	Digital Electronics						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Exam Time**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	The students will develop the knowledge of digital logic, digital systems, and their technical applications.
CO 2	The students will understand and design combinational logic circuits.
CO 3	The students will be able to design and analyze sequential circuits using flip-flops and counters.
CO 4	The students will be able to understand the concept of converters and memories.

UNIT-I

Introduction to Digital Systems & Binary Codes: Comparison of Analog and Digital Systems, Number Systems: binary, octal, hexadecimal, BCD and others. Conversion from one system to another, Binary Arithmetic including 1's and Two Complement Arithmetic, Importance of Binary and Hexadecimal Numbers.

Logic Gates and Boolean algebra: AND, OR, NOT, XOR, XNOR, operation NAND, NOR use of universal gates for performing different operations. Laws Boolean algebra, Demorgan's theorems. Relating truth table to a Boolean expression. Multi-level circuits.

UNIT-II

Combinational Logic Circuits: Canonical Logic Form, minterm, maxterm SOP and POS implementation. Implementing a logic function using universal gates. K-maps and their use in simplifying Boolean expressions, Variable entered maps for five variables functions.

Adders: half and full adder, Subtractors: half and full subtractor, Multiplexer and their use in combinational design, Demultiplexers, encoder and Decoder.

UNIT-III

Sequential Logic Circuits: Comparison of combinational and sequential circuits, flip-flops, SR, T, D, JK, master slave JK, converting one flip-flop to another. Synchronous and Asynchronous Counters, modulus of a counter, up / down counter, Counter designing by drawing state transition diagram and state transition table using all kinds of Flip –Flops. Ring counter, Johnson counter, twisted ring counter.

UNIT-IV

A/D and D/A Converters: Digital to Analog converters- Weighted Resistor, R-2R Ladder, Specifications of D/A Converters. Analog to digital Converters – Quantization and Encoding, Flash Type, Successive Approximation, Dual Slope A/D Converter.

Semi Conductor Memories: Memory Organisation and Operation, Classification and characteristics of Memories, Read-only Memory, Read and Write Memory

Text Books

1. R P Jain, Modern Digital Electronics, 4th Edition, TMH
2. Morris Mano (2008), "Digital Design", PHI, 4th edition.
3. Malvino & Brown (2008), "Digital Computer Electronics", Tata McGraw Hill, Reprint 3rd Edition.

Reference Books

1. Anand Kumar, Fundamental of Digital Circuits, 2nd Edition, PHI-2009
2. R.P Jain (2007), "Digital Electronics and Microprocessors", Tata McGraw-Hill, 25th reprint
3. Roth and John (2011), "Principles of Digital Systems Design", Cengage Learning, Sixth Indian Reprint.
4. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.

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

B24-ESC-201	Engineering Thermodynamics						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Exam Time**
3	**1**	**0**	**4**	**70**	**30**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	Analyze the work and heat interactions associated with a prescribed process path and to perform an analysis of a flow system.
CO 2	Define the fundamentals of the first and second laws of thermodynamics and explain their application to a wide range of systems.
CO 3	Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.
CO 4	Solve the problems related to Steam and plot the processes on H-S and T-S diagram. Understand thermodynamics relations.

Unit-I

Basic Concepts: Thermodynamics: Macroscopic and Microscopic Approach, Thermodynamic Systems, Surrounding and Boundary, Thermodynamic Property – Intensive and Extensive, Thermodynamic Equilibrium, State, Path, Process and Cycle, Quasi-static, Reversible and Irreversible Processes, Working Substance. Concept of Thermodynamic Work and Heat, Zeroth Law of Thermodynamic and its utility

Unit-II

First Law of Thermodynamics: Energy and its Forms, Energy and 1st law of Thermodynamics, Internal Energy and Enthalpy, 1st Law Applied to Non-Flow Process, Steady Flow Process, Free Expansion Process.

Second Law of Thermodynamics: Limitations of First Law, Thermal Reservoir Heat Source and Heat Sink, Heat Engine, Refrigerator and Heat Pump, Kelvin- Planck and Clausius Statements and Their Equivalence, Perpetual Motion Machine of Second Kind. Carnot Cycle, Carnot Heat Engine and Carnot Heat Pump.

Unit -III

Availability, Irreversibility and Equilibrium: High and Low Grade Energy, Available Energy and Unavailable Energy, Availability of a Non-Flow or Closed System, Availability of a Steady Flow System, Helmholtz and Gibb's Functions, Effectiveness and Irreversibility.

Entropy: Clausius Inequality and Entropy, Principle of Entropy Increase, Temperature-Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of thermodynamics.

Unit-IV

Pure Substance: Pure Substance and its Properties, Phase and Phase Transformation, Vaporization, Evaporation and Boiling , Saturated and Superheated Steam, Solid – Liquid – Vapour Equilibrium, T-V, P-V and P-T Plots During Steam Formation, Properties of Dry, Wet

and Superheated Steam, Property Changes During Steam Processes, Temperature – Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams, Throttling and Measurement of Dryness Fraction of Steam.

Thermodynamic Relations: TDS Relations, Enthalpy and Internal Energy as a Function of Independent Variables, Specific Heat Capacity Relations, Clapeyron Equation, Maxwell Relations.

Text Books:

1. Engineering Thermodynamics – C P Arora, Tata McGraw Hill
2. Engineering Thermodynamics – P K Nag, Tata McGraw Hill
3. Thermodynamics – An Engineering Approach; Y. A. Cengel, M. A. Boles; Tata McGraw Hill

Reference Books:

1. Thermal Science and Engineering – D S Kumar, S K Kataria and Sons
2. Engineering Thermodynamics -Work and Heat transfer – G F C Rogers and Maghew
Y R Longman

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

B24-ESC-203	Measurement and Control						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Exam Time**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	Students will understand the fundamentals of measurement systems and their performance characteristics.
CO 2	Students will be able to explain various instruments for the motion, force, torque measurement, measurement.
CO 3	Students will be able to explain various things related to pressure and temperature measurements.
CO 4	Students will be able to understand the various concepts related to control systems and different types of controller.

Unit-I

Introduction to Measurement: Significance of measurement, Different methods of measurement, Classification of measuring instruments, Application of measurement systems. Functional elements of a generalized measuring system, measuring standards. Introduction, types of error, uncertainties in performance parameters, propagation of uncertainties in compound quantity.

Performance Characteristics: Definition of range, span, accuracy, precision, drift, sensitivity, reproducibility, repeatability, dead zone, resolution, hysteresis, threshold, zero error, noise, linearity, loading effect, static characteristics.

Unit-II

Motion, Force and Torque Measurement: Introduction, relative motion, measuring devices, electro-mechanical, optical, photo electric, pneumatic, absolute motion devices, seismic devices, spring mass & force balance type, calibration, hydraulic load cell, pneumatic load cell, elastic force devices, separation of force components, electro-mechanical methods, torque transducer, torque meter.

UNIT-III

Pressure Measurement: Terminology, manometers, elastic transducer, calibration and testing.

Temperature Measurement: Introduction, measurement of temperature, non-electrical methods – solid rod thermometer, bimetallic thermometer, liquid in- glass thermometer, electrical methods – electrical resistance thermometers, semiconductor resistance sensors (thermistors), thermo-electric sensors, thermocouple materials, radiation methods (pyrometry), total radiation pyrometer, selective radiation pyrometer.

UNIT-IV

Control Analysis: Introduction, classification of control systems, control system terminology, servomechanism, process control and regulators, manual and automatic control systems, physical

systems and mathematical models, linear control systems, transfer function, block diagram, signal flow graphs.
Mechanical Controllers: Basics of actuators: pneumatic controller, hydraulic controller and their comparison, Comparators, form and finish measurement.

Text Books:

1. Mechanical measurements & control- By D.S. Kumar, Metropolitan book
2.Mechanical Measurements-BY S.P. Venkateshan, John Wiley & Sons Ltd., 2nd Edition
3.Fundamentals of Industrial Instrumentation and Process Control-By William C. Dunn, McGraw-Hill

Reference Books:

1. Automatic Control Systems- By S. Hasan Saeed
2. Instrumentation and Mechanical measurements- By A.K. Tayal, Galgotia Publ.
3. Measurements systems application and design-By Ernest Doebelin, McGraw-Hill

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

B24-MMAC-207	Theory of Machines Lab						
L	**T**	**P**	**Credit**	**Internal Assessment**	**Practical Exam**	**Total**	**Exam Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**

Course Outcomes	
CO1	To learn about various types of basic mechanism & their applications in different machines.
CO2	To learn about the working of Flywheel.
CO3	To experimentally calculate Gyroscopic couple of a motorized gyroscope.
CO4	To study the design and working of various gear, gear trains, steering systems, belt drives, brakes and dynamometers.

LIST OF EXPERIMENTS

1. To study inversions of single slider crank mechanisms.
2. To determine the modulus of rigidity of the material of a closed coil helical spring and the stiffness of a spring.
3. To determine experimentally, the moment of inertia of a flywheel.
4. To draw experimentally a curve of the follower-displacement v/s cam-angle.
5. To determine velocity & acceleration of slider in slider-crank mechanism and plot θ v/s x (displacement of slider).
6. To find out experimentally the coriolis component of acceleration and compare with theoretical values.
7. To determine the coefficient of friction between belt and pulley and plot a graph between $\log_{10} T_1/T_2$ v/s θ.
8. To study the different types of centrifugal and inertia governor with demonstration.
9. To find gyroscopic couple on motorized gyroscope and compare with applied couple.
10. To study different types of brakes and dynamometers with demonstration.
11. To calculate the torque on planet carrier and torque on internal gear using epicycle gear train and holding torque apparatus.
12. To study various types of steering mechanisms.

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

B24-MMAC-209	Mechanics of Solids Lab						
L	**T**	**P**	**Credit**	**Internal Assessment**	**Practical Exam**	**Total**	**Exam Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Course Outcomes							
CO1	To Familiarize with different Mechanical Properties						
CO2	Analyze the tensile and compressive strength of a specimen for applying in a practical design-based project work.						
CO3	Determine the hardness, impact strength, fatigue strength to analyze the application of a specific material for a given design requirements for different loading conditions of machines.						
CO4	Evaluate the capacity of a material to withstand torsional stresses for a safe and sustainable design of machine elements.						

LIST OF EXPERIMENTS

1. To study the Rockwell Hardness Testing Machine and to find the hardness of a given specimen
2. To Study Pendulum Impact Testing machine and to find out Impact Strength of a given Specimen
3. To perform Tensile Test on a given specimen on UTM and to plot Stress/Strain Curve and to find Ultimate Stress and Breaking Stress of a given Specimen
4. To perform Torsion Test on a given specimen and to find the modulus of rigidity, torsional yield strength and modulus of rupture in torsion
5. To study Fatigue Testing Machine and to find out the fatigue strength of a given specimen
6. To study the Brinell Hardness Testing Machine and to find the Brinell hardness of a given specimen
7. To perform Erichsen deep-drawing test to determine the stretch-forming capacity of sheet metals using Erichsen Cupping Machine
8. To study the Vicker's Hardness Testing Machine and to find Vicker's hardness of a given specimen
9. To calculate, MA, VR and Efficiency of Worm & Worm Wheel. Also plot a graph between Load & Effort, Load & Efficiency etc.
10. To calculate, MA, VR and Efficiency of Winch Crab. Also plot a graph between Load & Effort, Load & Efficiency etc.

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

B24-MMAC-211	Digital Electronics Lab						
L	**T**	**P**	**Credit**	**Internal Assessment**	**Practical Exam**	**Total**	**Exam Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Course Outcomes							
CO1	Student will get knowledge of digital trainer kit and associated equipment.						
CO2	Student will get knowledge of gates, multiplexer and demultiplexer.						
CO3	Student will get knowledge of adder and decoder.						
CO4	Student will get knowledge of flip flops and counter.						

LIST OF EXPERIMENTS

1. Familiarization with Digital Trainer Kit and associated equipment.
2. Study of gates AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.
3. Design and realize a given function using K-Maps and verify its performance.
4. To verify the operation of Multiplexer.
5. To verify the operation of De-multiplexer.
6. To verify the operation of Half adder and Full Adder.
7. Study of Encoder and Decoder.
8. To verify the truth table of S-R, J-K, T, D Flip-flops.
9. To design and verify the operation of 3-bit asynchronous counter.
10. To design and verify the operation of asynchronous decode counter.

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

B24-MAC-201	Environmental Studies						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Exam Time**
3	**0**	**0**	**1**	**70**	**30**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	Students will enable to understand environmental problems at local and national level through literature and general awareness.
CO 2	The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues
CO 3	The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.
CO 4	Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world

UNIT-I

Natural Resources :Renewable and non-renewable resources: Natural resources and associated problems.

a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources.

d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

UNIT-II

Ecosystems: Concept of an ecosystem. Structure and function of an ecosystem. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems:

a. Forest ecosystem

b. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT-III

Biodiversity and its conservation: Introduction – Definition : genetic, species and ecosystem diversity. Biodiversity at global, National and local levels. Inida as a mega-diversity nation. Hot-

sports of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India.

UNIT-IV

Social Issues and the Environment: From Unsustainable to Sustainable development. Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion. Nuclear accidents and holocaust. Case Studies. Public awareness.

Field Work (Practical, any three)-

- Visit to a local area to document environmental assets -river/forest/grassland/ hill/mountain.
- Visit to a local polluted site- Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, and birds.
- Study of simple ecosystems- pond, river, hill slopes, etc.

-Visit to any Wildlife sanctuary, National Park or Biosphere Reserve.

Suggested Readings:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Kaushik, Anubha and Kaushik, C.P. (2004 Perspectives in Environmental Studies, New age International Publishers.
3. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd.
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
5. Clerk B.S., Marine Pollution, Clanderson Pross Oxford (TB).
6. Cunningham, W.P.Cooper, T.H. Gorhani, E & Hepworth, M.T.2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai.
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down to Earth, Centre for Science and Environment (R).
9. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)

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

.

B24-ESC-202	Mechatronics						
L	**T**	**P**	**Credit**	**EndSemester Exam**	**Internal Assessment**	**Total**	**ExamTime**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs.**

CourseOutcomes	
CO 1	Students will be able to understand Mechatronics systems and their applications. The students will be able to understand different sensors.
CO 2	Students will be able to understand various types of actuator.
CO 3	Students will be able to understandtransducers, and digital principles of number system, gates and Booleanalgebra
CO 4	Students will be able to understand the architecture of microprocessor and microcontroller

Unit-I

Introduction: Definition of mechatronics, Evolution of mechatronics, scope of mechatronics, components of a mechatronic system, mechatronics design approach, Examples of mechatronic systems, Advantages and disadvantages of mechatronics engineering ,Role of various disciplines in mechatronics, Applications of mechatronics.

Sensors: Introduction, Proximity sensors: eddy current proximity sensors, capacitive proximity sensor, inductive proximity switch, pneumatic sensors, light sensors: photodiodes, phototransistors, photoresistor, Digital Optical Encoders, selection of sensors.

Unit-II

Actuators: Introduction, Electrical actuators: DC Motors- PMDC motor, Stepper Motor, AC Motors: Single phase induction motor: Construction & working, application & disadvantages Three Phase Induction Motor: Construction & operation. Hydraulic Actuators: General aspects, Hydraulic power supply, linear actuators: cylinder types, single and double acting, telescoping cylinders, rotary actuators: hydraulic motors, gear motor, vane motor, piston motor. Pneumatic actuators: components of pneumatic system, Linear actuators: pneumatic cylinders, Rotary actuators: air motors.

Unit-III

Transduces: Classification of transducers, Resistance transducers: linear and angular potentiometers, Variable inductance transducers: self-generating type, passive type (LVDT), capacitive transducers: capacitive tachometer, piezoelectric transducer: Piezoelectric accelerometer. Photoelectric transducers: photo emissive cell, photovoltaic cell, photoconductive cell, photoelectric tachometer.

Unit-IV

Microprocessors: Introduction, Microprocessor based digital control, Microprocessor architecture, Terminology, Instruction types, Addressing modes, Intel's8085A microprocessor.

Microcontrollers: Introduction, Difference between microprocessor and microcontroller, General requirements for control and their implementation in microcontrollers, Classifications, Introduction of Intel 8051 microcontroller.

Text books:

1. A Textbook of Mechatronics- R. K Rajput, S. Chand & Company, 4th Edition 2016
2. Mechatronics, W. Bolton – Pearson Education Asia – 6th Reprint Edition, 2015.

Reference books:

1. Mechatronics Principles, Concepts and Application-Nitaigour and Premchand, Mahilik – Tata McGraw Hill – 2003
2. MECHATRONICS A Foundation Course- Clarence W. de Silva-CRC Press, Taylor & Francis Group-2010.
3. Mechatronic Systems Fundamentals-Rolf Isermann, Springer-2005.

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

B24-MMAC-202	Fluid Mechanicsand Machines						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**ExamTime**
4	**1**	**0**	**5**	**70**	**30**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	By the end of this course,students will understand the fundamental concepts of fluid properties.
CO 2	To grasp the fundamental concepts of fluid kinematics and dynamics.
CO 3	Students will be capable of estimating major and minor losses in pipes.
CO 4	Students will be able to explore dimensional analysis methods and performance evaluation of pumps and turbines.

UNIT-I

Fluid Properties: Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, weight density, specific volume, specific gravity, viscosity, compressibility, surface tension and capillarity.

Fluid Kinematics and Fluid Dynamics: Types of fluid flows, stream, streak and path lines; flow rate and continuity equation, Euler's equation, Navier-Stokes equation, Bernoulli's equation and its practical applications (venturimeter, orificemeter and pitot tube),Problems.

UNIT-II

Viscous and Turbulent Flow: Flow of viscous fluid through circular conduits, methods of determination of coefficient of viscosity (capillary tube method, falling sphere resistance method and orifice type viscometer),Darcy Weisbach equation, friction factor, minor energy losses in pipes, flow through series and parallel connection of pipes, branched pipes, Problems.

Dimensional Analysis: Dimensional homogeneity, methods of dimensional analysis, type of forces acting in moving fluid, dimensionless numbers and its applications, Problems.

UNIT-III

Hydraulic Pumps: Centrifugal pumps, working principle, main parts of a centrifugal pump, workdone by the centrifugal pump on water, heads and efficiencies of a centrifugal pump, minimum speed for starting a centrifugal pump, priming, cavitation in pumps, Reciprocating pumps, working principle, main parts of a reciprocating pump, discharge, workdone and power required to drive a single and double acting pump, slip of reciprocating pump, Problems.

UNIT-IV

Hydraulic Turbines: Introduction, heads and efficiencies, Classification of hydraulic turbines, velocity triangles and workdone for Pelton wheel, Francis turbine and Kaplan turbines, draft tube and types, Specific speed, unit quantities, performance curves for turbines, governing of turbines. Problems.

Text Books:

1. Introduction to Fluid Mechanics – R.W. Fox, Alan T. McDonald, P.J. Pritchard, Wiley Publications.
2. Fluid Mechanics – Frank M. White, McGraw Hill.
3. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons.
4. Fluid Mechanics and Hydraulic Machines – R.K. Bansal, Laxmi Publications (P) Ltd.
5. Fluid Mechanics – Streeter V L and Wylie E B, McGraw Hill.
6. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, Tata McGraw Hill.

Reference Books:

1. Mechanics of Fluids – I H Shames, McGraw Hill.
2. Fluid Mechanics: Fundamentals and Applications - YunusCengel and John Cimbala, McGraw Hill.
3. Fluid Mechanics: Pijush K. Kundu, Ira M. Cohen and David R. Rowling, Academic Press.

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

B24-MMAC-204	Pneumatic and Hydraulic Systems						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Exam Time**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	Students will develop the knowledge of hydraulic systems & components.
CO 2	Students will develop the knowledge of the pneumatic system and its components.
CO 3	Students will develop the knowledge of hydraulic and pneumatic circuits.
CO 4	Students will develop the knowledge of failure troubleshooting and maintenance of hydraulic & pneumatic systems.

UNIT-I

Hydraulic Systems and its Components : Introduction, Principal, Pascal's Law, Pressure Drop, Viscosity, Pumps: Pumping Theory, Pump Classification, Hydrodynamic pumps, Hydrostatic pumps, Gear Pump, Vane Pump, Piston Pumps, Actuators: Cylinders, types of cylinders, Motors

Direction control valve (DCV): Poppet valve, spool valve, sliding spool valve, check valve & its types, two-way valves, four-way valves, Pilot operated DCV, Flow control valves, flow control methods: Meter-in, Meter-out, Bleed-off, Accumulator, pressure switches, pressure gauges, flow meter, manifolds, pressure intensifier, Hydraulic symbols.

UNIT-II

Pneumatic Systems and its Components: Introduction, Boyle's Law, Pneumatic symbols, Components: Air preparation, compressor, Reservoir/air receiver, Inlet filters, Inter coolers, After coolers, safety relief valve, Pressure switches, Air dryers, Air distribution, Sizing pipe system, flow resistances, pipe material, piping layout, types of layout: Dead end, Loop, Decentralized; service unit, air filters, standard filters, coalescing filters, vapor absorbing filters, air regulator, air lubricator (FRL), actuator and output devices, single and double acting cylinders, cylinders with end position cushioning, tandem double acting cylinder, double rod cylinder, multi-position cylinder, motors, Direction control valves: poppet valves, slides valves, 2/2-way, 3/2-way valves, check valves, air consumption.

UNIT-III

Hydraulic Circuits & Pneumatic Circuits: Hydraulic Circuits: Single acting cylinder circuit, double acting cylinder circuit, pump unloading circuit, regenerative circuit, Accumulator circuit

Pneumatic circuits: Control of single acting cylinder, manual controlled double acting cylinder, air pilot control of double acting actuator, two step speed control of a cylinder, Two handed safety circuit.

UNIT-IV

Maintenance, failure & troubleshooting in fluid power system: Introduction, Troubleshooting-oil hydraulics, troubleshooting-pneumatics, maintenance of pneumatic system and hydraulic system: maintenance schedule, operation task, periodic maintenance, annual maintenance, Trouble, possible causes and remedies of hydraulic system: Hydraulic motor, hydraulic cylinder, accumulator. Trouble, possible causes and remedies of pneumatic system: Compressor, FRL unit, Regulator, lubricator, Installation of pneumatic system: FRL units, pneumatic cylinder, compressor, piping.

Suggested Books:

1. Hydraulic & Pneumatic Controls, K ShanmugaSundaram, S Chand, 2012.
2. Introduction to Hydraulics and Pneumatics, S Ilango, V. Soundarajan, PHI 2013.
3. Pneumatic & Hydraulic, Andrew Parr PHI, 1999.

Reference Books:

1. Industrial Hydraulics, McGraw, John Pippenger, Tyler Hicks, Hill International Edition, 1980.
2. Esposito A., “Fluid Power with Applications”, Pearson Education 2005.
3. Michael J, Principles and Ashby J.G, “Power Hydraulics”, Prentice Hall, 1989.

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

B24-MMAC-206	Programmable Logic Controller						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Exam Time**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	Students will have the knowledge of PLC, its elements, types and operations.
CO 2	Students will have the knowledge of input output devices and their applications.
CO 3	Students will develop the ability to develop logic gate circuits using Boolean algebra.
CO 4	Students will develop the ability to develop the ladder diagram program.

UNIT-I

Introduction: Introduction to PLCS, History of PLC, Elements (components) of a PLC, Advantages and disadvantages of PLC, Programming languages for PLC, Rules for ladder diagram, Functions of PLC, PLC types, PLCS normal operation, Definitions of commonly used terms for PLC, Comparison between computer and PLC, Characteristic of PLC, Comparison between PICO, NANO, MICRO and MINI PLC, Comparison between small, medium and large PLC, Role of PLC in automation, types of PLC system.

UNIT-II

Input-Output Devices: Input devices, Mechanical switches, Proximity switches, Photoelectric sensors and switches, Encoders, Temperature sensors, Position/displacement sensors, Strain gauges, Pressure sensors, Liquid level detector, Fluid flow measurement, Smart sensors. Output devices: Relay, Directional control valves, Motors, Stepper motors, Examples of applications: conveyor belt, lift, robot control system, Liquid level monitoring.

UNIT-III

Number Systems & Fundamentals of Logic: Decimal System, Binary System, Negative Numbers, Octal System, Hexadecimal System, Binary Coded Decimal (BCD) System, Binary concept, AND, OR, NOT, Exclusive-OR (XOR)functions, Boolean algebra, Developing logic gate circuits from Boolean expressions, Producing the Boolean equation for a given logic gate circuit.

UNIT-IV

Ladder Diagram Programming: Introduction, Ladder logic programming, Rung in a ladder logic program,Program execution sequence in ladder logic,Rungcondition,Role of instructions in ladder diagram programming,Ladder diagram programs,Ladder diagram programs based on basic instructions, Ladder diagram program for realizing various Boolean functions (NOT, AND, OR, NOR, NAND, EX-OR).

Text Books:

1. Programmable Logic Controller and Microcontrollers,UmeshRathore, VedPrakashVerma, S K Kataria and Sons.
2. Programmable Logic Controller, Vijay R. Jadhav, Khanna Publisher

Reference Books:

1. Programmable Logic Controllers, W. Bolton, Newnes (an imprint of Butterworth-Heinemann Ltd); 6th edition, 2015
2. Programmable Logic Controllers, Frank D. Petruzella, 5th Edition, McGraw Hill Publication.

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

B24-MMAC-208	Manufacturing Technology						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Exam Time**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	Develop the knowledge of the concept of plant layout, casting and moulding processes.
CO 2	Develop the knowledge of metal forming and plastic processes.
CO 3	Develop the knowledge of different welding processes.
CO 4	Develop the knowledge of various machining processes.

UNIT-I

Plant Layout & manufacturing concept: Factors in plant layout, Principles and Objectives of plant layout, Types of plant layout, Comparison of different layouts, Manufacturing-Product Design and Concurrent Engineering-Sustainable Manufacturing.

Casting Processes: Metal casting–Patterns, Pattern material, Types of pattern, Pattern allowances, colour coding for patterns, Moulding, Mould materials, Moulding sand constituents, Types of mould, Moulding methods, Core types, Core making, Core chaplets, Melting equipment, Casting processes classification, permanent mould and die casting, Centrifugal casting, Investment casting, Continuous casting, Defects in castings.

UNIT-II

Metal forming processes: Hot working, Hot working processes, Hot rolling, Hot forging, Hot spinning, Hot extrusion, Hot drawing, Cold working, Cold working processes, Cold rolling, Cold forging, Cold spinning, Cold extrusion, Cold bending, Cold drawing.

Plastic Processing: Compression molding-Transfer molding-Injection molding, Blow molding–Extrusion-Thermoforming.

UNIT-III

Welding Processes: Welding classification, Oxy acetylene gas welding, Air acetylene gas welding, Electric Arc Welding principle, Polarity, Carbon arc welding, Flux shielded metal arc welding, TIG, MIG, Resistance welding principle, Spot and Seam welding, Friction welding, Explosion welding, Ultrasonic welding, Thermit welding, Laser Beam and Electron beam welding, Welding defects.

UNIT-IV

Machining Processes: Cutting tools, Cutting forces, Mechanism of chip formation, Lathe, Types of lathe, Principal parts of lathe, Lathe operations, Drilling, Types of drilling, Parts of drilling machine, Drilling operations, Shaper, Parts of shaper, Classification, Crank and slotted quick return mechanism principal, Planer and its types, Parts of planer Slotter, parts of slotter, Types of slotter, Milling, Principal parts of milling machine, Up and Down milling, Milling operations, Grinding, Types of grinding machine, Grinding wheel, Wheel shapes, Wheel truing.

Text Books:

1. Comprehensive Workshop Technology (Manufacturing Processes), S. K. Garg, Laxmi Publications (P) Ltd.
2. Manufacturing Technology (Volume 2) Foundry, ForgingandWelding,P.N.Rao,4th Edition, Tata McGraw Hill Education, New Delhi.
3. A Textbook of Manufacturing Technology: Manufacturing Processes, R. K Rajput, Laxmi Publications (P) Ltd.
4. Manufacturing Engineering and Technology, SeropeKalpakjian; Steven R. Schmid, 6th Edition, Publisher: Prentice Hall.

Reference Books:

1. Manufacturing Processes, H. N. Gupta, New Age Publishers, 2012.
2. Fundamentals of Modern Manufacturing Materials, Processes and Systems, Mikell P. Groover, Wiley India, 2012.

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

B24-HSM-202	Innovation, Start-up and Entrepreneurship						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Exam Time**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	Student will be able to understand and explain the concepts of Entrepreneurship
CO 2	Students will be able to understand the role of and importance of innovation in entrepreneurship and startups.
CO 3	Student will be able to understanding concept of start-ups, market analysis and creating the business models.
CO 4	Student will be able to understand the significance of Intellectual Property rights, Fundraising Strategies and risk analysis

Unit -I

Concepts of Entrepreneurship: Scope of Entrepreneurship, Definitions of Entrepreneurship and Entrepreneur, Characteristics of an Entrepreneur, Entrepreneurial Development models and Theories, Entrepreneurs Vs Managers Classification of Entrepreneurs; Major types of Entrepreneurship – Techno Entrepreneurship, Women Entrepreneurship, Social Entrepreneurship, Intrapreneurship (Corporate entrepreneurship), Rural Entrepreneurship, Family Business etc.; Problems for Small Scale Enterprises and Industrial Sickness; Entrepreneurial Trait Tests; Entrepreneurial Environment – Political, Legal, Technological, Natural, Economic, Socio – Cultural etc. ; Motivation; Business Opportunity Identification.

Unit -II

Innovation: Innovations and their forms, Innovation - features and characteristics, Factors initiating innovations, Innovation process and its stages, Statistical measurement of innovation, Model of innovation, Source of innovation, Technological transfer, Information technology to support innovation, difference between technological and non-technological innovation, Issues and Challenges in Commercialization of Technology Innovations.

Unit -III

Startups: Initial idea generation and planning stages, and incubation referring to the development process of identifying and developing new ideas for products, services, or processes, and creating a working model or prototype to test the feasibility of the concept.

Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Five Cs of Opportunity Identification, Market Opportunity Identification in emerging technology companies, Process of creating and growing a new business venture, Business plan of the innovation project.

Unit -IV

Fundraising, Investment and Risk Analysis: Risk management in venture projects, Financing and Protection of Ideas- Financing methods available for start-ups in India, Communication of Ideas to potential investors – Investor Pitch, Patenting and Licenses, Exit strategies for

entrepreneurs, bankruptcy, and succession and harvesting strategy, venture capital, angel investment, and crowd funding.

Government support- programs and initiatives aimed at supporting the development of new ideas, innovations, and startups, funding and mentorship, IPR - legal protection of a person's or organization's rights to their invention, brand, or creative work.

Books Recommended:

1. Design the Future: Simplifying Design Thinking to Help You, Shrutin N Shetty, Notion Press, 2018
2. Entrepreneurship Development Small Business Enterprises, Poornima M Charantimath, Pearson, 2013.
3. Entrepreneurship, Roy Rajiv, Oxford University Press, 2011.
4. Innovation and Entrepreneurship, Peter F Drucker, Harper Business, 2006.
5. Dynamics of Entrepreneurship Development – Vasant Desai.
6. Entrepreneurship Development and small business management – Poornima M. Charantimath
7. Dynamics of Entrepreneurship Development – Vasant Desai.
8. Innovation and Entrepreneurship – Peter F. Drucker
9. Kathleen R Allen, Launching New Ventures, An Entrepreneurial Approach, Cengage Learning, 2016.
10. Vijay Sathe, Corporate Entrepreneurship, Cambridge, 2009
11. Alexander Osterwalder and Yves Pigneur, Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, John Wiley & Sons, Jul2010.
12. Peter Thiel and Blake Masters, Zero to One: Notes on Startups, or How to Build the Future, Virgin Books, 2015.
13. Alejandro Cremades, The Art of Startup Fundraising: Pitching Investors, Negotiating the Deal, and Everything Else Entrepreneurs Need to Know" by, John Wiley & Sons, Inc., Hoboken, New Jersey, 2016.
14. Christensen, Clayton M. The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Boston, MA: Harvard Business School Press, 1997.
15. Brad Feld and Jason Mendelson, Venture Deals: Be Smarter Than Your Lawyer and Venture
16. Capitalist, Wiley; 4th edition, 1 October 2019.

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

B24-ESC-204	Mechatronics Lab						
L	**T**	**P**	**Credit**	**Internal Assessment**	**Practical Exam**	**Total**	**Exam Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**

Course Outcomes	
CO1	Students will get familiar with components of Mechatronics systems.
CO2	Students will develop the ability to perform operations on Pneumatic and Hydraulic training kit.
CO3	Students will be able to perform operations using 8085 microprocessor.
CO4	Students will be able to perform operations using 8051 microcontroller.

LIST OF EXPERIMENTS

1. To study and demonstration of Mechatronics system components
2. To perform an experiment on a hydraulic trainer kit.
3. To perform an experiment on a pneumatic trainer kit.
4. To study various types of sensors and transducers.
5. Study and Demonstration of Actuators.
6. To understand working principle of LVDT.
7. Measurement temperature of the temperature transducer (RTD) and verify the performance with output voltage.
8. To perform the 8-bit addition and subtraction using 8085 Microprocessor.
9. To perform 1's and 2's complement of 8 bit number using 8085 Microprocessor.
10. To control a traffic light system using 8051 Microcontroller.
11. Stepper motor interface with 8051– Microcontroller.

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

B24-MMAC-210	Fluid Mechanics and Machines Lab						
L	**T**	**P**	**Credit**	**Internal Assessment**	**Practical**	**Total**	**ExamTime**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**

CourseOutcomes	
CO1	Handle and operate equipment and instrumentation for fluid flow.
CO2	Collect and analyze data by applying fluid mechanics principles and experimental techniques.
CO3	Calculate the discharge coefficient for different flow measurement devices and hydraulic turbine performance evaluation.
CO4	Compute flow characteristics, including Reynolds number and friction factor, from laboratory measurements and hydraulic pumps and hydraulic ram.

LIST OF EXPERIMENTS

1. To verify the Bernoulli's Theorem experimentally.
2. To calculate flow of fluid using orifice meter. Find out coefficient of discharge for the given orifice meter.
3. To determine the coefficient of discharge of Notch (V or Rectangular type).
4. To determine the coefficient of discharge of Venturimeter.
5. To find critical Reynolds number for a pipe flow.
6. To determine the friction factor for the pipes.
7. Determination of the performance characteristics of Pelton Wheel.
8. Determination of the performance characteristics of a Francis Turbine.
9. Determination of the performance characteristics of a Kaplan turbine.
10. Determination of the performance characteristics of a Centrifugal Pump.
11. Determination of the performance characteristics of a Reciprocating Pump.
12. Determination of the performance characteristics of a Gear Pump.
13. Determination of the performance characteristics of a Hydraulic Ram.

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

B24-MMAC-212	Pneumatic and Hydraulic Systems Lab						
L	**T**	**P**	**Credit**	**Internal Assessment**	**Practical Exam**	**Total**	**ExamTime**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**

Course Outcomes	
CO1	Student will become familiar with symbolic representation of hydraulic and pneumatics.
CO2	Student will understand the working of hydraulic and pneumatic circuits
CO3	Student will develop the ability to perform control operations on hydraulic system.
CO4	Student will develop the ability to perform control operations on pneumatic system.

LIST OF EXPERIMENTS

1. Study of graphical symbol for hydraulic and pneumatic.
2. To understand working and construction of hydraulic components and basic circuits.
3. To understand working and construction of pneumatic components and basic circuits.
4. To study Different types of actuators in Hydraulic and Pneumatics.
5. Control of Single Acting Cylinder on hydraulic trainer kit.
6. Control of double acting cylinder on hydraulic trainer kit.
7. Control of Single Acting Cylinder on pneumatic trainer kit.
8. Control of double acting cylinder on pneumatic trainer kit.
9. To study of speed control circuit on hydraulic trainer
10. Study of synchronizing circuit on hydraulic trainer
11. To study single acting and double acting pneumatic cylinder uses D.C. Valve.
12. To study pressure sequence valve and time delay valve in pneumatic circuit.

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

B24-MMAC-214	Programmable Logic Controller Lab						
L	**T**	**P**	**Credit**	**Internal Assessment**	**Practical Exam**	**Total**	**Exam Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Course Outcomes							
CO1	Student will become familiar with PLC interface modules.						
CO2	Ability to understand logic gate functions and mathematical operations in PLC.						
CO3	Ability to develop control operations using PLC.						
CO4	Ability to implement ladder diagrams for process control.						

LIST OF EXPERIMENTS

1. Study of PLC field device interface modules.
2. Programming Logic Gates Function in PLC
3. Implementing mathematical operations in PLC
4. PLC Exercises:- 1. Traffic Light Control and Filling/Draining Control Operation
5. PLC Exercise: 1. Reversal of DC Motor Direction 2. ON/OFF Controller for Thermal Process.
6. To design a Water Level Controller using PLC.
7. Automatic bottle filling machine using PLC.
8. Identify Different types of LADDER LOGIC.
9. Develop ladder programming for a given statement - To on the bulb1 after 5sec of switch1 on. Turn the bulb2 on after the 5 sec of bulb1 on and test.
10. Develop ladder programming for a given statement -To on the bulb after 5sec of switch off. Turn the bulb2 off after the 5 sec of bulb1 on and test.
11. Develop ladder programming for a given statement - To on or off the motor via one switch and test.
12. Design a ladder to operate bottler filling plan and test.

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

B24-MAC-202	Essence of Indian Traditional Knowledge						
L	**T**	**P**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**ExamTime**
3	**0**	**0**	**1**	**---**	**100**	**100**	**3 Hrs.**

Course Outcomes	
CO 1	The students will be able to grasp, relate, and explain Indian traditional knowledge from a modern scientific perspective.
CO 2	The students will develop the understanding to holistic health through the Indian Knowledge System.
CO 3	The students will learn to manage thoughts and emotions, fostering positivity, self-regulation, and control
CO 4	The students will attain consciousness through the Indian Knowledge System.

UNIT-I

Introduction to Indian Traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge and its characteristics, Traditional Knowledge vis-à-vis Indigenous Knowledge, Traditional Knowledge vis-a-vis Western Knowledge.Philosophical systems, Basics of Rajyoga and Karamyoga, Benefits of Raj yoga and Karamyoga.

UNIT-II

Holistic Health using Indian Knowledge System: Basic principles of natural life style, Benefits through five elements. Healing through food, Chakras and Mudras.Physical, Mental, Emotional and Spiritual health using traditional knowledge.

UNIT-III

Positivity: Traditional approaches. Happiness: objective and subjective measures of wellbeing, life satisfaction. Resilience, Self-regulation and self-control, optimism, self-esteem.Managing thoughts and Emotions with the help of Rajyoga.Achieving Powers for Self Mastery.

UNIT-IV

Achieving Consciousness through Indian Knowledge System: Emotional intelligence, Indian approach to Psychology. Consciousness; levels, body-mind relationship, self motivation, Self and Identity in modern Psychology and Indian thought., Spirituality and well being.

Suggested Books:

1. Mahadevan, M., Bhat, V.R. &Pavana N. (2022). Introduction to Indian Knowledge System: Concepts and Applications. PHI Learning

2. Baumgardner, SR & Crothers, MK (2009). Positive Psychology. Prentice Hall/Pearson Education.
3. Cornelissen, R.M., Misra G. &Varma S. (2014). Foundations & Applications of Indian Psychology. Pearson Education.
4. Rajyoga Education and Consciousness Improvement Programme for Educators, Rajyoga Education and Research Foundation. Rajyoga Meditation Course, Thoughkart, Jaipur(Rajasthan), India.
5. PrakartikSwasthyaShastra, Publisher Natural Lifestyle

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