



**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA
(JHAJJAR)**

An Autonomous Institute

‘A’ GRADE ACCREDITED BY NAAC

Scheme of Studies and Examinations

(Under NEP-2020)

B-SCHEME

Bachelor of Technology (Mechanical Engineering)

Effective from

Academic Session 2026-27 (2nd Year)



APPROVED BY AICTE, NEW DELHI AND AFFILIATED TO MDU, ROHTAK

1. DEFINITION OF CREDIT

1	1 Lecture (L) per week	1 Credit
2	1 Tutorial (T) per week	1 Credit
3	1 Practical (P) per week	0.5 Credit
4	1 Project/Seminar/Practical Training/Internship per week	0.5 Credit

2. RANGE OF CREDIT

A range of credits from 160 to 180 for a student to be eligible to get Under Graduate degree in Mechanical Engineering. A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 18-20 credits. These could be acquired through MOOCs.

3. STRUCTURE OF UNDERGRADUATE ENGINEERING PROGRAM (B. TECH)

Sr. No.	Category	Breakup of Credits
1	Basic Science Courses	21*
2	Engineering Science Courses	22*
3	Professional Core Courses	73*
4	Professional Elective Courses	12*
5	Humanities and Social Sciences including Management Courses	12*
6	Multidisciplinary Open Electives Courses	09*
7	Value Added Courses	03*
8	Project work, seminar and internship in industry or appropriate work place/ academic and research institutions in India/abroad	18*
9	Mandatory Non-Credit Courses (Audit Course)	(Non-Credit)
	Total Credits	170*

**Minor variation is allowed as per need of the respective disciplines.*

4. COURSE CODE AND DEFINITIONS

Sr. No.	Category	Course Code
1	Basic Science Courses	BSC
2	Engineering Science Courses	ESC
3	Professional Core Courses	PCC
4	Professional Elective Courses	PEC
5	Humanities and Social Sciences including Management Courses	HSMC
6	Multidisciplinary Open Electives Courses	OEC
7	Value Added Courses	VAT
8	Project	PR
9	Practical Training	PT
10	Seminar	SM
11	Internship	INT
12	Mandatory Non-Credit Courses (Audit Course)	MC
13	Laboratory Courses	LC

General Notes:

1. Students will be required to obtain passing marks in Mandatory Non-Credit Courses.
2. Students will be allowed to use non programmable scientific calculator. However, sharing of calculator will not be permitted in the examination.
3. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer, if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.

**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA
JHAJJAR (HR.)**

Scheme of Studies and Examinations

B. Tech (Mechanical Engineering) – 3rd Semester

W.e.f. 2026-27

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Schedule (Marks)				Exam Duration in H
				L	T	P			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Professional Core Courses	PCC-ME-201B	Thermodynamics	3	1	0	4	4	40	60		100	3
2	Professional Core Courses	PCC-ME-203B	Computer Aided Design & Manufacturing	3	0	0	3	3	30	45		75	3
3	Professional Core Courses	PCC-ME-205B	Materials & Metallurgy	3	0	0	3	3	30	45		75	3
4	Engineering Science Courses	ESC-ME-207B	Engineering Mechanics	3	0	0	3	3	30	45		75	3
5	Basic Science Courses	BSC-ME-209B	Mathematics-III	3	1	0	4	4	40	60		100	3
6	Humanity Science & Management Courses	HSMC-01B	Fundamentals of Management and Organizational Behaviour	3	0	0	3	3	30	45		75	3
7	Professional Core Courses	LC-ME-211B	Materials & Metallurgy Lab	0	0	2	2	1	10		15	25	-
8	Professional Core Courses	LC-ME-213B	Computer Aided Design & Manufacturing Lab	0	0	2	2	1	10		15	25	-
9	Engineering Science Courses	LC-ME-215B	Engineering Mechanics Lab	0	0	2	2	1	10		15	25	-
10	Mandatory Non-Credit Course	MC-201B	Environmental Science	2	0	0	2		20	30			3
Total Credits								23				575	

**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA
JHAJJAR (HR.)**

Scheme of Studies and Examinations

B. Tech (Mechanical Engineering) – 4th Semester

W.e.f. 2026-27

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Schedule (Marks)				Exam Duration in H
				L	T	P			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Professional Core Courses	PCC-ME-202B	Applied Thermodynamics	3	0	0	3	3	30	45		75	3
2	Professional Core Courses	PCC-ME-204B	Strength of Materials	3	0	0	3	3	30	45		75	3
3	Professional Core Courses	PCC-ME-206B	Fluid Mechanics	3	0	0	3	3	30	45		75	3
4	Professional Core Courses	PCC-ME-208B	Kinematics of Machines	3	0	0	3	3	30	45		75	3
5	Professional Core Courses	PCC-ME-210B	Manufacturing Technology-I	3	0	0	3	3	30	45		75	3
6	Professional Elective Courses	-----	Refer Table 1	3	0	0	3	3	30	45		75	3
7	Professional Core Courses	LC-ME-220B	Applied Thermodynamics Lab	0	0	2	2	1	10		15	25	-
8	Professional Core Courses	LC-ME-222B	Strength of Materials Lab	0	0	2	2	1	10		15	25	-
9	Professional Core Courses	LC-ME-224B	Fluid Mechanics Lab	0	0	2	2	1	10		15	25	-
10	Professional Core Courses	LC-ME-226B	Kinematics of Machines Lab	2	0	0	2	1	10		15	25	-
11	Professional Core Courses	LC-ME-228B	3D Printing Lab	2	0	0	2	1	10		15	25	-
Total Credits								23				575	

Note: At the end of 4th semester, each student has to undergo Practical Training of 4/6 weeks in an Industry/ Institute/ Professional Organization/ Research Laboratory/ training center etc. and its evaluation shall be carried out in the 5th Semester. Assessment of Practical Training will be based on seminar, viva-voce, report and certificate of practical training obtained by the student from the Industry/ Institute/ Professional Organization/ Research Laboratory/ training center etc.

Table 1: Professional Elective Course-I

Sr. No.	Course Code	Course Title
1	PEC-ME-212A	Industrial Engineering
2	PEC-ME-214A	3D Printing
3	PEC-ME-216A	CNC Machining
4	PEC-ME-218A	Composite Materials
5		Any one of the MOOCs not studied earlier and of equal credits (3)

Note: Students have to select any one course from the above list of courses, provided that the course has not been studied earlier.

Course Code	PCC-ME-201B				
Category	Professional Core Courses				
Course Title	Thermodynamics				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	1	0	4	
Course Objectives	The objectives of this course are • To introduce the fundamental concepts and principles of thermodynamics. • To know thermodynamic processes involving entropy, availability, and irreversibility. • To learn thermodynamic relationships for analyzing the behaviour of pure substances and real systems. • To inculcate problem-solving skills related thermal engineering practice.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total Marks	100				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the thermodynamic concepts, laws, and properties of pure substances.	L1: Remember
CO2	Explain the laws, entropy, thermodynamic relations and energy interactions in various processes.	L2: Understand
CO3	Apply thermodynamic laws and equations to solve thermodynamic systems.	L3: Apply
CO4	Analyze behaviour and efficiency of system using thermodynamic properties and relations.	L4: Analyze

Note: The Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each, and the remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Basic concept: Thermodynamic system, surrounding & boundary, thermodynamics properties – intensive & extensive, thermodynamic equilibrium, state, path, process & cycle, reversible & irreversible processes, path and point function, Quasi-static process. Zeroth law of thermodynamics, temperature scales; methods of temperature measurement. First Law of thermodynamics: Joules experiments, first law of thermodynamics for cyclic and non-cycle processes, internal energy and enthalpy, first law applied to non- flow process.
Unit-II	First Law of thermodynamics for flow processes: Derivation of general energy equation for a control volume, steady state steady flow energy equation, throttling process and free expansion process. Problems. Second Law of Thermodynamics: Limitations of the first law of thermodynamics, thermal reservoir, heat source & heat sink, heat engine and heat pump, Kelvin- Planck and Clausius Statements and their Equivalence, PMMSK, Carnot Cycle, Carnot heat engine and Carnot heat pump, Carnot theorem and its corollaries.

Unit-III	Entropy: Definition of entropy, demonstration that entropy is a property, Clausius inequality, principle of entropy increase, temperature entropy plot, entropy change in different processes, introduction to Third Law of Thermodynamics. Problems. Availability & Irreversibility: High- and Low-Grade Energy, Availability 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, Second law efficiencies of processes & cycles. Problems.
Unit-IV	Pure Substances: Pure Substance: Pure Substance and its Properties, Phase and Phase Transformation, Vaporization, Evaporation and Boiling, Saturated and Superheat Steam, Solid – Liquid – Vapor 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. Problems. Thermodynamic Relations: Maxwell's Equations, TdS Equations, Difference in Heat Capacities, Ratio of Heat Capacities, Energy Equation, Clausius- Clapeyron Equation, Gibbs Phase Rule, Types of Equilibrium, Third Law of Thermodynamics.

Suggested Readings:

1. Thermal Science and Engineering - D.S Kumar, Laxmi Publisher, 6th Edition.
2. Thermodynamics: An Engineering Approach - Yunus A. Cengel, Michael A. Boles, McGraw Hill.
3. Fundamentals of Engineering Thermodynamics - Moran, M. J. and Shapiro, H. N, John Wiley and Sons.
4. Engineering Thermodynamics – PK Nag, Tata McGraw-Hill Publishing Co. Ltd
5. Applied Thermodynamics - R. Yadav, Central Publishing House.
6. Fundamentals of Classical Thermodynamics, Gordon J. Van Wylen and Richard E. Sonntag, WILEY.

Web References:

1. <https://nptel.ac.in/courses/101104063>
2. <https://nptel.ac.in/courses/112102255>
3. <https://nptel.ac.in/courses/112105220>
4. <https://nptel.ac.in/courses/112105266>
5. <https://nptel.ac.in/courses/112105123>
6. <https://nptel.ac.in/courses/101104067>

Course Code	PCC-ME-203B				
Category	Professional Core Courses				
Course Title	Computer Aided Design & Manufacturing				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	0	0	3	
Course Objectives	The objectives of this course are • To aware about the introduction of CAD/CAM, and CIM. • To learn the Modelling of different types of curves, surface and solid. • To know about the transformation of points and lines in CAD software. • To know the numerical control machines, FMS, GT & CAPP.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the basic concepts of CAD/CAM	L1: Remember
CO2	Describe CAD/CAM tools, modelling techniques, geometric transformations & process planning.	L2: Understand
CO3	Apply modelling and coding principles to CAD/CAM systems.	L3: Apply
CO4	Analyze integrated systems for productivity and automation.	L4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	CAD/CAM: Introduction, Design Process, Importance and Necessity of CAD, Applications of CAD, Hardware and Software requirement of CAD. Computer Integrated Manufacturing: Introduction, Components of CIM, CIM Architecture and Information Flow, CAD/CAM Integration in CIM, Advantages, Limitations and Applications of CIM.
Unit-II	Curve Modelling: Representation of curves, Parametric and non-parametric curves, straight lines, Hermite cubic splines, B splines curves, Bezier curves. Surface & Solid Modelling: Plane surface, ruled surface, surface of revolution, bi-cubic surface, Bezier surface, B spline surface, Solid modelling, boundary representation, sweeping, parametric solid modelling.
Unit-III	Geometric Transformations: Introduction, 2D & 3D Transformation, translation, rotation, Reflection, Scaling, shearing and combined transformation, Homogeneous coordinates. Group Technology: Introduction, Part families, Part classification and coding, Optiz method, product flow analysis, Machine cell Design, Advantages of GT.

Unit-IV	Numerical control: Types of NC systems, MCU & other components, Co-ordinate system, NC manual part programming, G & M codes, part program for simple parts, Computer assisted part programming. FMS & CAPP: Introduction, FMS component, Types of FMS, FMS layout, planning for FMS, advantage and applications of FMS, conventional process planning, Steps in variant process planning, types of CAPP, planning for CAPP
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Suggested Readings:

1. CAD/CAM theory and Practice by Ibrahim Zeid, Tata McGraw Hill.
2. CAD/CAM Computer Aided Design and Manufacturing by E Zimmer M Groover, Pearson.
3. CAD/CAM/CIM by P. Radhakrishnan, New Age International Publishers.
4. Automation, Production Systems, and Computer-Integrated Manufacturing, Mikell Groover, Pearson

Web References:

1. <http://www.digimat.in/nptel/courses/video/112102101/L43.html>
2. https://youtu.be/t7yv4gSnNkE?si=MbYZjlOhoRt-_4tg
3. https://youtu.be/_PIFbHuWFOI?si=idtfnZFN-INMjj-4
4. https://youtu.be/_J2m_ugWNtc?si=qvFki6d_3LjhAFR7
5. <https://youtu.be/iWxS2zpaRjk?si=8SROYKLus9Q4PfVP>
6. <https://youtu.be/y3-5ENFtqrQ?si=nwZ4kWVP6fVusQmW>
7. <https://www.youtube.com/watch?v=3qd1JT7sRG8>

Course Code	PCC-ME-205B				
Category	Professional Core Courses				
Course Title	Materials and Metallurgy				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce to crystal structures, defects and their effects on properties. • To know the mechanical properties and materials testing techniques. • To learn the mechanisms of material failure including fracture, fatigue, and creep. • To gain the knowledge of phase diagrams and heat treatment processes. • To explore severe plastic deformation techniques for advanced applications.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the fundamental concepts of materials and metallurgy.	L1: Remember
CO2	Explain the crystallography, defects, mechanical behaviour, phase transformations, heat treatments and advanced methods.	L2: Understand
CO3	Apply appropriate principles and method to enhance the material performance.	L3: Apply
CO4	Analyze the effects of internal structure, mechanical behaviour, and processing methods on material characteristics.	L4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Crystallography: Reviews of Crystal structure, Classification of Lattices - Bravais Lattice, Crystal planes, Crystal directions, Coordinate number, Atoms per unit cell, Atomic Packing Factor, Numerical related to crystallography. Imperfection in Solids: Point Defects; vacancy, substitutional, interstitial, Frenkel and Schottky defects; Line Defects; edge and screw dislocations, Planar Defects; grain boundaries and twin boundaries; Volume defects & effects of imperfections on metal properties.
Unit-II	Mechanical Property Measurement: Mechanical properties of materials, relation between true and engineering stress strain curves, generalized hook's law, yielding and yielding strength, hardness testing of materials, Tensile properties of the materials, Effect of strain rate, Impact Testing, Non-destructive testing (NDT). Fracture of Metals – Ductile Fracture, Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT), Fatigue – Endurance limit, Fatigue test, factors affecting fatigue, structural changes accompanying fatigue; Creep and stress rupture– mechanism of creep – stages of creep and creep test, Mechanisms of Strengthening in Metals and alloys.

Unit-III	Phase Diagrams and Transformations in Alloys: 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.
Unit-IV	Heat Treatment: Principles of heat treatment, Annealing, Concept of Recovery, Recrystallization and Grain Growth, Normalizing, Hardening, Tempering, Quenching, Special heat treatment processes: Austempering, Martempering, Ausforming, Hardenability of steel, Microstructure changes during heat treatment. Surface hardening processes - Carburizing – Nitriding – Cyaniding and carbo-nitriding, Induction and flame hardening, Laser and Electron beam hardening. Severe Plastic Deformation: Introduction; its importance in producing ultrafine-grained materials; SPD techniques: Equal Channel Angular Pressing (ECAP), High Pressure Torsion (HPT), and Accumulative Roll Bonding (ARB); applications, and limitations of SPD-processed materials

Suggested Readings:

1. Material Science and Engineering-An Introduction - Callister; W.D., John Wiley & Sons. Delhi.
2. A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpat Rai & Sons
3. Material Science & Engineering –V. Raghvan, Prentice Hall of India Pvt. Ltd, New Delhi.
4. Engineering Materials and Metallurgy - U. C. Jindal, Pearson.
5. Principles of Materials Science, W.F. Smith, McGraw Hill, 3rd Revised Edition, 1990.

Web References:

1. https://www.youtube.com/watch?v=OTDVov_kw6A
2. <https://archive.nptel.ac.in/courses/113/104/113104081/>
3. <https://archive.nptel.ac.in/courses/113/105/113105106/>
4. <https://archive.nptel.ac.in/courses/113/104/113104068/>
5. <https://archive.nptel.ac.in/courses/113/104/113104074/>
6. <http://digimat.in/nptel/courses/video/113106105/L39.html>

Course Code	ESC-ME-207B				
Category	Engineering Science Courses				
Course Title	Engineering Mechanics				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	0	0	3	
Course Objectives	The objectives of this course are • To know the fundamentals of mechanics. • To learn the concept of equilibrium of rigid bodies. • To find the C.G. & find M.I. of different geometrical figures. • To provide knowledge of simple machines and their applications. • To introduce to principles of kinematics & dynamics.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the basic terminologies and fundamentals of engineering mechanics.	L1: Remember
CO2	Describe the kinematics, dynamics, geometrical properties and simple machines.	L2: Understand
CO3	Apply the theorems and principles to solve the problems of engineering mechanics.	L3: Apply
CO4	Analyze the basic mechanical systems subjected to different loading conditions.	L4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Fundamentals: Definitions of Mechanics, Statics, Dynamics, Rigid Bodies, Force System, Resolution of Force. Analytical and graphical method for resultant of force, Moment of Force. Varignon's Theorem, Numerical Problems. Equilibrium: Definition, condition of equilibrium, types of equilibrium - stable equilibrium, unstable equilibrium, neutral equilibrium, free body diagram, method of equilibrium of coplanar forces – analytical method, graphical method, Lami's Theorem, Numerical Problems.
Unit-II	Truss and Frames: Truss, classification of truss, assumptions in truss analysis, perfect truss, analysis of perfect plane truss using method of joints and method of sections, Numerical Problems. Centroid: Centroid – Definition, Moment of an area about an axis, centroid of geometrical figures such as squares, rectangles, triangles, circles, semicircles & quarter circles, centroid of composite figures, Numerical Problems.
Unit-III	Moment of Inertia: Definition, Parallel axis & Perpendicular axis Theorems. M.I. of plane lamina & different engineering sections, Numerical Problems. Kinematics: Concept of rigid body, velocity and acceleration, relative velocity, translation and rotation of rigid bodies, equations of motion for translation and rotation, Numerical Problems.

Unit-IV	Dynamics: Newton's Laws of Motion, Motion of Particle acted upon by a constant force, Equations of motion, DE Alembert's Principle, Work, Power, Energy- Kinetic & Potential energy, Momentum & impulse, Laws of conservation of energy & linear momentum, collision of elastic bodies, Numerical Problems. Simple Machines: Definition of simple machine, explain simple & compound lifting machine, define M.A, V.R. & Efficiency, State Law of Machine, Reversibility of Machine, Self-Locking Machine. Study of simple machines – simple axle & wheel, single purchase winch crab & double purchase winch crab, Worm & Worm Wheel, Screw Jack, Types of hoisting machine.
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Suggested Readings:

1. Text Book of Engineering Mechanics – R.S Khurmi (S. Chand).
2. Engineering Mechanics by Timoshenko S, and Young D.H, Tata McGraw Hill.
3. Engineering Mechanics – Static and Dynamics by Shames I.H, and Rao G.K.M, Pearson Education.
4. Vector Mechanics for Engineers by Beer F.P and Johnson Jr. E.R, Tata McGraw Hill.
5. Engineering Mechanics –Statics & Dynamics, R. C. Hibbeler, 11th Ed., Macmillan Publication Co.

Web References:

1. <https://nptel.ac.in/courses/112103108>
2. <https://nptel.ac.in/courses/112106180>
3. <https://nptel.ac.in/courses/112106286>
4. <https://nptel.ac.in/courses/112104526>
5. <https://nptel.ac.in/courses/112103108>

Course Code	BSC-ME-209B				
Category	Basic Science Courses				
Course Title	Mathematics-III				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	1	0	4	
Course Objectives	The objectives of this course are to make the students - To provide an overview of PDE, Probability and Statistics to engineers. - To introduce the solution methodologies for PDE, Probability and Statistics with Applications in engineering.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total Marks	100				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall fundamental concepts and principles of differential equations, probability & statistics.	L1: Remember
CO2	Describe basic concepts of probability, statistics & partial differential equations.	L2: Understand
CO3	Apply the various methods and techniques to solve engineering problems.	L3: Apply
CO4	Analyze the different patterns and behaviour of statistics, probability & partial differential equations.	L4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second- order linear equations and their classification, Initial and boundary conditions, D' Alembert's solution of the wave equation.
Unit-II	Duhamel's principle for one-dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One-dimensional diffusion equation and its solution by separation of variables.
Unit-III	Measures of central tendency, Moments, Skewness and Kurtosis, Basic concepts of Probability, Conditional probability, Baye's theorem, Random variables, Discrete random variables, Expectation of discrete random variables, Variance of a sum, Binomial distribution, Poisson distribution, Continuous random variables and their properties, Distribution functions, Normal Distribution.
Unit-IV	Testing of hypothesis, Test of significance, large sample test for single proportion, Difference of proportions, Tests for single mean, Difference of means and Difference of standard deviations, Test for ratio of variances, Chi-square test for goodness of fit and Independence of attributes.

Suggested Readings:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publishing Company Limited
3. N. P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications
4. Business Statistics by T.R. Jain and S.C. Aggarwal, VK Global Publications Pvt. Ltd.
5. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India.

Web References:

1. <https://www.youtube.com/watch?v=KlZqe4UC1jk>
2. <https://www.youtube.com/watch?v=5eZbgxmpK3Q&t=520s>
3. <https://www.youtube.com/watch?v=PVUfuiuWaZQ>
4. <https://youtu.be/qu2kuCFCqbM?si=kcSK59hh5XoQrRdA>
5. <https://www.youtube.com/watch?v=DgvQzfLpaTY&t=92s>
6. https://youtu.be/1wxhLYiHFae?si=GApUpW3_VTOD8q-b
7. <https://youtu.be/60vHy2lA4o4>
8. <https://youtu.be/Sv9UYnp9tbs?si=eHqwSJETA5SO3NFI>
9. https://youtu.be/o2LB3KQME3U?si=NWap0TY_K8tPaAfu
10. https://youtu.be/14PQawp_rjk
11. <https://auece.digimat.in/nptel/courses/video/111105090/L72.html>
12. <https://youtu.be/SICsNb-VXds?feature=shared>

Course Code	HSMC-01B				
Category	Humanities and Social Science including Management Courses				
Course Title	Fundamental of Management and Organizational Behaviour				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	0	0	3	
Course Objectives	The objectives of this course are • Introduce students to foundational management theories, functions, and organizational concepts to build a strong conceptual framework. • Develop understanding of individual and group behaviour, motivation, communication, and leadership in organizational settings. • Equip students with practical skills to manage interpersonal processes, conflicts, and team dynamics effectively. • Foster critical analysis of organizational structures, cultures, and change mechanisms to enhance adaptability and effectiveness in organizations.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define fundamental management concepts, functions, organizational processes, and organizational behaviour elements.	L1: Remember
CO2	Explain the roles, skills, and interrelationships in management, individual behaviour, group dynamics, and communication processes within organizations.	L2: Understand
CO3	Apply principles of management, motivation techniques, leadership styles, and conflict management strategies to solve organizational behaviour challenges.	L3: Apply
CO4	Analyze organizational structure, culture, change processes, and behavioral dynamics to support effective decision-making and organizational development.	L4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Introduction of Management: Meaning, Definitions, Nature of Management; Managerial Levels, Skills and Roles in an Organization. Functions of Management: Planning, Organizing, Staffing, Directing & Controlling, Interrelationship of Managerial Functions, Scope of Management, Importance of Management, Difference between Management and Administration.
Unit-II	Introduction of Organization: Meaning and Process of Organization, Management v/s Organization. Fundamentals of Organizational Behaviour: Concepts, Evolution, Importance and Relationship with other Fields, Contemporary Challenges and Opportunities of OB. Individual Processes and Behaviour: Personality, Concept, Determinants and Applications. Perception: Concept, Process and Applications Learning: Brief Introduction Motivation: Concept, Techniques and Importance

Unit-III	Interpersonal Processes: Teams and Groups, Definition of Group, Stages of Group Development, Types of Groups, Meaning of Team, Merits and Demerits of Team, Difference between Team and Group, Conflict- Concept, Sources, Types, Management of Conflict. Leadership: Concept, Function, Styles, Qualities of Leadership. Communication: Meaning, Process, Channels of Communication, Importance and Barriers of Communication.
Unit-IV	Organizational Processes: Organizational Structure, Meaning and Types of Organizational Structure and their effect on Human Behaviour. Organizational Culture: Elements, Types and Factors affecting Organizational Culture. Organizational Change: Concept, Types and Factors affecting Organizational Change, Resistance to Change.

Suggested Readings:

1. Fundamentals of Management by Robbins, S.P. and Decenzo, Pearson Education, New Delhi.
2. Organizational Behaviour by Robbins, S.P. & Judge, T.A., Prentice Hall of India, New Delhi.
3. Management concept practice and cases by Ghuman Karminder, Aswathappa K., Tata McGraw Hill, New Delhi
4. Fundamental of Management by Chhabra T. N., Sun India Publications, New Delhi.
5. Organizational Behaviour by Stephen P Robin, Pearson Education.
6. Organizational Behaviour by McShane, Steven L, Tata McGraw Hill, New Delhi.
7. Organizational Behaviour by FC Sharma, Shree Mahavir Publications.

Web References:

1. <https://nptel.ac.in/courses/110105146>
2. <https://nptel.ac.in/courses/110103433>
3. <https://archive.nptel.ac.in/courses/110/106/110106145/>
4. <https://nptel.ac.in/courses/110105146>

Course Code	MC-201B				
Category	Mandatory Courses				
Course Title	Environmental Science				
Scheme and Credits	L	T	P	Credits	Semester- III
	2	0	0	-	
Course Objectives	The objectives of this course are • To create awareness of the multidisciplinary nature and importance of environmental studies, including the sustainable management and conservation of natural resources. • To develop an understanding of ecosystem dynamics, biodiversity, pollution types, and their impacts on environmental and human health. • To foster critical thinking on social, ethical, and legislative aspects of environmental protection, emphasizing the role of individuals and society. • To engage students in practical learning through field work and case studies to apply environmental concepts for sustainable development and responsible citizenship.				
Assessment	20 Marks				
End Semester Examination	30 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

CO	Skill Demonstrated	RBT Level
CO1	Describe key terminologies of environmental studies, natural resources, ecosystems, pollution, environmental laws and human-environment interactions.	L1: Remember
CO2	Explain the relationships among ecosystems, biodiversity, pollution, social issues, environmental ethics and related legislation for sustainable development.	L2: Understand
CO3	Apply principles of environmental management, pollution control, disaster management and sustainable practices in real world environmental contexts.	L3: Apply
CO4	Analyze environmental issues, population growth impacts, climate change, welfare programs and the role of information technology in promoting public health and environmental sustainability.	L4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 4 parts (Covering all units) of 1.5 marks each and remaining eight questions of 6 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

The Multidisciplinary Nature of Environmental Studies: Definition, Scope and Importance.

Natural Resources: Renewable and Non-Renewable Resources; Natural Resources and Associated Problems.

(a) Forest Resources: Use and Over-Exploitation, Deforestation, Case Studies, Timber Extraction, Mining, Dams and their effects on Forests and Tribal People.

(b) Water Resources: Use and Over-Utilization of Surface and Groundwater, Floods, Drought, Conflicts Over Water, Dams—Benefits and Problems.

(c) Mineral Resources: Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies.

(d) Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer and Pesticide Problems, Waterlogging, Salinity, Case Studies.

(e) Energy Resources: Growing Energy Needs, Renewable and Non-Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies.

(f) Land Resources: Land as a resource, Land Degradation, Man-Induced Landslides, Soil Erosion and Desertification.

Role of an Individual in Conservation of Natural Resources, Equitable Use of Resources for Sustainable Lifestyles.

Unit-II

Ecosystems: Producers, Consumers and Decomposers, Energy Flow in the Ecosystem, Ecological Succession, Food Chains, Food Webs and Ecological Pyramids—Introduction, Types, Characteristic Features, Structure and Function of Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem and Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans and Estuaries).

Biodiversity and Its Conservation: Introduction, Definition, Genetic Diversity, Species Diversity and Ecosystem Diversity. Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation, Hotspots of Biodiversity.

Values of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values.

Threats to Biodiversity: Habitat Loss, Poaching of Wildlife and Man–Wildlife Conflicts, Endangered and Endemic Species of India.

Conservation of Biodiversity: In-situ and Ex-situ Conservation.

Unit-III

Environmental Pollution: Definition, Causes, Effects and Control Measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution and Nuclear Hazards.

Solid Waste Management: Causes, Effects and Control Measures of Urban and Industrial Wastes, Role of an Individual in Prevention of Pollution, Pollution Case Studies.

Disaster Management: Floods, Earthquakes, Cyclones and Landslides.

Social Issues and the Environment: From Unsustainable to Sustainable Development, Urban Problems Related to Energy, Water Conservation, Rainwater Harvesting, Watershed Management, Resettlement and Rehabilitation of People, Problems and Concerns, Case Studies.

Environmental Ethics: Issues and Possible Solutions, Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies, Wasteland Reclamation, Consumerism and Waste Products.

Environmental Legislation: Environment Protection Act, Air Prevention and Control of Pollution Act, Water Prevention and Control of Pollution Act, Wildlife Protection Act, Forest Conservation Act, Issues Involved in Enforcement of Environmental Legislation, Public Awareness.

Unit-IV

Human Population and the Environment: Population Growth, Variation among Nations, 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, Case Studies.

Field Work (*Equivalent to 10 Lecture Hours*)

- Visit to a Local Area to Document Environmental Assets—River, Forest, Grassland, Hill or Mountain.
- Visit to a Local Polluted Site—Urban, Rural, Industrial or Agricultural.
- Study of Common Plants, Insects and Birds.
- Study of Simple Ecosystems—Pond, River, Hills, Slopes, etc.

Suggested Readings:

- Environmental Biology by K.C. Agarwal, Nidi Pub. Ltd., Bikaner

- The Biodiversity of India by Bharucha, MAP in Publishing Pvt.Ltd., Ahmedabad.
- Hazardous Waste Incineration by R.C. Brunner, McGraw Hill Inc.,1989
- Environmental Chemistry by A.K. De, Wiley Eastern Ltd.
- Global Biodiversity Assessment by V.H. Heywood & R.T.Watson, Cambridge University Press, 1995, 1140p.
- Environmental Protection and Laws by H. Jadhav & V.M. Bhosale, Himalaya Pub. House, Delhi, 1995, 284p.
- Matter Hazardous by A.K. Mhaskar, Techno-Science Publications.
- Waste Water Treatment by M.N. Rao & A.K. Datta, Oxford & IBH Publ. Co. Pvt. Ltd., 1987, 345p.
- Environmental Chemistry by B.K. Sharma, Goel Publ. House, Meerut, 2001.
- Survey of the Environment, The Hindu.
- Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II by R.K. Trivedi, Enviro Media.
- Introduction to Air Pollution by R.K. Trivedi & P.K. Goel, Techno-Science Publications.
- Environmental Management by K.D. Wagner, W.B. Saunders Co., Philadelphia, USA, 1998, 499p.
- A Textbook of Environmental Education by Dr. J.P. Yadav, G.V.S. Publishers.

Useful Video Links:

Unit No.	Topics	Links
Unit-I	Environment Science: Introduction	https://www.youtube.com/watch?v=5QxxaVfgQ3k
	Natural Resources	https://www.youtube.com/watch?v=CXCT2R1K6Ts
	Ecosystem	https://www.youtube.com/watch?v=1dBU6HB8G6s
Unit-II	Biodiversity and its conservation	https://archive.nptel.ac.in/courses/102/104/102104068/
Unit-III	Sustainable Water Management in Urban Areas	http://digimat.in/nptel/courses/video/127106004/L29.ht
	Environmental Pollution	https://archive.nptel.ac.in/courses/123/105/123105001/
Unit-IV	Population and population growth	https://archive.nptel.ac.in/courses/102/104/102104068/
	National Family Welfare Programme	https://www.youtube.com/watch?v=X5F99L8ZEtc

Course code	LC-ME-211B				
Category	Professional Core Courses				
Course title	Materials & Metallurgy Lab				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Course Objectives	The objectives of this course are • To study crystallography and imperfections in materials through models. • To learn how to prepare specimen for microstructure analysis. • To familiarise with heat treatment processes and their effects on materials properties and microstructure. • To enhance the skills in using microscopy and other testing equipment's.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total Marks	25				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

CO	Skill Demonstrated	RBT Level
CO1	Explain the crystallography, imperfections, and the working principles of metallurgical equipment's.	L2: Understand
CO2	Apply specimen preparation and etching techniques for metallographic examination of metals.	L3: Apply
CO3	Analyze the effect of heat treatment processes on material properties & microstructure.	L4: Analyze
CO4	Analyze the microstructures of different nonferrous materials.	L4: Analyze

List of Experiments

Sr. No.	Content	COs
1	To study various crystal structures through ball models.	CO1
2	To study of crystal imperfections through ball models.	CO1
3	To study the components and functions of metallurgical microscope.	CO1
4	To study of Muffle furnace and polishing machine.	CO1
5	To study modern characterization (microscopy) techniques.	CO1
6	To prepare chemical etchant for ferrous and non-ferrous alloys.	CO2
7	To prepare a specimen for metallographic examination.	CO2
8	To analyze the changes in hardness of steel / iron after heat treatment processes.	CO3
9	To analyze the changes in microstructure of steel / iron after annealing.	CO3
10	To analyze the changes in microstructure of steel / iron after normalizing.	CO3

11	To analyze the changes in microstructure of steel / iron after quenching.	CO3
12	To analyze the microstructure of non-ferrous metal (Aluminum).	CO4
13	To analyze the microstructure of non-ferrous metal (Copper).	CO4
14	To analyze the microstructure of non-ferrous metal (Brass).	CO4

Note: At least ten experiments are to be performed. Eight experiments should be from the above list and remaining two experiments may either be performed from the above list or as per the scope of the syllabus.

Web References:

1. <https://mrmsmtbs-iitk.vlabs.ac.in/exp/nucleus-cellsproliferation/simulation.html>
2. <https://mrmsmtbs-iitk.vlabs.ac.in/exp/hardness-modulus/simulation.html>
3. https://www.youtube.com/watch?v=OTDVov_kw6A
4. <https://archive.nptel.ac.in/courses/113/105/113105101/>

Course code	LC-ME-213B				
Category	Professional Core Courses				
Course title	Computer Aided Design & Manufacturing Lab				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Course Objectives	The objectives of this course are • To introduce students to the fundamentals and key features of CAD software used for part modelling and assembly design. • To provide hands-on experience in generating 3D models, part drawings, and assemblies using modern CAD tools. • To familiarize students with CNC programming for basic machining operations. • To expose students to classification systems and emerging technologies in manufacturing.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total Marks	25				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

CO	Skill Demonstrated	RBT Level
CO1	Explain the essential features and tools of CAD software and NC programming.	L2: Understand
CO2	Use drawing and modification tools to create 2D sketches and part models.	L3: Apply
CO3	Use CAD software for 3D models and assembly of mechanical components.	L3: Apply
CO4	Use G & M codes to write NC part programs for manufacturing operations.	L3: Apply

List of Experiments

Sr. No.	Content	COs
1	To Introduction to the different features of CAD software's.	CO1
2	To Work with the draw and modify tools like pattern, copy, rotate, move, mirror etc.	CO2
3	To Draw the 2D part drawing of product 1 using software.	CO2
4	To Draw the 2D part drawing of product 2 using software.	CO2
5	To Work with creating 3D features like extrude revolve etc.	CO3
6	To Work with tools like hole, round, chamfer etc.	CO3
7	To Draw 3D models by extruding simple 2D objects.	CO3
8	To make an assembly drawing using different parts.	CO3
9	To study the G codes and M codes.	CO1
10	To Write a NC program for milling operation.	CO4
11	To Write a NC program for drilling operation.	CO4

12	To Write a NC program for turning operation	CO4
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Note: At least ten experiments are to be performed. Eight experiments should be from the above list and remaining two experiments may either be performed from the above list or as per the scope of the syllabus.

Web References:

1. <https://youtu.be/UvP3fSGye-Y>
2. <https://youtu.be/ImtSsDLgAaI>
3. <https://youtu.be/B7MM5M7DzpM?si=SxDdSNolcFlwN4A9>
4. https://youtu.be/_5r2XR1h1aQ

Course code	LC-ME-215B				
Category	Basic Science Courses				
Course title	Engineering Mechanics Lab				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Course Objectives	The objectives of this course are ● To understand force laws using triangle law, polygon law, and parallel force experiments. ● To learn how to calculate mechanical advantage, velocity ratio, and efficiency of simple machines. ● To study the moment of inertia using a flywheel. ● To measure the deflections in a pin-jointed truss.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total Marks	25				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

CO	Skill Demonstrated	RBT Level
CO1	Determine the forces in members by applying laws of forces.	L3: Apply
CO2	Calculate mechanical advantage, velocity ratio, and efficiency of lifting devices.	L3: Apply
CO3	Analyze the internal forces and deflections in various structural elements.	L4: Analyze
CO4	Evaluate the moment of inertia and verify beam deflection principles including reciprocal and parallel force theorems.	L5: Evaluate

List of Experiments

Sr. No.	Content	COs
1	To determine the resultant force by applying law of polygon of forces.	CO1
2	To determine the resultant force by applying law of triangle of forces.	CO1
3	To calculate the mechanical advantage, velocity ratio and Mechanical efficiency of winch crab.	CO1
4	To calculate the mechanical advantage, velocity ratio and mechanical efficiency of a screw jack.	CO2
5	To calculate the mechanical advantage, velocity ratio and mechanical efficiency of single start worm and worm wheel.	CO2
6	To calculate the mechanical advantage, velocity ratio and mechanical efficiency of double & triple start worm and worm wheel.	CO2
7	To analyse the internal forces acting on various members of a jib crane using experimental methods.	CO2
8	To analyse the horizontal and vertical deflections at various joints of a pin-jointed truss using experimental data.	CO3
9	To analyse the behaviour of a 3-bar pin-jointed truss by comparing experimental results with analytical calculations.	CO3
10	To evaluate the moment of inertia of a given fly-wheel.	CO4

11	To verify the reciprocal theorem of deflection using a simply supported beam.	CO4
12	To verify the principle of forces in beam of parallel forces apparatus.	CO4

Note: At least ten experiments are to be performed. Eight experiments should be from the above list and remaining two experiments may either be performed from the above list or as per the scope of the syllabus.

Web References:

1. http://phy-sc22-au.vlabs.ac.in/mechanics/Moment_of_Inertia_of_Flywheel/
2. <https://virtual-labs.github.io/exp-trusses-iiith/index.html>
3. <https://amrita.olabs.edu.in/?sub=1&brch=5&sim=20&cnt=4>

Course Code	PCC-ME-202B				
Category	Professional Core Courses				
Course Title	Applied Thermodynamics				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To learn about dynamics involved in thermal energy transformation. • To know thermal system components for improving efficiency and effectiveness. • To provide a knowledge of steam generation systems, fuels, and combustion processes used in power generation. • To introduce about gas and vapour power cycles.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define fundamental concepts of steam generation, fuels, power cycles, and related equipment.	L1: Remember
CO2	Describe principles and functions involved in thermodynamic cycles and devices.	L2: Understand
CO3	Apply thermodynamic principles and equations to solve energy and flow problems.	L3: Apply
CO4	Analyze the effects of operating parameters on the performance of thermal systems and machinery.	L4: Analyze

Note: The Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each, and the remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Steam Generators: Introduction, classification of boilers, comparison of fire tube and water tube boilers, description of boilers; Lancashire, Babcock Wilcox, Cochran etc. boiler's mountings and accessories, design of natural draught chimney, artificial draught, mechanical draught, efficiency of boiler and heat balance. Fuel and Combustion: Classification of fuels – solid, liquid and gaseous fuels, calorific values of fuels, bomb calorimeter and analyse of combustion product, stoichiometric air fuel ratio, excess air requirement, efficiency of boiler and heat balance. Problems.
Unit-II	Vapor power cycles: Carnot vapour power cycle, Simple and modified Rankine cycle, p-v, h-s and T-s diagram for Rankine and Modified Rankine Cycle, effect of operating parameters on Rankine cycle performance. Effect of maximum pressure, effect of exhaust pressure, reheating and regenerative Rankine cycle. Gas power cycles: Air standard Otto, Diesel and Dual Cycles-Air standard Brayton cycle, effect of reheat, regeneration and inter cooling- Combined gas and vapor power cycles. Problems

Unit-III	Steam Nozzles: Function of steam nozzles, shape of nozzles for subsonic and supersonic flow of steam, steady state energy equation, continuity equation, nozzle efficiency, critical pressure ratio for max. discharge, design of steam nozzle, problems. Steam Condensers: Classification of condensers, sources of air leakage in condensers, effect of air leakage in condenser, vacuum efficiency, condenser efficiency, air pumps, calculation of cooling water requirement, and problem.
Unit-IV	Reciprocating compressors: Staging of reciprocating compressors, optimal stage pressure ratio, effect of inter cooling, isothermal efficiency, volumetric efficiency, minimum work for multistage reciprocating compressors. Problems. Steam Turbine: Classification of steam turbine, impulse turbine, working principle, compounding of impulse turbine, velocity diagram, power output and efficiency of a single stage impulse turbine, reaction turbine, working principle, degree of reaction, velocity diagram, power output, efficiency, condition for max. Efficiency, governing of steam turbines, problem.

Suggested Readings

1. Engineering Thermodynamics - Nag, P.K, Tata McGraw-Hill Publishing Co. Ltd
2. Thermal Engineering - P.L. Ballaney Khanna Publisher.
3. Engineering Thermodynamics - Jones, J. B. and Duggan, R. E., Prentice Hall of India.
4. Thermodynamics and Heat Engines Vol II - R. Yadav, Central Publishing House.
5. I.C. Engines - M.L. Mathur and Sharma Dhanpat Rai & Sons.
6. Thermodynamics- An Engineering Approach, Y. Cengel and M. Boles, McGraw Hill Education; Eighth Edition, 2017

Web References:

1. <https://youtu.be/fscJadXHhTU?feature=shared>
2. <https://youtu.be/4-BI22Wx4Pc?feature=shared>
3. <https://youtu.be/G02aeguJBwc?feature=shared>
4. <https://youtu.be/t-Kucwi3SDI?feature=shared>
5. <https://nptel.ac.in/courses/112103307>
6. <https://nptel.ac.in/courses/112107291>
7. <https://nptel.ac.in/courses/112103421>

Course Code	PCC-ME-204B				
Category	Professional Core Courses				
Course Title	Strength of Materials				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To familiarize with stress, strain and deformation of solids under different loading conditions. • To equip students with ability to think critically and solve problems related to the strength and stability of structures. • To learn how materials, behave under different types of forces and conditions. • To develop an ability to analyse the real engineering problems and design engineering systems.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the fundamental concepts of strength of materials.	L1: Remember
CO2	Explain the expression and behaviour of structural elements under various loading and support conditions.	L2: Understand
CO3	Solve problems related to internal forces, stresses, and deformations in structural members.	L3: Apply
CO4	Analyze the structural components for performance under different loading conditions.	L4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Stress & Strain: Concept & types of Stresses and Strains, Poisson's ratio, Hooks law, Stress Strain diagrams, stresses and strains in simple and compound bars under axial loading, elastic constants & their relationships, temperature stresses and strains in simple and compound bars under axial loading, Problems. Principle Stresses& Strains: Two-dimensional stress system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stresses, Problems.
Unit-II	Shear Force & Bending Moment: Definitions, Beams and types transverse loading on beams, types of beam support, SF& BM diagram for cantilevers, simply supported and over-hanging beams, calculation of maximum BM & SF and Point of contra flexure, Problems. Bending & Shear Stresses in Beams: Bending stresses in Beam, Theory of bending of beams, bending stress distribution and neutral axis, shear stresses in beam, shear stress distribution Problems.

Unit-III	Torsion of Circular Members: Torsion, stresses and deformation in circular solid and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, Problems. Columns & Struts: Introduction, Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler's formulae for the elastic buckling load, Euler's, Rankine, Gordon's formulae Johnson's empirical formula for axial loading columns and their applications, eccentric compression of a short strut of rectangular & circular sections, Problems.
Unit-IV	Slope & Deflection: Relationship between bending moment, slope & deflection, Mohr's theorem, moment area method, method of integration, 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 & uniformly distributed loads and Maxwell's reciprocal theorem, Problems.

Suggested Readings:

1. Strength of Materials – G.H. Ryder - Macmillan, India.
2. Strength of materials, RK Bansal, Laxmi Publication.
3. Engineering Mechanics of Solids - E.GOR. P. POPOV, Prentice Hall of India.
4. Strength of Materials - R. Subramanian, Oxford University Press.
5. Mechanics of Materials, F.P. Beer, E.R. Johnston (Jr.) and J.T. DeWolf, Tata McGraw Hill

Web References:

1. <https://nptel.ac.in/courses/112106319>
2. <https://youtu.be/vC8h1RFKYs?feature=shared>
3. <https://nptel.ac.in/courses/112107147>
4. <https://youtu.be/sP34uzn7diA?feature=shared>
5. https://youtu.be/ZSQ_5lRj5gI?feature=shared
6. <https://youtu.be/IQB0bJRCRxo?feature=shared>
7. <https://nptel.ac.in/courses/105105108>

Course Code	PCC-ME-206B				
Category	Professional Core Courses				
Course Title	Fluid Mechanics				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce the fundamental concepts and properties of fluids. • To learn the fluid behavior under various flow conditions. • To learn applications involving compressible flow, viscous effects, boundary layers, and turbulence. • To understand flow measurement devices and solve problems pertaining to flow through pipes.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define fundamental concepts and basics of fluid mechanics.	L1: Remember
CO2	Explain the fluid properties & principles governing fluid motion and behavior.	L2: Understand
CO3	Apply fluid mechanics laws and equations to solve flow problems.	L3: Apply
CO4	Analyze performance characteristics and behavior of fluid under various conditions.	L4: Analyze

Note: The Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each, and the remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Fluid Properties and Fluid Statics: Concept of fluid and flow, properties of fluids, Newtonian and non-Newtonian fluids. Pascal's law, hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium, Problems. Fluid Kinematics: Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation, differential equation of continuity in cylindrical and polar coordinates, rotation, vorticity and circulation, stream and potential functions, flow net, Problems.
Unit-II	Fluid Dynamics: Concept of system and control volume, Euler's equation, Bernoulli's equation, venturi meter, orifices, orifice meter, mouthpieces, kinetic and momentum correction factors, Impulse momentum relationship and its applications, Problems. Compressible Fluid Flow: Introduction, continuity momentum and energy equation, sonic velocity, propagation of elastic waves due to compression of fluid, propagation of elastic waves due to disturbance in fluid, stagnation properties, isentropic flow, effect of area variation on flow properties, isentropic flow through nozzles, diffusers, injectors, Problems.

Unit-III	Viscous Flow: Flow regimes and Reynolds's number, Relationship between shear stress and pressure gradient, Hagen-Poiseuille law, uni-directional flow between stationary plates, movement of piston in a dashpot, power absorbed in bearings. Problems. Flow Through Pipes: Major and 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.
Unit-IV	Boundary Layer Flow: Boundary layer concept, displacement, momentum and energy thickness, Von-Karman momentum integral equation, laminar and turbulent boundary layer flows, drag on a flat plate, boundary layer separation and control. Streamlined and bluff bodies lift and drag on a cylinder and an airfoil, Problems. Turbulent Flow: Shear stress in turbulent flow, Prandtl mixing length hypothesis, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes, Problems.

Suggested Readings

1. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons.
2. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill.
3. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, TMH.
4. Mechanics of Fluids – I H Shames, Mc Graw Hill.
5. Fluid Mechanics – Streeter, Wylie and Bedford, TMH.

Web References:

1. https://youtu.be/mKROgeUc_Ow?feature=shared
2. <https://youtu.be/H38vI93exns?feature=shared>
3. <https://youtu.be/nftfzCxQKfk?feature=shared>
4. <https://youtu.be/cVmK3dLeCZ4?feature=shared>
5. <https://youtu.be/p7-oAAAszHc?feature=shared>
6. <https://youtu.be/CzrQxXK0CKk?feature=shared>
7. <https://youtu.be/zw2F4utGoVQ?feature=shared>
8. https://youtu.be/OsCTach_rBc?feature=shared

Course Code	PCC-ME-208B				
Category	Professional Core Courses				
Course Title	Kinematics of Machines				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To learn the fundamentals of mechanisms and motion transmission. • To develop students for generation of cam profile • To equip students with tools for kinematic analysis and synthesis. • To know the friction and belt drive systems used in machines.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the basic terminologies related to kinematics of machines.	L1: Remember
CO2	Explain the principles of kinematics, motion and function of mechanical systems and components.	L2: Understand
CO3	Apply graphical and analytical methods to solve the kinematics related problems.	L3: Apply
CO4	Analyze the performance and motion characteristics of mechanisms and power transmission systems.	L4: Analyze

Note: The Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each, and the remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Introduction: Mechanism and machines, kinematics links, kinematics pairs, kinematics chains, degree of freedom, Grubler's rule, kinematics inversion, equivalent linkages, four link planar mechanisms, straight line mechanisms, steering mechanisms, pantograph, problems. Kinematics Analysis of Plane Mechanisms: displacement analysis, velocity diagram, velocity determination, relative velocity method, instantaneous center of velocity, Kennedy's theorem, graphical and analytical methods of velocity and acceleration analysis, problems.
Unit-II	Cams: Classification of cams and followers, disc cam nomenclature, construction of displacement, velocity and acceleration diagrams for different types of follower motions, analysis of follower motions, determination of basic dimension, synthesis of cam profile by graphical methods, cams with specified contours, problems. Gears: Fundamental law of gearing, involute spur gears, characteristics of involute and cycloidal action, interference and undercutting, center distance variation, path of contact, arc of contact, non-standard gear teeth, helical, spiral bevel and worm gears, problems.

Unit-III	Gear Trains: Synthesis of simple, compound and reverted gear trains, analysis of epicyclic gear trains, problems. Kinematics synthesis of Mechanisms: Function generation, path generation, Freudenstein's equation, two and three position synthesis of four bar and slider crank mechanisms by graphical and analytical methods, precision positions, structural error; Chebychev spacing, transmission angle, problems.
Unit-IV	Friction: Types of friction, laws of friction, motion along inclined plane, screw threads, efficiency on inclined plane, friction in journal bearing, friction circle and friction axis, pivots and collar friction, uniform pressure and uniform wear. Belts and pulleys: Open and cross belt drive, velocity ratio, slip, material for belts, crowning of pulleys, law of belting, types of pulleys, length of belts, ratio of tension, centrifugal tension, power transmitted by belts and ropes, initial tension, creep, chain drives, chain length, classification of chains.

Suggested Readings:

1. Theory and Machines - S.S. Rattan, Tata McGraw Hill.
2. Theory of Machines - Bevan, Pearson Indian Education Service Pvt. Ltd. India.
3. Mechanism and Machine Theory - J.S. Rao and R.V. Duggipati, New Age International.
4. Theory of Mechanisms and Machines - Amitabha Ghosh and Ashok Kumar Malik, East-West Press.
5. Theory of Machines and Mechanisms, J. J. Uicker, G. R. Pennock, J. E. Shigley, Oxford Education, Fourth Edition, 2011.

Web References:

1. <https://archive.nptel.ac.in/courses/112/104/112104121/>
2. <https://archive.nptel.ac.in/courses/112/106/112106270/#>
3. <https://archive.nptel.ac.in/courses/112/105/112105268/>
4. <https://nptel.ac.in/courses/112103108>
5. <https://nptel.ac.in/courses/112106286>
6. <https://nptel.ac.in/courses/112105124>

Course Code	PCC-ME-210B				
Category	Professional Core Courses				
Course Title	Manufacturing Technology -I				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To know how cutting tools work, how chips are formed, and what affects the life of a cutting tool. • To learn how to calculate machining costs and choose the best cutting conditions to save time and money. • To know how jigs and fixtures help in holding work-pieces and how measuring tools are used to check sizes and surface finish. • To understand how gears are made, how machines are specified, and how milling and drilling operations are done.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the fundamental concepts of Manufacturing Technology.	L1: Remember
CO2	Explain principles of cutting, forming, metrology, and machine tools.	L2: Understand
CO3	Apply suitable tools, conditions, and setups for machining operations.	L3: Apply
CO4	Analyze the effects of process parameters and tool specifications on performance.	L4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Metal Cutting & Tool Life: Introduction, basic tool geometry, single point tool nomenclature, chips types and their characteristics, mechanics of chips formation, theoretical and experimental determination of shear angle, orthogonal and oblique metal cutting, relationship of velocity, forces, and power consumption, cutting speed, feed and depth of cut, coolant, temperature profile in cutting, tool life relationship, Taylor equation of tool life, tool material and mechanism. Economics of Metal Machining: Cost considerations in manufacturing, elements of machining cost, minimum cost per piece, maximum production rate, optimum cutting speed and optimum tool life for minimum cost of production and maximum production rate.
Unit-II	Jigs and Fixtures: Introduction to jigs and fixtures, principles of locations, locating and clamping devices, jigs bushes, drilling jigs, milling fixtures, turning fixtures, boring and broaching fixtures, welding fixtures, different materials for jigs and fixtures. Metrology: Measurement, linear and angular simple measuring instruments, various clampers, screw gauge, sine bar, auto-collimator, comparator- mechanical, electrical, optical, surface finish and its measurements, micro and macro deviation, factors influencing surface finish and evaluation of surface finish.

Unit-III	Gear manufacturing and finishing: Introduction, Classification of gear production method, Gear generation processes: gear hobbing, gear shaping, Gear finishing methods: shaving, roll finishing, burnishing, grinding, lapping, honing. Specification of Machine Tools: Introduction, purpose of machine tool specifications, Methods of specification of conventional machine tools: specification of lathes, specification of drilling and boring machines, specification of shaper, planer and slotter machines, specification of milling machine, specification of gear teeth generating machines, specification of grinding machines.
Unit-IV	Milling Process: Milling Machine Operations performed on Milling machine, Parts of Milling Machine, Types of Milling machines- Column and Knee Type Milling Machines, fundamentals of Milling process, Milling Cutters, Elements of Plain Milling cutter, Cutter Holing devices, Indexing, Methods of Indexing. Drilling Machine: Construction of twist drill, Parts of twist drill, Drilling machine Types Radial drilling machine, Gang drilling machine, Drilling machine operations, Main parts of drilling machine, cutting speed, Feed and Depth of cut in drilling, MRR in drilling.

Suggested Readings:

1. Manufacturing Engineering Technology, K. Jain, Pearson Education
2. Principles of Manufacturing Materials and Processes, James S. Campbell, TMH.
3. Production Engineering Sciences by P.C. Pandey and C.K. Singh, Standard Publishers Ltd.
4. Manufacturing Science by A. Ghosh and A.K. Mallik, Wiley Eastern

Web references:

1. <https://youtu.be/-R-fySRLa9Q?si=rjouuxiO4PYAi8VL>
2. <https://www.youtube.com/watch?v=YDSdhiMksoQ>
3. <https://www.youtube.com/watch?v=7yzvno4AvKw>
4. <https://www.youtube.com/watch?v=HpIEeBtJupY>
5. <https://www.youtube.com/watch?v=B8w-0Oi0Yf4>
6. <https://archive.nptel.ac.in/courses/112/105/112105233/>
7. <https://youtu.be/Rf90Jbbcr3M?si=3oMLtK3cYdBA1koj>
8. <https://www.youtube.com/watch?v=a07gtJbK9aU>

Course code	LC-ME-222B				
Category	Professional Core Courses				
Course title	Applied Thermodynamics Lab				
Scheme and Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	
Course Objectives	The objectives of this course are • To introduce students to the fundamental principles and operational features of thermal equipment. • To enable students to gain practical knowledge in analysing and evaluating the performance of thermal systems. • To provide hands-on experience in conducting experiments related to steam generation, heat transfer, and power generation systems.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total Marks	25				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

CO	Skill Demonstrated	RBT Level
CO1	Explain the construction details of various types of boilers, mountings and accessories.	L2: Understand
CO2	Demonstrate the working principle of various thermal equipment's.	L3: Apply
CO3	Analyze the thermodynamic properties of steam and system performance.	L4: Analyze
CO4	Evaluate the performance of reciprocating air compressor and cooling tower.	L5: Evaluate

List of Experiments

Sr. No.	Content	COs
1	To study low pressure boilers and their accessories and mountings.	CO1
2	To study high pressure boilers and their accessories and mountings.	CO1
3	To study the working of impulse and reaction steam turbines.	CO2
4	To study principle, construction and working of Bomb Calorimeter.	CO2
4	To study of heat balance sheet for given boiler.	CO2
5	To find power output & efficiency of a steam turbine.	CO3
6	To find dryness fraction of steam by separating and throttling calorimeter.	CO3
7	To find the condenser efficiencies.	CO3
8	To evaluate the volumetric efficiency of a reciprocating air compressor.	CO4
9	To study cooling tower and evaluate its efficiency.	CO4
10	To evaluate the isothermal efficiency of a reciprocating air compressor.	CO4

Note: At least ten experiments are to be performed. Eight experiments should be from the above list and remaining two experiments may either be performed from the above list or as per the scope of the syllabus.

Web References:

1. [https://vmtitg.vlabs.ac.in/Separating_and_Throttling_Calorimeter\(theory\).html](https://vmtitg.vlabs.ac.in/Separating_and_Throttling_Calorimeter(theory).html)
2. [https://vmt-iitg.vlabs.ac.in/Water_cooling_tower\(procedure\).html](https://vmt-iitg.vlabs.ac.in/Water_cooling_tower(procedure).html)
3. <https://www.youtube.com/watch?v=AQEQl8qJgfl>
4. <https://www.youtube.com/watch?v=S1pDhYR7ZQg>

Course code	LC-ME-224B				
Category	Professional Core Courses				
Course title	Strength of Materials Lab				
Scheme and Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	
Course Objectives	The objectives of this course are ● To learn the working principles of various material testing machines and perform tests. ● To enhance the knowledge stress, strain of materials and ability to interpret the data from the experiments. ● To evaluate the mechanical properties of materials through impact, tensile, compression, bending, and shear tests.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total Marks	25				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

CO	Skill Demonstrated	RBT Level
CO1	Apply hardness testing procedures to determine the hardness of various engineering materials.	L3: Apply
CO2	Use appropriate methods to determine material behaviour under sudden impact & sheet deformation.	L3: Apply
CO3	Analyze the behaviour of materials under different types of loading.	L4: Analyze
CO4	Evaluate torsional, spring, and fatigue behaviour of materials using theoretical relationships.	L5: Evaluate

List of Experiments

Sr. No.	Content	COs
1	To determine the hardness of the given specimen using Brinell hardness test.	CO1
2	To determine the hardness of the given Specimen using Rockwell hardness test.	CO1
3	To determine the hardness of the given Specimen using Vickers hardness test.	CO1
4	To conduct sheet metal test in Erichsen sheet metal testing machine.	CO2
5	To determine the Impact strength of a given specimen using Izod impact test.	CO2
6	To determine the Impact strength of a given specimen using Charpy impact test	CO2
7	To perform tensile test on UTM.	CO3
8	To perform compression test on UTM.	CO3
9	To perform bending tests on UTM.	CO3
10	To perform the shear test on UTM.	CO3
11	To evaluate the torsional properties of mild steel using a torsion testing machine.	CO4

12	To evaluate the stiffness of a spring and the modulus of rigidity of its wire.	CO4
13	To evaluate a material's response to cyclic loading with a fatigue test machine.	CO4

Note: At least ten experiments are to be performed. Eight experiments should be from the above list and remaining two experiments may either be performed from the above list or as per the scope of the syllabus.

Web References:

1. <https://sm-nitk.vlabs.ac.in/exp/brinell-hardness-test/>
2. <https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test/>
3. <https://sm-nitk.vlabs.ac.in/exp/vickers-hardness-test/>
4. <https://sm-nitk.vlabs.ac.in/exp/izod-impact-test/>
5. <https://sm-nitk.vlabs.ac.in/exp/charpy-impact-test/>
6. <https://sm-nitk.vlabs.ac.in/exp/tensile-test-mild-steel/>
7. <https://sm-nitk.vlabs.ac.in/exp/bending-test-mild-steel/>
8. <https://sm-nitk.vlabs.ac.in/exp/compression-test-mild-steel/>
9. <https://sm-nitk.vlabs.ac.in/exp/direct-shear-test-steel-rod/>
10. <https://sm-nitk.vlabs.ac.in/exp/torsion-test-mild-steel/>

Course code	LC-ME-226B				
Category	Professional Core Courses				
Course title	Fluid Mechanics Lab				
Scheme and Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	
Course Objectives	The objectives of this course are ● To gain knowledge of fluid flow principles and pipe flow behavior. ● To measure key flow parameters such as friction factor, Reynolds number, and viscosity. ● To know the causes and impact of energy losses in pipe systems. ● To provide hands-on experience to observe fluid flow phenomena through experiments.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total Marks	25				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

CO	Skill Demonstrated	RBT Level
CO1	Apply fluid flow measurement techniques to determine discharge coefficients and fluid properties.	L3: Apply
CO2	Calculate friction factor, Reynolds number, viscosity and flow losses in pipes.	L3: Apply
CO3	Analyze stability of floating bodies and fluid flow characteristics.	L4: Analyze
CO4	Evaluate the fundamental fluid properties and mechanics principles through experimentation.	L5: evaluate

List of Experiments

Sr. No.	Content	COs
1	To find out the coefficient of discharge of an orifice meter.	CO1
2	To find out the coefficient of discharge of venturi meter	CO1
3	To find out the coefficient of discharge of Notch (V and Rectangular types).	CO1
4	To find out the coefficient of discharge, contraction & velocity of an orifice.	CO1
5	To calculate the friction factor for the pipes.	CO2
6	To calculate the minor losses due to sudden enlargement, sudden contraction and bends.	CO2
7	To analyze the stability of a floating body by determining the metacentric height of a floating body.	CO3
8	To analyze the velocity and pressure variation with radius in a forced vortex flow.	CO3
9	To analyse the critical Reynolds number for a pipe flow.	CO3
10	To evaluate the viscosity of a fluid by Stokes' law apparatus.	CO4

11	To verify the Bernoulli's Theorem.	CO4
12	To verify the momentum equation.	CO4

Note: At least ten experiments are to be performed. Eight experiments should be from the above list and remaining two experiments may either be performed from the above list or as per the scope of the syllabus.

Web References:

1. <https://fm-nitk.vlabs.ac.in/exp/friction-in-pipes/simulation.html>
2. <https://fm-nitk.vlabs.ac.in/exp/venturimeter/>
3. <https://me.iitp.ac.in/Virtual-Fluid-Laboratory/reynolds/simulation.html>
4. https://me.iitp.ac.in/Virtual-Fluid-Laboratory/bernoulli/about_setup.html
5. https://me.iitp.ac.in/Virtual-Fluid-Laboratory/notch/about_setup.html
6. https://me.iitp.ac.in/Virtual-Fluid-Laboratory/metacenter/about_setup.html

Course code	LC-ME-228B				
Category	Professional Core Courses				
Course title	Kinematics of Machines Lab				
Scheme and Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	
Course Objectives	The objectives of this course are • To provide knowledge of the basic elements and working principles of mechanical linkages and mechanisms. • To introduce the motion characteristics of mechanisms used in machinery and equipment. • To equip students with skills to analyse the performance of motion transmission systems such as cams, gears, and gear trains. • To enable hands-on experience in evaluating the behaviour and efficiency of mechanical systems through laboratory experiments.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total Marks	25				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

CO	Skill Demonstrated	RBT Level
CO1	Understand various kinematic links, pairs, chains, and mechanisms, including their inversions.	L2: Understand
CO2	Apply graphical methods to draw displacement, velocity, and acceleration diagrams of mechanisms.	L3: Apply
CO3	Analyze the characteristics and profiles of cams, followers, and gears.	L4: Analyze
CO4	Evaluate the performance and efficiency of power transmission elements.	L5: Evaluate

List of Experiments

Sr. No.	Content	COs
1	To study various types of Kinematic links, pairs, chains and Mechanisms.	CO1
2	To study inversions of 4 Bar Mechanisms, Single and double slider crank mechanisms.	CO1
3	To plot slider displacement, velocity and acceleration against crank rotation for single slider-crank mechanism.	CO2
4	To draw velocity diagram of four bar mechanism.	CO2
5	To draw velocity diagram of slider crank mechanism.	CO2
6	To draw acceleration diagram of four bar mechanism.	CO2
7	To categories various type of cam and follower arrangements.	CO3
8	To plot follower displacement vs cam rotation for various cam follower systems.	CO3
9	To classify various types of gears- spur, helical, worm, bevel gear etc.	CO3

10	To classify various types of gear trains - simple, compound, reverted & epicyclic.	CO3
11	To generate spur gear involute tooth profile using simulated gear shaping process.	CO3
12	To evaluate the MA, V.R. and efficiency of screw jack.	CO4
13	To evaluate the coefficient of friction between belt and pulley.	CO4

Note: At least ten experiments are to be performed. Eight experiments should be from the above list and remaining two experiments may either be performed from the above list or as per the scope of the syllabus.

Web References:

1. <https://mm-nitk.vlabs.ac.in/exp/velocity-analysis-grashof/>
2. <https://mr-iitkgp.vlabs.ac.in/exp/cam-follower-mechanism/>

Course code	LC-ME-230B				
Category	Professional Core Courses				
Course title	3D Printing Lab				
Scheme and Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	
Course Objectives	The objectives of this course are ● To understand the basics of FDM 3D printing and slicing software. ● To develop skills in STL file conversion and G-code generation. ● To design and fabricate 3D models using CAD and additive manufacturing techniques. ● To perform reverse engineering and print customized 3D objects ● using different materials.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total Marks	25				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

CO	Skill Demonstrated	RBT Level
CO1	Explain the components, pre-processing and post procession of 3D printing.	L2: Understand
CO2	Explain slicing procedures, process parameters, and G-code generation for additive manufacturing.	L2: Understand
CO3	Use FDM-based 3D printing systems and prepare models for fabrication using appropriate printing materials and settings.	L3: Apply
CO4	Analyze the additive manufacturing materials and process parameters to achieve desired mechanical properties and performance of 3D-printed components.	L4: Analyze

List of Experiments

Sr. No.	Content	COs
1	To study the different components and configuration of an FDM 3D printer.	CO1
2	To study the various material options such as PLA, ABS, PETG, and others for 3D printing applications.	CO1
3	To study the Post Processing for 3D printing.	CO1
4	To study Slicing Software basics-I. Setting up the build temperature, nozzle temperature, speed, material, layer height	CO2
5	To study Slicing Software basics-II Setting up infill density, infill pattern, orientation of object, support material wall thickness, converting .stl file to .G-code file etc.	CO2
6	To convert a .stl file of a simple object into G code and print with FDM 3D Printer at 30% infill density.	CO2
7	To convert a .stl file of simple objects which require support material into G-code and print with FDM 3D Printer.	CO2
8	To make and print objects containing moving parts without assembly.	CO3
9	To make the Coupling in CAD software and print it using PLA material.	CO3

10	To make the key ring of your own name in CAD software and print it using PLA material.	CO3
11	To make a model of your own name and print it.	CO3
12	To Emboss / engrave your name on a 3D object and print it with ABS material.	CO3
13	Analyze the reverse engineering process by scanning a facial geometry using a 3D scanner, processing the scanned data, and resulting 3D-printed model.	CO4
14	To analyze the effect of various materials and printing parameters on the mechanical behavior of 3D-printed samples.	CO4
15	To analyze and optimize key printing parameters, including layer height, print speed, temperature, and infill patterns.	CO4

Note: At least ten experiments are to be performed. Eight experiments should be from the above list and remaining two experiments may either be performed from the above list or as per the scope of the syllabus.

Web Reference:

1. <https://3dp-dei.vlabs.ac.in/List%20of%20experiments.html>
2. https://3dp-dei.vlabs.ac.in/?utm_source=chatgpt.com
3. https://www.nielit.gov.in/aurangabad/aurangabad/aurangabad/content/3d-printingadditive-manufacturing-lab?utm_source=chatgpt.com
4. https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_me115
5. <https://nptel.ac.in/courses/102106095>

Course Code	PEC-ME-212B				
Category	Professional Elective Courses				
Course Title	Industrial Engineering				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce to different recording charts and PPC. • To learn techniques for accurate sales forecasting and demand estimation. • To grasp inventory management principles for cost-effective control and stock optimization. • To know value analysis methods to enhance product and process value while reducing costs.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the fundamental concepts and techniques related to industrial engineering.	L1: Remember
CO2	Explain the principles, procedures, techniques, and tools used to improve industrial systems.	L2: Understand
CO3	Apply standard methods, analytical and practical tools for managing industrial operations.	L3: Apply
CO4	Analyze industrial processes and organizational systems for performance improvement.	L4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Introduction to work study; Method study; Basic procedure, Recording techniques (Charts and diagrams); Elemental breakdown; Micro-motion studies; Therbligs; SIMO- chart principles of motion- economy. Introduction; Objectives; techniques (time) information recording; methods of things, Time study allowances; work sampling technique, Performances rating and its determinant ion technique, Performance rating and its determination PMTS; M.T.M., Work factor.
Unit-II	Principle of organization; Importance and characteristics of organization; Organization theories; Classical Organization theory; Neo-Classical organization theory, modern organization theory; Types of organization. Military or line organization, Functional organization, line and staff organization, Committee objectives of PPC; Functions of PPC Preplanning and planning; Routing; Estimating; scheduling; master schedule; Daily schedule; Gantt chart; Dispatching.
Unit-III	Introduction, Objectives and importance of sales forecasting, Types of forecasting, Methods of sales forecasting, Collective opinion method, Delphi technique, economic indicator method; Regression analysis, introduction, Functions of inventory; Types of inventory; Control importance functions, Inventory costs, factors affecting inventory control, Various inventory controls models; A.B.C. analysis, lead-time calculations.

Unit-IV	Introduction, Objective; Concept and life cycle of a product and V.E.; Steps in V.E. Methodology and techniques, Fast diagram, Matrix method. Various concepts in industrial engineering. a) Wages and Incentives; Concept; Types, plans, Desirable characteristics. b) Supply Chain Management; Its Definition, Concept, Objectives, Applications, Benefits, some successful cases in Indian Industries. c) JIT; Its definition, concept, importance, misconception, relevance, Applications, Elements of JIT (brief description) d) Time Management; Introduction, steps of time man agreement, Ways for saving time KEY for time saving.
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Suggested Readings:

1. Industrial Engineering and Organization Management-S.K. Sharma & Savita Sharma, KATSONs.
2. Industrial Engineering and Production Management by M. Mahajan, Dhanpat Rai & Co.
3. Production planning and control by S. Elion.
4. Industrial Engineering and management -I P Singh, Neelam Publications.

Web References:

1. <https://youtu.be/BGxW2T8lhFU?feature=shared>
2. <https://youtu.be/iTBirKYQ6zw?feature=shared>
3. <https://youtu.be/xZs7WsNPJXY?feature=shared>
4. https://youtu.be/6_3VHAAJddY?feature=shared
5. <https://youtu.be/i7uPIBLBG4I?feature=shared>
6. <https://youtu.be/9tJv5COGkD0?feature=shared>
7. <https://youtu.be/PmR2SKeY9Ms?feature=shared>
8. <https://youtu.be/HkdoR-NNEoI?feature=shared>

Course Code	PEC-ME-214B				
Category	Professional Elective Courses				
Course Title	3D Printing				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To aware the working principle and process parameters of additive manufacturing processes. • To learn applications of AM processes in various fields. • To know different post processing methods for AM. • To learn the basics of different tooling and its methods for AM				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the fundamentals of additive manufacturing processes, materials, equipment, and applications.	L1: Remember
CO2	Explain STL conversion, additive manufacturing technologies, material characteristics, process parameters, and product quality requirements.	L2: Understand
CO3	Apply additive manufacturing principles for process, material, and post-processing selection in engineering applications.	L3: Apply
CO4	Analyze additive manufacturing systems, defects, troubleshooting methods, and application-specific requirements.	L4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	3D Printing (Additive Manufacturing): Introduction, Process, Classifications, Advantages, Additive v/s Conventional Manufacturing processes, Applications. CAD for Additive Manufacturing: CAD Data formats, Data translation, Data loss, STL format.
Unit-II	Additive Manufacturing Techniques: Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology, Process, Process parameter, Process Selection for various applications, Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools.
Unit-III	Materials: Polymers, Metals, Non-Metals, Ceramics Process, Process parameter, Process Selection for various applications, Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties, Support Materials. Additive Manufacturing Equipment: Process Equipment- Design and process parameters, Governing Bonding Mechanism, Common faults and troubleshooting, Process Design.
Unit-IV	Post Processing: Requirement and Techniques, Support Removal, Sanding, Acetone treatment, polishing. Product Quality: Inspection and testing, Defects and their causes.

Suggested Readings:

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing- Ian Gibson, David W. Rosen and Brent Stucker, Springer, 2010.
2. Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing- Andreas Gebhardt, Hanser Publisher, 2011.
3. 3D Printing and Design- Khanna Editorial, Khanna Publishing House, Delhi.
4. 3D Printing and Rapid Prototyping- Principles and Applications- CK Chua, Kah Fai Leong, World Scientific, 2017.

Web References:

1. <https://youtu.be/t7yv4gSnNkE?feature=shared>
2. <https://youtu.be/W2QpGdsTIJ8?feature=shared>
3. <https://youtu.be/Neb9IdIctmI?feature=shared>
4. <https://youtu.be/Aq6Ea8TBlbs?feature=shared>
5. <https://youtu.be/Ua7pEn7RsWs?feature=shared>
6. <https://youtu.be/jq9Lqil6bLw?feature=shared>

Course Code	PEC-ME-216B				
Category	Professional Elective Courses				
Course Title	CNC Technology				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce the fundamentals and evolution of CNC technology. • To learn CNC machine structure, hardware components, and coordinate systems. • To learn manual and computer-aided part programming methods. • To enable students to gain programming skills and tooling knowledge.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the key concepts & components of CNC machines and part programming.	L1: Remember
CO2	Explain the working principles and structure of CNC systems and tooling.	L2: Understand
CO3	Apply CNC programming techniques to generate part programs for various machining operations.	L3: Apply
CO4	Analyze CNC machine operations & programs to improve machining efficiency and accuracy.	L4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Contents
Unit-I	Computer Numerical Control (CNC) Technology: Numerical Control (NC), Historical Development of CNC Machines, NC Coordinate Systems, NC Modes, Advantages and Limitations of CNC Machine Tools. CNC Hardware: Structure of CNC Machine tools, Drives used in CNC machines, Actuation Systems of CNC Machines Tools, Feedback Devices used in CNC Machine.
Unit-II	CNC Programming Fundamentals: Part Programming Steps, Axes Identification in CNC Turning and Machining Centres, Machine Zero and Home Position, ISO Standards for Coding. Manual Part Programming: Preparatory Functions, Miscellaneous Functions, Absolute and Incremental Programming, Tool Length Compensation.
Unit-III	Turning Centre Programming: Motion Commands, Tool Nose Radius Compensation, Cut Planning, Thread Cutting, Part Program Numerical. Machining Centre Programming: Canned Cycles, Cutter Radius Compensation, Part Program Numerical.
Unit-IV	Computer Aided Part Programming: APT Language, Geometry Statements, Motion Statements, Post Processor Statements, Auxiliary Statements, Part Program Numerical. CNC Tooling: Cutting Tool Material and Characteristics, Turning Tool Geometry, Tooling System for Turning, and Milling. Tool Presetting, Automatic Tool Changers, Work Holding.

Suggested Readings:

1. Computer Numerical Control: Operation and Programming by Jon Stennerson, Prentice Hall.
2. CNC Programming Principles & Applications by Mattson Mike, Cengage learning.
3. Machining and CNC Technology by Fitzpatrick, McGraw-Hill Higher Education.
4. Industrial Engineering and management by I P Singh, Neelam Publications.
5. CNC Tips and Techniques: A Reader for Programmers by Peter Smid, Industrial Press Inc.

Web References:

1. <https://youtu.be/Gi42gKGiCl0?feature=shared>
2. <https://youtu.be/Mj6VbVL4tn0?feature=shared>
3. https://youtu.be/PN_tGm5Gip4?feature=shared
4. https://youtu.be/_5r2XR1h1aQ?feature=shared

Course Code	PEC-ME-218B				
Category	Professional Elective Courses				
Course Title	Composite Materials				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce the fundamental concepts of composite materials. • To learn the mechanical behaviour of composite materials. • To get an overview of the methods of manufacturing composite materials.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total Marks	75				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

CO	Skill Demonstrated	RBT Level
CO1	Define the basic concepts and fundamental of composite materials.	L1: Remember
CO2	Describe the roles and characteristics of matrix and reinforcement materials in composite structures.	L2: Understand
CO3	Apply preparation and processing methods for different types of composite materials.	L3: Apply
CO4	Analyze the influence of composite composition & manufacturing techniques on material performance.	L4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts of 1.5 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit No.	Content
Unit-I	Introduction: Definition - Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.
Unit-II	Reinforcements: Preparation-layup, curing, properties and applications of glass fibres, carbon fibres, Kevlar fibres and Boron fibres. Properties and applications of whiskers, particle reinforcements. Mechanical Behaviour of composites: Rule of mixtures, Inverse rule of mixtures. Iso-strain and Iso-stress conditions.
Unit-III	Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding - Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration - Liquid phase sintering. Manufacturing of Carbon - Carbon composites: Knitting, Braiding, Weaving. Properties and applications.
Unit-IV	Manufacturing of Polymer Matrix Composites: Preparation of moulding compounds and prepreps - hand layup method – Autoclave method – Filament winding method- Compression moulding – Reaction injection moulding. Properties and applications.

Suggested Readings:

1. Hand Book of Composite Materials-George Lubin
2. Composite Materials– K.K. Chawla.
3. Composite Materials Science and Applications–Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tsai.

Web References:

1. <https://youtu.be/0kB0G6WKhKE?feature=shared>
2. https://www.youtube.com/watch?v=_JAGKikeCSY
3. <https://youtu.be/649fIwvIvRc?feature=shared>
4. <https://www.youtube.com/watch?v=IZXH5IqOrM>
5. <https://www.youtube.com/watch?v=dj8r0M5LsnQ>
6. <https://www.youtube.com/watch?v=aNie6dhPKZk>
7. <https://www.youtube.com/watch?v=bdC8yySkARs>
8. <https://www.youtube.com/watch?v=zC3M51uosDc>
9. <https://youtu.be/uO8EMAUh1po?feature=shared>
10. <https://www.youtube.com/watch?v=qos45EwMmd0>
11. <https://www.youtube.com/watch?v=T4C4m0Q8a6Q>