DEPARTMENT OF MECHANICAL ENGINEERING
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR

B.Tech. (Mechanical Engineering) Programme

IV- Semester

Sr. No.	Category	Course Code		Course Title	Hours per week			Course Credits		
		Theory	Practical		L	T	P	Theory	Practical	Total
1.	Basic Science Courses	BSC202-T	BSC202-P	Numerical Methods	2	0	2	2.0	1.0	3.0
2.	Professional Core Courses	PCC-ME204-T	PCC-ME204-P	Material Science	3	0	2	3.0	1.0	4.0
3	Professional Core Courses	PCC-ME205-T	PCC-ME205-P	Fluid Mechanics	3	1	2	4.0	1.0	5.0
4	Professional Core Courses	PCC-ME206-T	--	Steam and Power Generation	3	0	0	3.0	--	3.0
5	Professional Core Courses	PCC-ME207-T	--	Mechanics of Solids-II	3	1	0	4.0	--	4.0
6	Project work, Seminar and Internship in Industry	--	PROJ-ME201-P	Skill and Innovation Lab	0	0	2	--	1.0	1.0
7.	Mandatory Courses	MC104-T	--	Essence of Indian Traditional Knowledge	3	0	0	0.0	--	0.0
					17	2	8			
Total credits										20.0

Note- At the end of the IV-semester each student would undergo 4-6 weeks practical training in an industry/research laboratory.

4th Semester

NUMERICAL METHODS (THEORY)

General Course Information

Course Code: BSC-202-T Course Category: Basic Science Course Course Credits: 2.0 Contact Hours: 2 hours/week Mode: Lectures Examination Duration: 3 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to memorize and describe various interpolation formulae	L1
CO2	Students will be able to make comparison between direct and iterative methods	L2
CO3	Students will be able to solve problems relating to numerical differentiation and integration	L3
CO4	Students will be able to differentiate between single step and multi-step methods of ordinary differential equations	L4
CO5	Students will be able to construct polynomial from the tabular data	L5

Course Contents

UNIT-I

Finite differences operators and their relationship, difference table. Interpolation with equal intervals: Newton-Gregory forward & backward interpolation formulae. Central Differences interpolation: Gauss's forward and backward difference interpolation formulae. Interpolation with unequal intervals: Lagrange interpolation, Newton Divided difference.

UNIT-II

Non-Linear Equations: Bisection method, Regula-Falsi method, Secant method, Newton-Raphson's method, Newton's iterative method for finding pth root of a number. Simultaneous Linear Algebraic Equations: Gauss Elimination method, Gauss-Jordan method, Jacobi's method, Gauss-Seidal method, Relaxation method.

UNIT-III

Numerical Differentiation: Derivatives from differences tables, Higher order derivatives. Numerical Integration: Newton -Cotes integration formula, Trapezoidal rule, Simpson's one- third rule and Simpson's three-eighth rule, Boole's rule and Weddle's rule.

UNIT-IV

Numerical Solution of Ordinary Differential Equations: Taylor series method, Euler method, modified Euler method, and Runge-Kutta methods. Multiple step methods of Ordinary Differential Equations: Predictor-corrector method, Milne's method, Adams-Moulton method.

Text and Reference Books

1. Applied Numerical Analysis: Curtis F. Gerald and Patrick G. Wheatley, Person, Education Ltd.
2. Numerical Method: E. Balagurusamy, TataMcGraw-Hill
3. Numerical methods for Scientific and Engg. Computations: M.K. Jain, S.R.K. Iyengar and R.K. Jain, Wiley Eastern Ltd.
4. Introductory methods of Numerical Analysis: S.S. Sastry, P.H.D.
5. Numerical Methods in Engg. & Science: B.S. Grewal.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	--	2	1	--	--	--	--	--	--	--	--	1	--
CO2	3	2	--	2	2	--	--	--	--	--	--	--	--	1	--
CO3	3	3	--	3	2	--	--	--	--	--	--	--	--	2	--
CO4	3	3	--	3	2	--	--	--	--	--	--	--	--	2	--
CO5	1	2	--	2	1	--	--	--	--	--	--	--	--	1	--

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

NUMERICAL METHODS (LAB)

General Course Information

Course Code: BSC-202-P Course Category: Basic Science Course Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to memorize and describe various data types and file handling functions	L1
CO2	Students will be able to translate given algorithm to a working and correct program in C language	L2
CO3	Students will be able to write, compile and debug programs in C language	L3
CO4	Students will be able to compare and contrast algorithms to solve mathematical problems	L4
CO5	Students will be able to evaluate the numerical solutions of mathematical problems using C programming language	L5
CO6	Students will be able to assemble object oriented features of C programming language in developing the programs to solve real world problems	L6

Lab Contents

Write down and execute the following programs using C :

1. To interpolate the data using Newton's forward/ backward interpolation formula
2. To interpolate the data using Gauss's forward/ backward interpolation formula
3. To interpolate the data using Lagrange's interpolation formula
4. To compute derivatives of a tabulated function at a specified value using the Newton's interpolation approach.
5. To find the roots of non-linear equation using Bisection method.
6. To find the roots of non-linear equation using Regula-Falsi method.
7. To find the roots of non-linear equation using Newton-Raphson method.
8. To solve the system of linear equations using Gauss -elimination method.
9. To solve the system of linear equations using Gauss -Seidal iteration method.
10. To solve the system of linear equation using Gauss – Jordan method.
11. To integrate numerically using Trapezoidal rule.
12. To integrate numerically using Simpson's rules.
13. To find numerical solution of ordinary differential equations by Euler's method/ Modified Euler's method.
14. To find numerical solution of ordinary differential equations by Runge -Kutta method.
15. To find numerical solution of ordinary differential equations by Milne's method.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

Text and Reference Books

1. Applied Numerical Analysis: Curtis F. Gerald and Patrick G. Wheatley - Pearson Education Ltd.
2. Numerical Methods : E. Balagurusamy, Tata McGraw-Hill.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	--	--	--	--	--	--	--	--	2	2
CO2	3	2	3	2	2	--	--	--	--	--	--	--	--	2	2
CO3	3	3	3	3	2	--	--	--	--	--	--	--	--	2	2
CO4	3	3	3	3	3	--	--	--	--	--	--	--	--	2	2
CO5	3	3	3	3	2	--	--	--	--	--	--	--	--	2	2
CO6	3	2	3	2	3	--	--	--	--	--	--	--	--	2	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

MATERIAL SCIENCE (THEORY)

General Course Information

Course Code: PCC-ME204-T Course Category: Professional Core Course Course Credits: 3.0 Contact Hours: 3 hours/week (L: 3; T: 0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to define crystals, its basic concepts, imperfection in crystals, equilibrium diagrams and their objectives.	L1
CO2	Students will be able to understand phase & phase diagram, heat treatment, failure of materials & their protection, applications of materials	L2
CO3	Students will be able to examine the mechanical behavior of materials in different operating conditions	L3
CO4	Students will be able to select the materials accordance to their structure and properties.	L4

Course Contents

UNIT-I

Crystallography: Review of crystal structure, space lattice, crystal planes and crystal directions, co-ordination number, number of atoms per unit cell, atomic packing factor, Numericals related to crystallography.

Imperfection in metal crystals: Crystal imperfections and their classifications, point defects, line defects, edge & screw dislocations, surface defects, volume defects & effects of imperfections on metal properties.

UNIT-II

Solid solutions and phase diagram: Introduction to single and multiphase solid solutions and types of solid solutions, importance and objectives of phase diagram, systems, phase and structural constituents, cooling curves, unary & binary phase diagrams, Gibbs's phase rule, Lever rule, eutectic and eutectoid systems, peritectic and peritectoid systems, iron carbon equilibrium diagram and TTT diagram.

Heat Treatment: Principles, purpose, classification of heat treatment processes, annealing, normalizing, stress relieving, hardening, tempering, carburizing, nitriding, cyaniding, flame and induction hardening, Allotropic transformation of iron and steel, Properties of austenite, ferrite, pearlite, martensite.

UNIT-III

Deformation of Metal: Elastic and plastic deformation, mechanism of plastic deformation, twinning, conventional and true stress strain curves for polycrystalline materials, yield point phenomena, strain ageing, work hardening, Bauschinger effect, season cracking, Recovery, re-crystallization and grain growth.

Failures of metals: Failure analysis, fracture, process of fracture, types of fracture, fatigue, characteristics of fatigue, fatigue limit, mechanism of fatigue, factors affecting fatigue.

UNIT-IV

Creep & Corrosion: Definition and concept, creep curve, mechanism of creep, impact of time and temperature on creep, creep fracture, creep testing and prevention against creep. Corrosion: Mechanism and effect of corrosion, prevention of corrosion.

Plastic, Composite and Ceramics: Polymers, formation of polymers, polymer structure and crystallinity, polymers to plastics types, reinforced particles-strengthened and dispersion strengthened composites. Ceramic materials: Types of ceramics, properties of ceramic, ceramic forming techniques, mechanical behavior of ceramic.

Text and Reference Books

1. Elements of Material Science and Engineering: VanVlack, Wesley Pub. Comp.
2. Material Science - Narula, Narula and Gupta. New Age Publishers
3. Material Science & Engineering –V. Raghvan, Prentice Hall of India Pvt. Ltd, New Delhi
4. A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpat Rai & Sons
5. Material Science and Engineering-An Introduction - Callister; W.D., John Wiley & Sons., Delhi.
6. Engineering Materials: Kenneth G. Budinski, Prentice Hall of India, New Delhi

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	--	2	1	1	1	2	--	2	3	2	2
CO2	3	2	2	1	--	2	1	1	2	2	--	2	3	2	2
CO3	3	1	2	1	--	3	1	1	2	2	--	2	3	2	2
CO4	3	1	2	1	--	3	1	1	2	2	--	3	2	2	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

MATERIAL SCIENCE (LAB)

General Course Information

Course Code: PCC-ME204-P Course Category: Professional Core Course Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to understand the basic concepts of crystalline materials, phase & phase diagram, heat treatment process & types	L1
CO2	Students will be able to select the materials accordance to their structure and properties.	L2
CO3	Students will be able to analyze the structure of materials at different levels	L3
CO4	Students will be able to examine crystals imperfections	L4

Lab Contents

1. To study crystal structures of a given specimen.
2. To study crystal imperfections in a given specimen.
3. To study microstructures of metals/ alloys.
4. To prepare solidification curve for a given specimen.
5. To study heat treatment processes (hardening and tempering) of steel specimen.
6. To study microstructure of heat-treated steel.
7. To study thermo-setting of plastics.
8. To study the creep behavior of a given specimen.
9. To study the mechanism of chemical corrosion and its protection.
10. To study the properties of various types of plastics.
11. To study Bravais lattices with the help of models.
12. To study crystal structures and crystals imperfections using ball models.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	--	--	1	1	--	1	--	3	3	3	2
CO2	3	1	2	1	--	--	1	1	--	1	1	3	3	3	2
CO3	3	3	3	2	3	--	1	1	2	2	1	3	3	3	2
CO4	3	3	3	2	3	--	1	1	2	2	2	3	3	3	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

FLUID MECHANICS (THEORY)

General Course Information

Course Code: PCC-ME205-T Course Category: Professional Core Course Course Credits: 4.0 Contact Hours: 4 hours/week (L: 3; T: 1) Mode: Lectures and Tutorials Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to define the fluid, its properties and various laws governing fluid flow.	L1
CO2	Students will be able to identify and explain fluid flow under static, kinematics and dynamic conditions.	L2
CO3	Students will be able to apply engineering knowledge to solve the fluid flow problems under given conditions.	L3
CO4	Students will be able to examine flow through pipes and boundary layer phenomenon on a flat surface.	L4
CO5	Students will be able to evaluate various parameters related to laminar and turbulent flows.	L5

Course Contents

UNIT-I

Fluid Properties and Fluid Statics: Introduction, fluid continuum, fluid properties, types of fluids, Pascal's law, hydrostatic law, Manometers: simple and differential, Hydrostatic forces on plane and curved surfaces, Buoyancy and Flotation: Centre of buoyancy, Archimedes' principle, Metacentre and Metacentric height, Stability of floating and submerged bodies, Numerical Problems.

Fluid Kinematics: Types of fluid flows, description of fluid flow: stream, streak, path and time lines, Eulerian and Lagrangian methods, flow rate and continuity equation in 3-D and in cylindrical and polar coordinates, rotation, vorticity and circulation, stream and potential functions, flow net, Numerical Problems.

UNIT-II

Fluid Dynamics: Energy and forces acting on a flowing fluid, Equations of motion, Euler's equation, Bernoulli's equation, Venturimeter, orifice meter, Pitot tube, Impulse momentum relationship and its applications, Numerical Problems.

Orifices, Mouthpieces, Notches and Weirs: Classification of orifices and mouthpieces, Hydraulic coefficients, Discharge through a large rectangular orifice, Time of emptying a tank through an orifice, Classifications of notches and weirs, Empirical formulae for discharge over rectangular weirs, Discharge over rectangular & triangular notch or weir, Numerical Problems.

UNIT-III

Laminar Flow (Viscous Flow): Introduction, Reynolds experiment, Laminar flow in circular pipes (Hagen-Poiseuille theory), Laminar flow between two parallel plates when both plates are at rest, Laminar flow between two parallel plates when one plate moves and other at rest (Couette flow), Numerical Problems.

Turbulent Flow: Loss of head in pipes (Darcy-Weisbach equation), Characteristics of turbulent flow (turbulence), Shear stresses in turbulent flow: Boussinesq's theory, Reynolds theory, Prandtl's mixing length theory, Von-Karman similarity concept, Universal velocity distribution equation, hydrodynamically smooth and rough boundaries, velocity distribution for smooth and rough pipes, friction coefficients for smooth and rough pipes, Moody diagram, Numerical Problems.

UNIT-IV

Flow Through Pipes: Major and minor head losses in pipes, hydraulic gradient and total energy lines, Pipes in series and parallel, equivalent pipe, branched pipes, power transmission through pipes, numerical Problems.

Boundary Layer Flow: Description of boundary layer, displacement, momentum and energy thickness, Drag force on a flat plate (Von Karman momentum integral equation), Blasius solution for laminar boundary layer flows, Velocity profiles for laminar boundary layer, boundary layer separation and control, Numerical Problems.

Text and Reference Books

1. Fluid Mechanics and Hydraulics Machines, Mahesh Kumar, Pearson Education, 2019.
2. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill
3. Mechanics of Fluids – I H Shames, Mc Graw Hill
4. A text book of Fluid Mechanics and Hydraulic Machines", R.K Rajput., S. Chand & Company Ltd., New Delhi
5. Fluid Mechanics and Hydraulics Machines, R.K. Bansal, Laxmi publications (P) Ltd., New Delhi
6. Hydraulics and Fluid Mechanics, Modi P.N., & Seth S.M Standard Book House, New Delhi
7. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, TMH
8. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
9. Fluid Mechanics and Machinery – S.K. Agarwal, TMH, New Delhi
10. Fluid Mechanics, Yunus A Cengel & John M. Cimbala, Tata McGraw Hill Edition, New Delhi, 2006
11. Fluid Mechanics White, F.M, Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
12. Fluid Mechanics & Fluid Machines: Basic Concepts & Principles, Shiv Kumar, Ane Books Pvt. Ltd., New Delhi, 2010.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	--	1	1	--	2	1	1	--	1	--	3	3	2	3
CO2	3	3	2	2	1	3	2	--	1	1	1	3	2	1	3
CO3	3	2	3	3	2	2	2	2	2	2	1	3	2	2	2
CO4	3	2	2	2	1	2	2	--	--	2	2	3	3	2	3
CO5	3	2	2	2	3	2	2	--	1	2	2	3	3	2	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

FLUID MECHANICS (LAB)

General Course Information

Course Code: PCC-ME205-P Course Category: Professional Core Course Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to describe the fundamentals involved in measuring various performance parameters.	L1
CO2	Students will be able to understand the working of various flow meters.	L2
CO3	Students will be able to operate flow discharge measuring device used in pipes channels.	L3
CO4	Students will be able to examine types of flow and major and minor losses during fluid flow.	L4
CO5	Students will be able to Evaluate the error between theoretical and experimental results.	L5

Lab Contents

1. To verify the Bernoullis Theorem.
2. To determine the coefficient of discharge of an orifice meter.
3. To determine the coefficient of discharge of venturimeter.
4. To determine the coefficient of discharge of Notch (V and Rectangular types).
5. To determine the major loss due to friction in pipe flow.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To find critical Reynolds number for a pipe flow.
8. To determine the meta-centric height of a floating body.
9. To determine the minor losses due to pipe fittings in pipes
10. To determine the density and viscosity of any three fluids.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	--	1	--	1	1	2	--	3	3	2	2
CO2	3	1	1	1	--	1	--	1	2	2	--	3	2	2	2
CO3	3	2	2	3	2	1	2	2	3	3	--	3	2	2	2
CO4	3	1	3	3	3	2	3	2	2	3	2	3	2	3	2
CO5	3	1	3	3	3	2	2	2	2	3	3	3	2	3	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

STEAM AND POWER GENERATION (THEORY)

General Course Information

Course Code: PCC-ME206-T Course Category: Professional Core Course Course Credits: 3.0 Contact Hours: 3 hours/week (L: 3; T: 0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to define combustion process of fuels and change in thermodynamic properties of steam in boilers, turbines, engines and condensers.	L1
CO2	Students will be able to discuss the construction and working of bomb calorimeter, steam generators, steam turbines, steam engines and steam condensers.	L2
CO3	Students will be able to examine the process of energy conversion in fuel combustion and steam power generating devices.	L3
CO4	Students will be able to formulate the performance parameters for the equipments used in fuel combustion and power generation through steam.	L4

Course Contents

UNIT- I

Fuels and Combustion: Characteristics of fuels, Laws of combustion and reactions, Gravimetric and volumetric analysis, Air-fuel ratio, Exhaust gas analysis, Orsat apparatus. Calorific values of fuel, Bomb calorimeter, Numericals.

Steam: Formation of steam at constant pressure, Variation in steam properties during phase change, Steam tables and their uses, Enthalpy – entropy (Mollier) diagram, Carnot and Rankine vapour cycles, Rankine cycle with reheat and regeneration, Numericals.

UNIT - II

Steam Generators: Classification of steam boilers, Essentials of a good boiler, Construction and operational details of Cochran, Babcock Wilcox, Locomotive, Benson, Lamont, and Loeffler Boilers, Boiler mountings and accessories.

Boiler Draught (Draft) and Performance: Natural (Chimney) draught, Maximum discharge through a chimney, Artificial draught, Evaporative capacity and efficiency of boilers, Energy balance in a boiler, Numericals.

UNIT - III

Steam Nozzles: Steam flow through a nozzle, Critical pressure ratio (maximum discharge condition) and its physical significance, Flow through actual nozzles, Supersaturated expansion of steam, Numericals.

Steam Turbines: Working principle of impulse and reaction steam turbines, Vector diagrams of velocities, Optimum operating conditions of turbines, Compounding of impulse turbines, Performance analysis of steam turbines, Numericals.

UNIT - IV

Steam Engines: Construction and working of steam engines, Indicator diagrams, Performance of steam engines, Governing of steam engines, Numericals.

Steam Condensers: Elements of a condensing plant, Types of condensers, Comparison of jet and surface condensers, Condenser and vacuum efficiency, Cooling towers, Numericals.

Text and Reference Books

1. P. L. Ballaney, "Thermal Engineering", Khanna Publishers, 2005
2. Mahesh M. Rathore, "Thermal Engineering", Tata McGraw-Hill Education, 2010
3. R. K. Rajput, "Thermal Engineering", Laxmi Publication, 2018.
4. D. S. Kumar, "Steam and Power Generation", S.K. Kataria and Sons, 2012

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	--	2	2	1	1	2	1	3	3	3	2
CO2	3	3	2	1	--	2	3	1	1	2	1	3	3	3	3
CO3	3	3	2	1	--	2	2	1	1	2	1	3	3	3	2
CO4	3	3	3	1	--	2	2	1	1	2	1	3	3	3	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

MECHANICS OF SOLIDS-II (THEORY)

General Course Information

Course Code: PCC-ME207-T Course Category: Professional Core Course Course Credits: 4.0 Contact Hours: 4 hours/week (L: 3; T: 1) Mode: Lectures and Tutorials Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to determine stresses in pressure vessels, beam columns, rotating rims & discs and springs.	L1
CO2	Students will be able to calculate slope and deflection in various beams subjected to different types of transverse loads using Energy, Double Integration, Macaulay's and Area Moment methods.	L2
CO3	Students will be able to carry out stress-strain analysis in solids subjected to bi-axial, tri-axial and combined torsion, bending & axial loads.	L3
CO4	Students will be able to design mechanical components such as pressure vessels, springs, flywheels, shaft, etc. in accordance with realistic constraints of safety and economical constraints.	L4

Course Contents

UNIT-I

Thin Pressure Vessels: Hoop and Longitudinal stresses & strains in cylindrical and spherical vessels under internal pressure, wire would thin cylinders.

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

UNIT-II

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 & solids cylinders

Beam columns: Beam columns subjected to single concentrated load, number of concentrated loads, continuous lateral Load, end couple, couples at both ends triangular loads.

UNIT-III

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 & Maxwell's theorems.

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

UNIT-IV

Slope & deflection: Relationship between bending moment, slope & deflection, calculations for slope and deflection using Integration, Macaulay's and area moment methods of (i) cantilevers and (ii) simply supported beams with or without overhang (iii) fixed beams under (i) concentrated loads, (ii) uniformly distributed load and (iii) a combination of concentrated loads & uniformly distributed load (iv) varying load (v) application of moments, propped beams, sinking of prop, continuous beams.

Theories of Elastic Failure: Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading.

Text and Reference Books

1. Mechanics of Solid by Muubeen Abdul, Pearson Publications, India.
2. Engineering Mechanics of Solids by Popov E.P, Prentice Hall of India Mechanics of Materials by Ferdinand P. Beer and E. Russel Johnston, Jr. Second Edition, McGraw Hill.
3. Solid Mechanics by Kazmi, Tata Mc Graw Hill.
4. Strength of Materials by G.H.Ryder, Macmillan, India.
5. Strength of Materials by D.S. Bedi, S. Chand & Co. Ltd.
6. Advanced Mechanics of Solids and Structures by N. Krishan Raju and D.R.Gururaje, Narosa Publishing House.
7. Strength of Materials by Andrew Pytel and Fredinand L. Singer, Int. Student Ed. Addison, Wesley Longman.
8. Strength of Materials by Sadhu Singh, Khanna Publishers, India.
9. Strength of Materials by Timoshenko S, East-West Press Pvt. Ltd., New Delhi.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	--	--	--	1	1	2	3	3	3	1
CO2	3	2	2	2	2	--	--	--	1	1	2	3	3	3	1
CO3	3	2	3	2	2	--	--	--	1	1	2	3	3	3	1
CO4	3	2	3	2	2	--	--	--	1	1	2	3	3	3	1

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

SKILLS AND INNOVATION (LAB)

General Course Information

Course Code: PROJ-ME201-P Course Category: Project work, Seminar and Internship in Industry Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to explore novel ideas/modified techniques on topics related to Mechanical Engineering.	L1
CO2	Students will be able to work in groups and collectively mange to present their ideas into a concept.	L2
CO3	Students will be able to identify and interpret practical problems/issues in existing mechanical systems.	L3
CO4	Students will be able to employ modern design and analysis tools for carrying out their project work.	L4

Course Contents

A group of 5-7 students are required to carry out a project related to current research & development in the field of Mechanical Engineering. Each group of students will try to propose a novel idea/modified technique/new interpretation after identifying an existing research work. They will work towards finding solutions to the identified problem such as cost reduction, enable new processes and/or materials, create a higher impact than the existing practices etc. using their innovative ideas and concept generation abilities.

The topic of the project will be decided by the students in consultation with the course coordinator. The project report will be submitted by a group at the end of semester. The students may use the equipments/machines/instruments available in the labs/workshops with the due permission of Chairperson on recommendation of the course coordinator.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	--	--	2	--	3	--	2	2	2	2	3
CO2	3	2	2	2	--	--	2	--	3	2	2	2	2	2	3
CO3	3	3	2	2	--	--	2	--	--	2	2	2	2	2	3
CO4	3	--	2	2	3	--	2	--	--	--	2	2	2	2	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)