

Bachelor of Technology (Aeronautical Engineering) Kurukshetra University, Kurukshetra

SCHEME OF EXAMINATIONS w.e.f: 2025-26 (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*	Oscillations, Waves and Optics	3:1:0	4	4	70	30	--	100	3
2	B24-AER-201	Introduction to Aeronautical Engineering	3:1:0	4	4	70	30	--	100	3
3	B24-BSC-203*	Mathematics-III	3:1:0	4	4	70	30	--	100	3
4	B24-AER-203	Propulsion-I	3:1:0	4	4	70	30	--	100	3
5	B24-MEC-203*	Mechanics of Solids-I	3:1:0	4	4	70	30	--	100	3
6	B24-ESC -201*	Engineering Thermodynamics	3:1:0	4	4	70	30	--	100	3
7	B24-AER-205	Propulsion Lab	0:0:2	2	1	--	40	60	100	3
8	B24-MEC-207*	Mechanics of Solids Lab	0:0:2	2	1	--	40	60	100	3
9	B24-MAC-201*	Environmental Studies	3:0:0	3	1	70	30	--	100	3
Total				31	27	490	290	120	900	

➤ NCC/NSS/Sports/Yoga/Technical or cultural club/society activities may also be joined by students in second year and will be evaluated in 7th semester by the institute based upon continuous evaluation model as per guidelines.

- *Common with Mechanical Engineering

Bachelor of Technology (Aeronautical Engineering) Kurukshetra University, Kurukshetra

SCHEME OF EXAMINATIONS w.e.f: 2025-26 (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*	Materials Engineering	3:0:0	3	3	70	30	--	100	3
2	B24-MEC-202*	Fluid Mechanics and Machines	4:1:0	5	5	70	30	--	100	3
3	B24-AER-202	Aircraft Structure-I	3:1:0	4	4	70	30	--	100	3
4	B24-MEC-206*	Mechanics of Solids-II	3:1:0	4	4	70	30	--	100	3
5	B24-AER-204	Aerodynamics-I	3:0:0	3	3	70	30	--	100	3
6	B24-MEC-208*	Manufacturing Technology	3:0:0	3	3	70	30	--	100	3
7	B24-ESC-204*	Materials Engineering Lab	0:0:2	2	1	--	40	60	100	3
8	B24-MEC-210*	Fluid Mechanics and Machines Lab	0:0:2	2	1	--	40	60	100	3
9	B24-AER-206	Aircraft Structure I Lab	0:0:2	2	1	--	40	60	100	3
10	B24-MAC-202*	Essence of Indian Traditional Knowledge	2:0:0	2	1	--	100	--	100	3
Total				30	26	420	400	180	1000	

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

- ***Common with Mechanical Engineering**

	B. Tech (3 rd Semester) Aeronautical Engineering						
B24-BSC-201	Oscillations, Waves and Optics						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	1	-	4	70	30	100	3 h
Purpose	To familiarize the basic principle of aviation, flight & aircraft propulsion. Also understand various flight controls and dynamics of the aircraft.						
Course Outcomes							
CO1	Understand the history, basic principle of aviation, trends in aerospace Industry.						
CO 2	Understand the basics of flight & aircraft propulsion.						
CO 3	Understand the various flight controls and dynamics of aircraft.						
CO4	Understand different systems of an aircraft.						

UNIT- I

Simple harmonic motion: Equation of simple harmonic motion and its solution, characteristics of SHM, Energy of harmonic oscillator; Damped harmonic oscillator: Equation of damped oscillator and its solution, Energy of weakly damped harmonic oscillator, Quality factor or Q-Value of damped oscillator; Forced oscillations and resonance: Forced damped harmonic oscillator, Power supplied to the forced oscillator, Band width of resonance and Quality factor.

Unit- II

Waves: Travelling waves, Characteristics of waves, Mathematical representation of travelling waves, General wave equation, Phase velocity, Light source emit wave packets, Wave packet and bandwidth, Group velocity and real waves.

Propagation of Light Waves: Maxwell's equations, Electromagnetic waves and constitutive relations, Wave equation for free space, Uniform plane waves, Wave polarization, Energy density, Pointing vector and intensity, Radiation pressure and momentum, Light waves at boundaries, Wave incident normally on boundary, Wave incident obliquely on boundary: Law of reflection, Snell's law.

Unit- III

Interference: Huygens' principle, superposition of waves, conditions of sustained interference, Young's double slit experiment, Division of wave front: Fresnel's Biprism and its application;

Division of Amplitude: Interference due to reflected and transmitted light, wedge shaped thin film, Newton's rings and its applications, Michelson interferometer and its application.

Diffraction: Types of diffraction, Fraunhofer diffraction due to single slit, Plane transmission grating: Theory, secondary maxima and minima, width of principal maxima, absent spectra, overlapping of spectral lines, determination of wavelength; Rayleigh criterion for limit of resolution, Dispersive and resolving power of diffraction grating.

Unit- IV

Lasers: Elementary idea of laser production: Stimulated absorption, Spontaneous and Stimulated emission; Einstein's theory of matter radiation interaction and A and B coefficients, amplification of light by population inversion, pumping schemes, different types of lasers: gas lasers (He-Ne, CO₂), solid-state lasers (ruby, Neodymium), semiconductor lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers.

Text/Reference books

1. P.K. Diwan, Applied Physics for Engineers, *Wiley India Pvt. Ltd., India*
2. S.P. Taneja, Modern Physics for Engineers, *R. Chand & Company Ltd., India*
3. N. Subrahmanyam, B.Lal, M.n. Avadhanulu, A Textbook of Optics, *S. Chand & Company Ltd., India*
4. A. Ghatak, Optics, *McGraw Hill Education (India) Pvt. Ltd., India.*
5. E. Hecht, A.R. Ganesan, Optics, *Pearson India Education Services Pvt. Ltd., India.*

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

	B. Tech (3 rd Semester) Aeronautical Engineering						
B24-AER-201	Introduction to Aeronautical Engineering						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	1	-	4	70	30	100	3 h
Purpose	To familiarize the basic principle of aviation, flight & aircraft propulsion. Also understand various flight controls and dynamics of the aircraft.						
Course Outcomes							
CO1	Understand the history, basic principle of aviation, trends in aerospace Industry.						
CO 2	Understand the basics of flight & aircraft propulsion.						
CO 3	Understand the various flight controls and dynamics of aircraft.						
CO4	Understand different systems of an aircraft.						

UNIT-I

Introduction to Aircrafts: History of aviation; History of Indian Aviation Sector, History of Unmanned Air Vehicles, Basic components of an aircraft; structural members; Helicopters, their parts and functions.

Introduction to Military Aircraft, Transport Aircraft, Unmanned Aircraft, Classification of aircraft and space vehicles, Classification and Applications of Unmanned Air Vehicles, global and Indian Aircraft scenario. Aircraft materials.

UNIT-II

Basic principles of flight: International standard atmosphere and its properties; significance of speed of sound; Mach number, airspeed and groundspeed; Bernoulli's theorem and derivation for Bernoulli's equation, measurement of airspeed; aerofoil nomenclature, Types of Aerofoils, forces acting on Aerofoil, pressure distribution over aerofoil. Centre of pressure, Aerodynamic center, Aspect Ratio, Introduction to Lift and drag components.

Circulation and its effects. Magnus effect and Kutta condition, Introduction to wind tunnel testing. Introduction to rotary wing and flapping wing aerodynamics. Introduction to Boundary layer, Types and effect of boundary layer.

UNIT-III

Aircraft Propulsion: Classification of Aircraft power plants, Aircraft power plants – basic principles of piston & jet engines and Rocket engine, Brayton cycle and its application to gas turbine engines; SFC, TSFC, Specific Impulse, Propulsive Efficiency, Thermal efficiency, Overall efficiency, production of thrust by propellers and jets.

Introduction to Rocket and Missile propulsion.

UNIT-IV

Aircraft Performance and Stability: Phases of flight, Steady level flight, stalling speed, High lift Devices, Thrust and power curves, Excess power, Range and endurance, Introduction to maneuver and accelerated flight performance.

Aircraft axis system; aircraft motions; static and dynamic stability; longitudinal, lateral and directional static stability; Numerical on trim conditions, Effect of wings and Tail configurations on static stability. Introduction to transonic and supersonic flight.

Text Books:

1. John D. Anderson, "Introduction to Flight", McGraw-Hill Education, 2011. ISBN 9780071086059.
2. Lalit Gupta and O P Sharma, "Fundamentals of Flight Vol-I to Vol-IV", Himalayan Books, 2006, ISBN-13: 978-8170020974

Reference Books:

1. Nelson R.C., "Flight stability and automatic control", McGraw-Hill International Editions, 1998. ISBN 9780071158381.
2. Ian Moir, Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", John Wiley & Sons, 2011. ISBN 978111965006.
3. Sutton G.P., "Rocket Propulsion Elements", John Wiley, New York, 8th Ed., 2011; ISBN: 1118174208, 9781118174203.

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

	B. Tech (3 rd Semester) Aeronautical Engineering						
B24- BSC-203	MATHEMATICS-III [For Mechanical, Aeronautical, Electrical & Comp. Sc. Engg. students only]						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	1	-	4	70	30	100	3 h
Purpose	To familiarize the prospective students with Laplace Transform to solve the differential equations and how to apply the principles of probability & statistics to model and analyze various phenomena in fields like finance, economics, and engineering, aiding in making informed decisions and predicting outcomes.						
Course Outcomes							
CO1	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 have various engineering applications.						
CO4	To make the students familiar about basic statistics including measures of central tendency, measures of dispersion, correlation, and regression.						

UNIT-I

(08 Hrs)

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

(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-III

(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-IV

(12 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.

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.

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

	B. Tech (3 rd Semester) Aeronautical Engineering						
B24-AER-203	Propulsion-I						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	1	-	4	70	30	100	3 h
Purpose	To familiarize the basic principle of aviation, flight & aircraft propulsion. Also understand various flight controls and dynamics of the aircraft.						
Course Outcomes							
CO1	Comparison between ideal cycles and practical cycles						
CO 2	Mathematical analysis of jet propulsion cycles						
CO 3	Understanding the centrifugal compressor						
CO4	Introduction to axial flow compressors						

Unit – I

Ideal cycles and their analysis: Assumptions, simple gas turbine cycle, cycles with heat exchange, reheat and inter-cooling and their combinations, comparison of various cycles, Ericsson Cycle.

Practical cycles and their analysis: Assumptions, stagnation properties, compressor and turbine efficiency, pressure losses, heat exchanger effectiveness, effect of varying mass flow and variable specific heat, mechanical losses and losses due to incomplete combustion, cycle efficiency, poly-tropic efficiency, actual cycle performance.

Unit-II

Jet propulsion cycles and their analysis: Propeller engines, gas turbine engines, Ramjet, Pulse Jet, Turboprop and Turbojet engines, analysis of turbofan engines, Thrust and thrust equation, specific thrust of the turbojet engine, efficiencies, parameters affecting flight performance, thrust augmentation.

Unit-III

Centrifugal Compressor: Essential parts, principle of operation, ideal energy transfer, blade shapes and velocity triangles, flow analysis through the compressor, diffuser, volute casing, performance parameters, losses in centrifugal compressors, compressor characteristics, surging and choking.

Unit-IV

Axial flow compressors: Historical background, geometry and working principle, stage velocity triangles, work done factor, h-s diagram, stage efficiency, performance coefficients, degree of reaction, flow through blade rows, flow losses, stage losses, pressure rise calculation in blade ring, performance characteristics, comparison with centrifugal compressors.

Text Book:

1. Gas Turbines, V Ganesan, McGraw Hill.
2. Gas Turbine Theory, H. Cohen, GFC Rogers and HHH Saravanamuttoo, Pearson.

Suggested Books:

1. Gas Turbine, Jet and Rocket Propulsion, Mathur, M.L. and Sharma, R.P., Standard Publishers & Distributors.
2. Aero thermodynamics of Aircraft Engine Components, G.C. Oates, AIAA Education Series.

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

B. Tech (3 rd Semester) Aeronautical Engineering							
B24-MEC-203	MECHANICS OF SOLIDS-I [For Aeronautical, Mechanical students only]						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	1	-	4	70	30	100	3 h
Purpose	The objective of this course is to make the students aware of Stress, Strain and deformation of solids with the applications to beams, shafts and column and struts. The course will help the students to build the fundamental concepts in order to solve engineering problems.						
Course Outcomes							
CO1	Apply fundamental principles of mechanics & principles of equilibrium to simple and practical problems of engineering, determine centroid and moment of inertia of different geometrical shapes and be able to understand its importance. Explain the basic concepts of stress and strain and solve the problems.						
CO 2	Determine and calculate the values of principal stresses on 2-D inclined planes. Understand the concepts of shear force and bending moment of beams. Able to construct shear force and bending moment diagrams for beams under different loading conditions.						
CO 3	Understand the concept of torsion of circular shaft and be able to solve the problems on torsion of circular shaft. Illustrate and solve the problems on bending and shear stresses on beams.						
CO4	Understand the concept of column and strut and be able to solve the problems. Derive the concept of slope and deflection and solve the problems on slope and deflection using different methods.						

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, conditions for equilibrium, Concept of centre of gravity and centroid of various shapes: Triangle, circle, semicircle and trapezium, theorem of parallel and perpendicular axes, moment of inertia of simple geometrical figures, polar moment of inertia. Numerical Problems.

Simple Stresses & Strains: Different types of stresses and strains, Poisson's ratio, stresses and strain in simple and compound bars under axial loading, stress strain diagrams, Hook's law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading, Numerical problems.

Unit-II

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

Shear Force & Bending Moments: Definitions, SF & BM diagrams for cantilevers, simply

supported beams with or without over-hang and calculation of maximum BM & SF and the point of contraflexure under (i) concentrated loads, (ii) uniformly distributed loads over whole span or a part of it, (iii) combination of concentrated loads and uniformly distributed loads, (iv) uniformly varying loads and (v) application of moments, relation between the rate of loading, the shear force and the bending moments, Numerical Problems.

Unit-III

Torsion of Circular Members: Derivation of equation of torsion, Solid and hollow circular shafts, tapered shaft, stepped shaft & composite circular shafts, Numerical problems.

Flexural and Shear Stresses – 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, composite beams, shear stresses in beams with derivation, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections. Combined bending and torsion, equivalent torque, Numerical problems.

Unit-IV

Columns & Struts: Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler's formula for crippling load for columns with different end conditions, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations, Numerical problems.

Slope & Deflection: Relationship between bending moment, slope & deflection, double integration method, Macaulay's method, calculations for slope and deflection of (i) cantilevers and (ii) simply supported beams with or without overhang under concentrated load, uniformly distributed loads or combination of concentrated and uniformly distributed loads, Numerical problems.

Text 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 Materials – D.S. Bedi, Khanna Publications.

Reference Books:

1. Strength of Materials – Popov, PHI, New Delhi.
2. Strength of Materials – Robert I. Mott, Pearson, New Delhi
3. Strength of Material – Schaum's Outline Series – McGraw Hill

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

	B. Tech (3 rd Semester) Aeronautical Engineering						
B24-ESC -201	ENGINEERING THERMODYNAMICS [For Aeronautical, Mechanical students only]						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	1	-	4	70	30	100	3 h
Purpose	The objective of this course is to make the students aware of Energy, Entropy, and Equilibrium, various laws of thermodynamics, concepts and principles. The course will help the students to build the fundamental concepts to apply in various applications like IC engines and Air conditioning systems.						
Course Outcomes							
CO1	Analyse 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.						
CO4	Understand the design and analysis of flow through steam nozzles. Solve the problems related to vapour power cycle and steam nozzle.						

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 Thermodynamics and its utility.

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 and Transient Flow Process, Throttling Process and Free Expansion Process.

Unit-II

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, Carnot's Theorem and its Corollaries, Thermodynamic Temperature Scale, Numericals.

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

Unit-III

Availability, Irreversibility and Equilibrium: High and Low Grade Energy, Available Energy and Unavailable Energy, Loss of Available Energy Due to Heat Transfer Through a Finite Temperature Difference, Availability of a Non-Flow or Closed System, Availability of a Steady Flow System, Helmholtz and Gibb's Functions, Effectiveness and Irreversibility, Thermodynamic Relations.

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.

Unit-IV

Vapour Power Cycles: Simple and modified Rankine cycle; effect of operating parameters on Rankine cycle performance; effect of superheating; effect of maximum pressure; effect of exhaust pressure; reheating and regenerative Rankine cycle; types of feed water heater; reheat factor; binary vapour cycle.

Steam Nozzle: Function of steam nozzle; shape of nozzle for subsonic and supersonics flow of steam; variation of velocity; area of specific volume; steady state energy equation; continuity equation; nozzle efficiency; critical pressure ratio for maximum discharge; physical explanation of critical pressure; super saturated flow of steam; design of steam nozzle.

Text Books:

1. Engineering Thermodynamics – C P Arora, Tata McGraw Hill
2. Engineering Thermodynamics – P K Nag, Tata McGraw Hill
3. Thermal Engineering- R. K. Rajput, Laxmi Publications

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.
3. Thermodynamics – An Engineering Approach; Y. A. Cengel, M. A. Boles; Tata McGraw Hill

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

	B. Tech (3 rd Semester) Aeronautical Engineering						
B24- AER -205	PROPULSION LAB						
Lecture	Tutorial	Practical	Credits	Practical Exam	Internal Assessment	Total	Time (Hrs.)
-	-	2	1	60	40	100	3 h
Purpose	To give the practical knowledge of Propulsion.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Propulsion.						

List of experiments

1. To study the constructional details of axial flow compressor.
2. To study the constructional details of centrifugal compressor.
3. To study of accessory gear box and its construction.
4. To study the constructional details of main fuel pump.
5. To study the constructional details of combustion chamber.
6. To study the constructional details of after burning system.
7. To study the constructional details of piston engines.
8. To study the functioning of complete jet engine.
9. To study the constructional details of propellers.

Suggested Books:

1. Gas Turbines, V Ganesan, McGraw Hill.
2. Gas Turbine Theory, H. Cohen, GFC Rogers and HH Saravanamuttoo, Pearson.

Note: - For better understanding of the experiments, department is also required to utilize the resources available on various websites, digital media & industrial visits etc.

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

B24- MEC -207	MECHANICS OF SOLIDS LAB						
Lecture	Tutorial	Practical	Credits	Practical Exam	Internal Assessment	Total	Time (Hrs.)
-	-	2	1	60	40	100	3 h
Purpose	To make the students aware of different properties of materials using different experimental set-up.						
Course Outcomes							
CO1	Ability to design and conduct experiments, acquire data, analyse and interpret data.						
CO2	Ability to determine the behaviour of ferrous metals subjected to normal and shear stresses by means of experiments.						
CO3	Ability to determine the behaviour of structural elements, such as bars subjected to tension, compression, shear, bending, and torsion by means of experiments.						
CO4	Physical insight into the behaviour materials and structural elements, including distribution of stresses and strains, deformations and failure modes.						
CO5	Write individual and group reports: present objectives, describe test procedures and results, synthesize and discuss the test results.						

List of experiments

1. To study the Brinell hardness testing machine & perform the Brinell hardness test on given specimen.
2. To study the Rockwell hardness testing machine & perform the Rockwell hardness test on a given specimen.
3. To study the Vickers hardness testing machine & perform the Vickers hardness test on a given specimen.
4. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test on a given specimen.
5. To study the Impact testing machine and perform the Impact tests (Izod & Charpy) on a given specimen.
6. To study the Universal testing machine and perform the tensile, compression & bending tests on a given specimen.
7. To perform the shear test on UTM on a given specimen.
8. To study the torsion testing machine and perform the torsion test on a given specimen.
9. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under point and distributed Loads.
10. To prepare the composite specimen using a hot compression moulding machine and test for different mechanical properties.

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

B. Tech (3rd Semester) Aeronautical Engineering							
B24- MAC -201	ENVIRONMENTAL STUDIES						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	-	-	1	70	30	100	3 h
Course Outcomes							
CO1	Students will be able to understand the importance of natural resources.						
CO 2	Students will understand the concept of an ecosystem, its structure, and its functions.						
CO 3	The students will be able to understand the causes and impacts of various environmental pollution.						
CO4	Students will be able to understand the relationship between human population and the environment.						

Unit – I

Introduction to Environmental studies: The Multidisciplinary nature of environmental studies Definition; Scope and importance, Need for public awareness.

Natural Resources: Forest resources: Use and Over-exploitation, deforestation. Timber extraction, mining, dams, and their effects, Water resources: Use and over-utilization of surface and groundwater, conflicts over water, dams benefits and problems, Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, Food resources: changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Energy resources: renewable and non-renewable energy sources, Land resources: land degradation, soil erosion, and desertification.

Unit-II

Ecosystems: Concept of an ecosystem, Structure, and function of an ecosystem, Energy flow in the ecosystem, Ecological succession, Food chains, food webs, and ecological pyramids. Major types of ecosystem-Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystem.

Biodiversity and its Conservation: Introduction-Definition: genetic, species, and ecosystem diversity. Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit-III

Environmental pollution: Causes, effects, and control measures of: - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, nuclear hazards, and Solid waste Management: Causes, effects, and control measures of urban and industrial wastes, Disaster management: floods, earthquake, cyclone and landslides.

Social Issues and the Environment: Sustainable development, Water conservation, rainwater harvesting, Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, and wasteland reclamation. Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act., and Forest Conservation Act.

Unit-IV

Human population and the Environment: Population growth, Population Explosion-Family welfare Programme, Environment and human health. Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Drugs and their effects; Useful and harmful drugs; Use and abuse of drugs; Stimulant and depressant drugs. Concept of drug de-addiction. Legal position on drugs and laws related to drugs.

Field Work (Practical)-

- 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.

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., Ahmedabad - 380013, India, Email: mapin@icenet. net (R).
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
5. Clerk B.S., Marine Pollution, Clanderson Press Oxford (TB).
6. Cunningham, W.P.Cooper, T.H. Gorhani, E & Hepworth, M.T.2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p.
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down to Earth, Centre for Science and Environment (R).

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

	B. Tech (4 th Semester) Aeronautical Engineering						
B24-ESC-202	MATERIALS ENGINEERING [For Aeronautical, Mechanical students only]						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	-	-	3	70	30	100	3 h
Purpose	To develop capacity to identify crystal structure, designate various steels, create phase diagrams, analyse material failure mechanisms, perform heat treatment, study green energy materials and basic functioning of sophisticated material characterization techniques. with overall objective of developing the understanding of microstructure-property relations.						
Course Outcomes							
CO1	Students will be able to identify and differentiate various types of the crystal structures and deformation mechanisms in various materials						
CO 2	Students will be able to designate various types of steels as per BIS and AISI-SAE standard specifications of steels						
CO 3	Students will be able to draw various types of phase diagrams, Fe-C diagram and TTT curve.						
CO4	Students will be able to classify heat treatment processes and will be able to select suitable heat treatment process for any industrial application.						
CO5	Students will be able to explain various mechanisms of deformation and failure mechanisms like Creep and Fatigue						
CO6	Students will be able to study various materials used for green energy production						
CO7	Students will be able to explain the basic principles involved in the working of various types of material characterization techniques and will develop the capability to select a particular material characterization process for any given application.						

Unit – I

Crystallography: Review of Crystal Structure, Space Lattice, Co-ordination Number, Number of Atoms per Unit Cell, Atomic Packing Factor; Numerical Problems Related to Crystallography.

Imperfection in Metal Crystals: Crystal Imperfections and their Classifications, Point Defects, Line Defects, Edge & Screw Dislocations, Surface Defects, Volume Defects.

Introduction to Engineering materials and Standard Materials Designation: Introduction to Engineering materials, Steel Terminology, Indian Standard specifications for steels as per BIS: Based on *Ultimate Tensile Strength* and based on *Composition*, AISI-SAE standard designation for Steels and Aluminium Alloys.

Unit-II

Phase Diagrams: Basic concepts and terms, Alloy Systems, Solid solutions, Hume- Rothery's Rules, Phase Diagrams, Gibbs Phase Rule, Cooling curves, Binary phase diagrams, The Lever

Rule, Applications of Phase Diagrams, Phase Transformation, Allotropic Forms of Iron, Micro- constituents of Fe-C system, Iron-iron carbide phase diagram, Modified Iron Carbon Phase Diagrams, Isothermal Transformation, TTT Curve, CCT curve.

Heat Treatment: Heat treatment of steels, Annealing, Normalising, Hardening, Tempering, Ageing, Aus tempering and Martempering, Surface hardening and Case hardening processes, Major Defects in Metals or Alloys due to faulty Heat treatment.

Unit-III

Deformation of Metal: Elastic and Plastic Deformation, *Mechanism of Plastic Deformation:* Slip; Critical Resolved Shear Stress, Twinning, Conventional and True Stress Strain Curves for Polycrystalline Materials, Yield Point Phenomenon, Bauschinger Effect, Work Hardening.

Fatigue Failure of Materials: Fatigue, fatigue-failure models, Fatigue loads, Mechanism of Fatigue Failure, Theories of Fatigue, Factors affecting fatigue, SN diagram, Fatigue Life calculations, Fatigue Tests.

Creep: Creep Curve, Types of Creep, Factors affecting Creep, Mechanism of Creep, Creep Resistant Material, Creep Tests, Improving creep resistance.

Unit-IV

Materials for green energy: Biodiesel, Bioethanol, Production methods of Biofuels; Overview of key fuel cell technologies- various types of fuel cells, materials for electrodes, electrolytes and other components, working mechanisms, hydrogen generation and storage; limitations, recent progress in fuel cells.

Materials Characterization Techniques: Characterization techniques such as X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Energy dispersive X-ray spectroscopy (SEM-EDX), Transmission Electron Microscopy (TEM), Atomic force microscopy (AFM), Scanning tunnelling microscopy (STM).

Text Books:

1. Fundamentals of Material Science and Engineering by W. D. Callister, Wiley.
2. Material science and metallurgy by O.P Khanna, Dhanpat Rai Publication.
3. Material Science by S.L. Kakani, New Age Publishers.
4. The Science and Engineering of Materials by Donald R. Askeland , Chapman & Hall.
5. Material Science by Narula, TMH.
6. Machine Design by Robert Norton, Pearson.
7. Phase Transformation in Metals and Alloys by D. A. Porter & K. E. Easterling
8. Fuel Cell Systems Explained by Larminie and A. Dicks, , 2nd Edition, Wiley.

9. Principles of Fuel Cells by Xianguo Li, Taylor and Francis.
10. Fuel Cells: From Fundamentals to Applications by S. Srinivasan, Springer.
11. Fundamental of Light Microscopy and Electronic Imaging by Douglas B. Murphy, Kindle Edition 2001.
12. Concise Encyclopedia of Materials Characterization by Robert Cahn, 2nd Edition (Advances in Materials Science and Engineering) Elsevier Publication 2005.

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

	B. Tech (4 th Semester) Aeronautical Engineering						
B24-MEC-202	FLUID MECHANICS AND MACHINES [For Aeronautical, Mechanical students only]						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
4	1	-	5	70	30	100	3 h
Purpose	To build a fundamental understanding of concepts of Fluid Mechanics and their application in rotodynamic machines						
Course Outcomes							
CO1	The students will be able to understand the basic concepts of fluid statics, kinematics and dynamics; and apply mass and momentum conservation laws to mathematically analyze simple flow situations.						
CO 2	The students will be able to understand laminar, turbulent and boundary layer flows and solve problems for the same						
CO 3	The students will be able to apply dimensional analysis to simple flow problems and understand the basics of hydraulic machines						
CO4	The students will be able to design and evaluate the performance of hydraulic turbines and pumps.						

Unit – I

Fluid Statics: Properties of fluids, Newton’s law of viscosity, hydrostatic law, hydrostatic forces on submerged plane and curved surfaces, buoyancy, stability of floating and submerged bodies, Problems.

Fluid Kinematics: Types of fluid flows, stream, streak and path lines; flow rate and continuity equation, differential equation of continuity in cartesian and polar coordinates, rotation and vorticity, circulation, stream and potential functions, flow net. Problems.

Fluid Dynamics: Concept of system and control volume, Euler’s equation, Navier-Stokes equation, Bernoulli’s equation and its practical applications, Impulse momentum equation. Problems.

Unit-II

Viscous Flow: Flow regimes and Reynold’s number, relationship between shear stress and pressure gradient. Exact flow solutions, Couette and Poiseuille flow, laminar flow through circular conduits. Problems.

Turbulent Flow Through Pipes: Darcy Weisbach equation, friction factor, Moody’s diagram, minor losses in pipes, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes. Problems.

Boundary Layer Flow: Concept of boundary layer, measures of boundary layer thickness, Blasius solution, von-Karman momentum integral equation, laminar and turbulent boundary layer flows, separation of boundary layer and its control. Problems.

Unit-III

Dimensional Analysis: Need for dimensional analysis – methods of dimensional analysis – Dimensionless parameters – application of dimensionless parameters. Problems.

Hydraulic Pumps: Introduction, theory of Rotodynamic machines, Classification, various efficiencies, velocity components at entry and exit of the rotor, velocity triangles; Centrifugal pumps: working principle, work done by the impeller, performance curves, cavitation in pumps; Reciprocating pumps: working principle, indicator diagram, effect of friction and acceleration, air vessels, Problems.

Unit-IV

Hydraulic Turbines: Introduction, Classification of water turbines, heads and efficiencies, velocity triangles, axial, radial and mixed flow turbines, Pelton wheel, Francis turbine and Kaplan turbines, working principles, work done, design of turbines, draft tube and types, specific speed, unit quantities, performance curves for turbines, governing of turbines. Problems.

Text Books:

1. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
2. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, Tata McGraw Hill.
3. Fluid Mechanics and Fluid Machines - S.S. Rattan, Khanna Publishing House.
4. Fluid Mechanics and Hydraulic Machines – R. K. Rajput, S. Chand & Company

Reference 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 – Streeter V L and Wylie E B, Mc Graw Hill
4. Mechanics of Fluids – I H Shames, Mc Graw Hill
5. Fluid Mechanics: Fundamentals and Applications - Yunus Cengel and John Cimbala, McGraw Hill.
6. 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.

	B. Tech (4 th Semester) Aeronautical Engineering						
B24- AER-202	AIRCRAFT STRUCTURE-I [For Aeronautical students only]						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	1	-	4	70	30	100	3 h
Purpose	To understand, analyse, derive and calculate various parameters of mechanical vibration systems with different degrees of freedom in different modes and conditions and to understand the basics of tribology.						
Course Outcomes							
CO1	Students will be able to understand the vibration fundamentals for a single degree of freedom system under free and damped vibrations, various spring/ shaft combinations and will also be able to solve mathematical problems based on the same.						
CO 2	Students will be able to analyse different types of single degree of freedom forced vibration systems and damped, undamped, free and forced systems with two D.O.F. and will also be able to solve mathematical problems based on the same.						
CO 3	Students will be able to evaluate frequencies and principal modes of vibrations for various spring-mass combinations and rotor-shaft systems and will be able to derive frequency expressions for continuous systems viz. transverse, longitudinal and torsional vibration for beams, bars and shafts respectively and will also be able to solve mathematical problems based on the same.						
CO4	Students will be able to understand the fundamentals of tribology, lubrication, friction and wear.						

Unit – I

Fundamentals: Introduction, elements of a vibratory system, periodic and S.H.M., degrees of freedom (DOF), types of vibrations, work done by a harmonic force, beats, Problems.

Free vibration systems with single degree of freedom undamped systems: Introduction, differential equations, torsional vibrations, spring and shaft combinations: series & parallel, linear and torsional systems, compound pendulum, bifilar and trifilar suspensions, problems.

Free vibration systems with single degree of freedom damped systems: Introduction, types of damping, differential equations of damped free vibrations, initial conditions, logarithmic decrement, vibrational energy, Problems.

Unit-II

Forced vibration systems with single degree of freedom damped systems: Introduction, excitation and sources, equations of motion, rotating and reciprocating unbalanced system, support motion, vibration isolation, force and motion transmissibility, forced vibration system with different types of damping, vibration measuring instruments, resonance, bandwidth, quality factor and half power points, critical speed of shaft with and without damping with single and multiple discs, problems.

Two degrees of freedom system: Introduction, torsional vibrations, principal modes of vibrations for two D.O.F., damped and undamped forced and free vibrations, semi-definite systems, coordinate coupling, spring and mass type vibration absorber, problems.

Unit-III

Multi-degree of freedom systems: Introduction, principal modes of vibrations for three or more DOF, influence coefficients, orthogonality principle, matrix method, matrix iteration method, Dunkerley's equation, Holzer's Method, Rayleigh Method, Stodola method, problems.

Continuous systems: Introduction, lateral vibrations of strings, longitudinal vibrations of bars, transverse vibration of beams, torsional vibration of uniform shafts, problems.

Unit-IV

Tribology: Introduction, tribology in design, tribology in industry, economic aspects.

Lubrication: Introduction, basic modes of lubrication, lubricants, properties of lubricants: physical and chemical, types of additives, extreme pressure lubricants, recycling of used oils and oil conservation, disposal of scrap oil, oil emulsion.

Friction and wear: Introduction, laws of friction, kinds of friction, causes of friction, friction measurement, theories of friction, effect of surface preparation. Introduction to wear, types of wear, various factors affecting wear, measurement of wear, wear between solids and liquids, theories of wear.

Text Books:

1. Mechanical Vibrations by G. K. Grover, Nem Chand and Bros., Roorkee.
2. Elements of Mechanical Vibrations by Meirovitch, McGraw Hill.
3. Introductory course on theory and practice of Mechanical Vibration by J.S. Rao and K.Gupta, New Age International.
4. Friction and wear of Materials by E. Robinowicz, Johan Wiley
5. Tribology an Introduction by Sushil Kumar Srivastava
6. Introduction to Tribology and Bearings by B. C. Majumdar, S. Chand and Company Ltd. New Delhi.

Reference Books:

1. Mechanical Vibrations by S.S. Rao, Pearson Education Inc. Dorling Kindersley (India) Pvt. Ltd. New Delhi.
2. Mechanical Vibrations by V.P. Singh, Dhanpat Rai & Co. Pvt. Ltd., Delhi.

3. Engineering Tribology by Prashant Sahoo, PHI publications.

4. Principles of Tribology by J. Hailing, McMillan Press Ltd.

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

	B. Tech (4 th Semester) Aeronautical Engineering						
B24-MEC-206	MECHANICS OF SOLID-II [For Aeronautical, Mechanical students only]						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	1	-	4	70	30	100	3 h
Purpose	The objective of this course is to show the concept of strain energy and different stresses in springs, pressure vessels, rotating rims/discs, links, curved bars under different loads. The course will help the students to build the fundamental concepts in order to solve engineering problems.						
Course Outcomes							
CO1	Understand the concepts of strain energy and various theories of failures and solve the problems.						
CO 2	Differentiate different types of stresses induced in thin and thick pressure vessels and solve the problems. Use of Lamé's equation to calculate the stresses induced in thick pressure vessels.						
CO 3	Able to compute stresses in ring, disk and cylinder due to rotation. Classify the different types of spring and analyse the stresses produced due to loading.						
CO4	Determine the stresses in crane hook, rings, chain link for different cross sections and also the deflection of curved bars and rings. Analyse the stresses due to unsymmetrical bending and determine the position of shear centre for different sections.						

Unit – I

Strain Energy & Impact Loading: Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano's theorem, Numerical.

Theories of Elastic Failures: Various theories of elastic failures with derivations and their limitations, comparisons and applications to problems of 2- dimensional stress system, Numerical.

Unit-II

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

Thick Cylinders & Spheres: Derivation of Lamé's equations, radial & hoop stresses and strains in thick and compound cylinders and spherical shells subjected to internal fluid pressure only, hub shrunk on a solid shaft, Numerical.

Unit-III

Rotating Rims & Discs: Stresses in uniform rotating rings & discs, rotating discs of uniform strength, stresses in (i) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders, hollow cylinders & solid cylinders. Numerical.

Springs: Stresses in closed coiled helical springs, Stresses in open coiled helical springs subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numerical.

Unit-IV

Bending of Curved Bars: Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars & rings, stresses in simple chain links, deflection of simple chain links, Problems.

Unsymmetrical Bending: Introduction to unsymmetrical bending, stresses due to unsymmetrical bending, deflection of beam due to unsymmetrical bending, shear centre for angle, channel, and I- sections, Numerical.

Text 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 Materials – D.S. Bedi, Khanna Publications.

Reference Books:

1. Strength of Materials – Popov, PHI, New Delhi.
2. Strength of Materials – Robert I. Mott, Pearson, New Delhi
3. Strength of Material – Schaum's Outline Series – McGraw Hill
4. Strength of Material – Rider – ELBS

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

	B. Tech (4 th Semester) Aeronautical Engineering						
B24-AER-204	AERODYNAMICS-I [For Aeronautical students only]						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	-	-	3	70	30	100	3 h
Purpose	To familiarize the students with the fundamentals of Aerodynamics						
Course Outcomes							
CO1	Understanding conformal transformations and its applications						
CO 2	Introduction to the concept inviscid, incompressible and irrotational flows						
CO 3	Understanding the thin air foil theory						
CO4	Introduction to flow over finite wings						

Unit – I

Conformal Transformations: Complex potential function, Blasius theorem, principles of conformal transformation, Kutta -Juokowaski transformation of a circle into flat plate, air foils & ellipses.

Review of basic fluid mechanics: Differential and Integral forms of continuity, momentum and energy equations. Path lines and streamlines, angular velocity, vorticity and strain, circulation, stream function, velocity potential and their relationship.

Unit-II

Inviscid Incompressible flow: Bernoulli's Equation, flow in a duct, pitot tube, pressure coefficient, condition on velocity for incompressible flow, Laplace equation, uniform flow, source flow, flow past a half body and Rankine oval, doublet, non-lifting flow over a circular cylinder, vortex flow, lifting flow over a circular cylinder, Kutta- Joukowski theorem.

Unit-III

Incompressible flow over airfoils: Airfoil nomenclature and characteristics, vortex sheet, Kutta condition, Kelvin's Circulation theorem and the starting vortex, Classical thin airfoil theory- symmetric and cambered airfoils, modern low speed airfoils, flow over an airfoil- the real case, role of airfoil thickness on airplane design.

Unit-IV

Incompressible flow over finite wings: Downwash and induced drag, vortex filament, Biot-Savart Law, Helmholtz theorems, Prandtl's classical lifting line theory, numerical non-linear lifting line method, flow over a delta wing.

Text Book:

1. Fundamentals of Aerodynamics, J. D. Anderson, McGraw Hill.
2. Aerodynamics for Engineers, Bertin and Smith, Prentice Hall.

Suggested Books:

1. Aerodynamics, L. J. Clancey, Pitman.
2. Aerodynamics for engineering students, Houghton EL & Brock AE.

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

	B. Tech (4 th Semester) Aeronautical Engineering						
B24-MEC-208	MANUFACTURING TECHNOLOGY [For Aeronautical, Mechanical students only]						
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	-	-	3	70	30	100	3 h
Purpose	To build a foundation in different manufacturing processes related to castings, metal forming, joining, powder metallurgy and plastic material shaping processes.						
Course Outcomes							
CO1	After completing the course, students will be able to understand the casting fundamentals, and different casting processes.						
CO 2	The students will be able to understand and analyse the different metal forming processes.						
CO 3	The students will understand different welding processes with their applications.						
CO4	The student will have the basic understanding of powder metallurgy processes and different plastic shaping processes.						

Unit – I

Fundamentals of castings: Introduction to casting; basic requirements of casting processes, casting terminology, solidification process: cooling curves, prediction of solidification time, fluidity and pouring temperature, role of gating system, solidification shrinkage, casting defects.

Expandable-mould casting processes: Sand casting, cores and core making, other expendable-mould processes with multiple use patterns, shakeout, cleaning and finishing.

Multiple-use-mould casting processes: Permanent mould casting, die casting, squeeze casting and semisolid metal casting, centrifugal casting, cleaning, finishing and heat treating of castings, automation in foundry operations.

Unit-II

Metal forming processes: Classifications of metal forming processes, bulk deformation processes, material behaviour in metal forming, temperature in metal forming, rolling: flat rolling, shape rolling, rolling mills, forging: open-die forging, impression-die forging, fleshless forging, extrusion: types of extrusion, extrusion dies and presses, defects in extruded products, wire and bar drawing, tube drawing.

Sheet metal working: Cutting operations: shearing, blanking, and punching, engineering analysis of sheet-metal cutting, other sheet-metal-cutting operations, bending operations: v-bending and edge bending, spring back effect, drawing: mechanics of drawing, defects in drawing.

Unit-III

Joining processes: Principles of fusion welding processes, arc welding processes, consumable electrodes: shielded metal arc welding, gas metal arc welding, flux-cored arc welding, submerged arc welding, Arc welding processes-non-consumable electrodes: gas tungsten arc welding, plasma arc welding, resistance welding processes, electron-beam welding, laser beam welding, thermit welding.

Principles of solid-state welding processes: friction welding, explosive welding, ultrasonic welding processes. Brazing, soldering, and adhesive bonding: Principles of adhesive, brazing and soldering processes, origins of welding defects.

Unit-IV

Powder metallurgy: Characterization of engineering powders: geometric features, other features production of metallic powders: atomization: other production methods, conventional pressing and sintering: blending and mixing of the powders, compaction, sintering, heat treatment and finishing, design considerations in powder metallurgy.

Shaping processes for plastics: Properties of polymer melts, extrusion, production of sheet and film, fibre and filament production (spinning), coating processes, injection moulding, compression and transfer moulding, blow moulding and rotational moulding, thermoforming.

Text Books:

1. Fundamentals of modern manufacturing: materials processing and systems by Mikell P. Grover, John Wiley and Sons.
2. Materials and processes in manufacturing by J.T. Black and R.A. Kosher, John Wiley.
3. Principles of Manufacturing Materials & Processes by Campbell J. S., Publisher – Mc Graw.
4. Production Technology by R. K. Jain, Khanna Publishers
5. Manufacturing Technology-Foundry, Forming and Welding by P.N. Rao, Tata McGraw Hill
6. Advanced Manufacturing Process by Hofy, H.E., B and H Publication.
7. Manufacturing Science by Ghosh, A. and Mullik, A, East –West private Limited.

Reference Books:

1. Welding and Welding Technology by Richard L. Little Tata McGraw Hill Ltd.
2. Manufacturing Processes and Systems by Ostwald Phillip F., Munoz Jairo, John Wiley
3. Elements of Manufacturing Processes by B.S. Nagendra Parasher, RK Mittal, PHI N. Delhi
4. Manufacturing Engineering and Technology by Serope Kalpakjian and Steven R. Schmid, Pearson publications.

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

B24-ESC-204	MATERIALS ENGINEERING LAB						
Lecture	Tutorial	Practical	Credits	Practical Exam	Internal Assessment	Total	Time (Hrs.)
-	-	2	1	60	40	100	3 h
Purpose	To make the students prudent in metallographically sample preparation, microstructure analysis, basic heat treatment operations and production of Biofuels.						
Course Outcomes							
CO1	Students will have the ability to design and conduct experiments, acquire data, analyse and interpret data						
CO2	Students will have the ability to determine the grain size and microstructure in different Ferrous alloys by means of experiments.						
CO3	Students will have the ability to identify and differentiate microstructures of different Non-Ferrous alloys.						
CO4	Students will be able to perform various heat treatment processes using muffle furnace in the lab.						
CO5	Students will have the ability to analyse microstructure of Heat-treated specimens and perform Fatigue and creep test on different materials.						
CO6	Students will be able to perform lab scale production of Biofuel.						

List of experiments

1. To Study various Crystal Structures through Ball Models.
2. To study the components and functions of Metallurgical Microscope.
3. To learn about the process of Specimen Preparation for metallographic examination.
4. To perform Standard test Methods for Estimation of Grain Size.
5. To perform Microstructural Analysis of Carbon Steels and low alloy steels.
6. To perform Microstructural Analysis of Cast Iron.
7. To perform Microstructural Analysis of Non-Ferrous Alloys: Brass & Bronze.
8. To perform Microstructural Analysis of Non-Ferrous Alloys: Aluminium Alloys.
9. To Perform annealing of a steel specimen and to analyse its microstructure.
10. To Perform Hardening of a steel specimen and to analyse its microstructure.
11. To perform Jominy End-Quench Hardenability Test.
12. To perform Fatigue test on fatigue testing machine.
13. To perform Creep test on creep testing machine.
14. To produce a sample of Biodiesel.
15. To study the functioning of fuel cells.

Note: Any 8 experiments from the above list are required to be performed by students in the laboratory.

B24-MEC-210	FLUID MECHANICS AND MACHINES LAB						
Lecture	Tutorial	Practical	Credits	Practical Exam	Internal Assessment	Total	Time (Hrs.)
-	-	2	1	60	40	100	3 h
Purpose	To familiarize the students with the equipment and instrumentation of Fluid Mechanics and Machines						
Course Outcomes							
CO1	Collect, analyse and interpret data using fluid mechanics principles and experimentation methods.						
CO2	Determine the coefficient of discharge for various flow measurement devices.						
CO3	Calculate flow characteristics such as Reynolds number, friction factor from laboratory measurements.						
CO4	Analyse the performance characteristics of hydraulic pumps and turbines.						
CO5	Write individual and group reports, present objectives, describe test procedures and results, synthesize and discuss the test results.						

List of experiments

1. To determine the meta-centric height of a floating body.
2. To verify the Bernoulli's Theorem.
3. To determine coefficient of discharge of an orifice meter.
4. To determine the coefficient of discharge of venturi meter.
5. To determine the coefficient of discharge of Notch.
6. To find critical Reynolds number for a pipe flow.
7. To determine the friction factor for the pipes.
8. Determination of the performance characteristics of Pelton Wheel.
9. Determination of the performance characteristics of a Francis Turbine.
10. Determination of the performance characteristics of a Kaplan Turbine.
11. Determination of the performance characteristics of a centrifugal pump.
12. Determination of the performance characteristics of a reciprocating pump.
13. Determination of the performance characteristics of a gear pump.
14. Determination of the performance characteristics of a Hydraulic Ram.

Note: Any 8 experiments from the above list are required to be performed by students in the laboratory.

B24-AER-206	AIRCRAFT STRUCTURE I LAB						
Lecture	Tutorial	Practical	Credits	Practical Exam	Internal Assessment	Total	Time (Hrs.)
-	-	2	1	60	40	100	3 h
Purpose	The aircraft structures lab with enable the student to conduct experiments so that they are able to understand the theoretical concepts and principles in a better way.						
Course Outcomes							
CO1	Students will be able to gain basic knowledge on the mechanical behaviour of materials like aluminium, mild steel and cast iron.						
CO2	Students will be able to obtain buckling strength of both long columns using different elastic supports.						
CO3	Students will be able to interpret the concept of locating the shear centre for open and closed section of beams						
CO4	Students will be able to describe test procedures, synthesize and discuss the results.						

List of experiments

1. Compute stress and deflections of beams for various end conditions, verification of Maxwell's theorem
2. Perform Compression tests on long columns and evaluate critical buckling loads.
3. Evaluation of Young's modulus by bending of cantilever Beams
4. Perform unsymmetrical bending on a beam and tabulate the results.
5. Evaluate shear centres of open section beam.
6. Evaluate shear centres of closed section beam.
7. Perform inspection and non-destructive testing (NDT) on aircraft structural components.
8. Fabricate and determine the young's modulus of a sandwich structure.

Note: Any 8 experiments from the above list are required to be performed by students in the laboratory.

	B. Tech (4 th Semester) Aeronautical Engineering						
B24-MAC-202	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE						
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
2	-	-	1	-	100	100	3 h
Purpose	To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the importance of roots of knowledge system, analyse and apply to their day-to-day life.						
Course Outcomes							
CO1	The students will be able to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective						
CO 2	The students will be able to understand Holistic Health using Indian Knowledge System.						
CO 3	The students will be able to Manage thoughts and Emotions, will learn positivity, self-regulation and control						
CO4	The students will be able to Achieve Consciousness through Indian Knowledge System						

Unit – I

Introduction to Indian Traditional knowledge: Define traditional knowledge, importance, kinds of traditional knowledge. Philosophical systems, Basics of Raj yoga and Karam yoga, Benefits of Raj yoga and Karam yoga.

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 Raj yoga. 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.

Refrence and Text Books:

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

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

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