DEPT. OF MECHANICAL ENGINEERING

Algebra and Calculus

	B. Tech (For ALL Branches)	**L-T-P-C**
MA11001	**First Semester (Professional Core)**	**3- 0-0- 3**

Pre-requisites: *Matrix and determinants, Limit, Continuity, Differentiability, Basic idea of integration*.

	Course Content	**Hours**
Unit-1	**Linear Algebra:** R^n as a vector space, Linear dependence and independence of vectors in R^n, Basis & Dimension; Rank and nullity of a matrix, Elementary transformations, Consistency of a System of linear equations & their solutions by Direct Methods: Gaussian Elimination method, Gauss-Jordan method; Eigenvalues & Eigenvectors, Hermitian, Skew-Hermitian & Unitary matrices, Cayley-Hamilton's theorem & its applications.	**8**
Unit-2	**Infinite Series:** Definition of Sequence & Infinite Series, Convergence & Divergence of real Sequence & Infinite Series, Tests of Convergence of positive term infinite series: Comparison Test, D' Alembert's Ratio Test, Raabe's Test, Cauchy's root Test, Integral Test, Alternating Series, Leibnitz's Test (all tests without proofs).	**8**
Unit-3	**Differential Calculus:** Successive Differentiation, Leibnitz's Theorem, Rolle's theorem, Lagrange's & Cauchy's Mean value theorems, Curvature, Radius & centre of curvature, Partial differentiation, Euler's theorem, Jacobian, Taylor's & Maclaurin's Theorems with Lagrange's form of remainder for functions of one and two variables, Expansions of functions of one and two variables, Extreme values for functions of two or more variables, Lagrange's method of undetermined multipliers.	**14**
Unit-4	**Integral Calculus:** Reduction Formulae. Application of integrals in Quadrature, Rectification, Volume and surface area of solids of revolution.	**6**
		Total: 36

Course Outcomes:

On completion of this Course,

1. The students will be able to apply the consistency concepts, eigenvalues, and eigenvectors concepts in engineering problems.

2. The students will be able to apply the concept of convergence of infinite series in mathematical & engineering problems.

3. The students will be capable of applying the knowledge of differentiation in the expansion of functions and optimizing functions appearing in engineering and daily life problems.

4. The students will be able to apply knowledge of integration in finding area, length of arc of curves, volume, and surface area appearing in engineering and real-life problems.

PH11001	Wave Mechanics and Optics	L-T-P-C
	B.Tech (CE, CSE and ME)	3-0-0-3
	First Semester (Common)	

Prerequisites: None

	Course Content	Hours
Unit-1	**Waves and Oscillation:** Introduction to Vibrations and Oscillations, Review on Free Oscillations, Damped motions -under damping -Logarithmic decrement, relaxation time and Q-Factor, overdamping and critical damping, Forced oscillations with damping - Steady state solution and its frequency response, Power absorbed and dissipation in forced oscillator, Resonance- amplitude, velocity and power- sharpness of resonance.	**7**
	Coupled oscillations, introduction of normal modes and normal coordinate and their physical significance- general solutions, wave equation in one dimension, Characteristics and solution, superposition, travelling and standing waves, phase and group velocity.	**5**
Unit-2	**Electromagnetic Waves:** Vector Calculus : Scalar and Vector Fields – Differential calculus, Del operator, Gradient, Divergence and Curl, Product rules, Second Derivative with Del operator, Laplacian operator –Line, Surface and Volume Integrals (definition), Fundamental theorem of Integral calculus qualitatively (Gradient, Divergence and Curl)	**4**
	Electromagnetic theory: Maxwell's equations, Displacement current, Maxwell's equation in matter, Electromagnetic waves: The wave equation, Sinusoidal waves, Polarization EM waves in vacuum, Monochromatic plane waves, Energy in electromagnetic waves, EM waves in conductors, Conservation laws: continuity equation, Poynting's theorem, boundary conditions, reflection and transmission at normal incidence.	**6**
Unit-3	**Wave Optics:** Wave fronts- Huygens Principle, Temporal and spatial coherence, Division of wave front and amplitude, intensity distribution in an interference pattern, Young's double slit experiment, diffraction - single slit, double slit, grating, polarization – polarisation by reflection, refraction and scattering.	**6**
Unit-4	**Modern Physics and Quantum Mechanics:** Failure of classical physics, qualitative review of relevant experiments such as blackbody radiation, photo- electric effect, Compton scattering, de Broglie matter waves and Davison-Germer experiment, Uncertainty principle, Wave packet.	**3**
	Basic postulates of quantum mechanics, Wavefunction, normalization of wave function, quantum mechanical operators, probability density, expectation value, Development of Schrödinger equation (time dependent & time independent), particle on a 1D infinite potential well, potential barrier and quantum tunnelling.	**5**
	Total	**36**

Course Outcomes (COs):

After completion of the course, students will be able to

6. Explain the fundamental concepts of **classical and quantum wave mechanics.**
7. Interpret fundamental physical laws and principles for relevant engineering applications.
8. Apply principles of physics to solve numerical problems in **classical and quantum wave mechanics**.
9. Analyze various physical phenomena using appropriate concepts such as superposition, wave-particle duality, polarization, and quantization.
10. Evaluate the validity and limitations of theories in waves, electromagnetism, and quantum physics through comparison with experimental observations.

Text Books/ Reference Books:

7. Vibration and waves, A. P. French, CBS Publishers
8. Introduction to Electrodynamics, D. J. Griffiths, *Pearson*
9. *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles*, Resnick and Eisberg, John Wiley & Sons
10. Quantum Mechanics, D. J. Griffiths, Cambridge University Press
11. Principles of Optics, Max Born and Emil Wolf, Cambridge University Press
12. Optics, Ajoy Ghatak, ata Mcgraw-Hill Publishing Company

CS11001

Programming and Data Structure **L-T-P-C**

B.Tech (CE, CSE and ME) 2-0-2-3

First Semester (Professional Core)

Prerequisites: Nil

		Hours
Unit-1	**Introduction:** Basic operations of digital computers, basic concepts of integer and floating point number representation, algorithm and efficiency.	**4**
Unit-2	**(Elements of C Programming)**: Data types, variables, operators, expression and assignment statements, conditional and branch statements, Loops and iteration statements, 1-d arrays, functions and parameter passing, recursions, Strings, pointers and structures, dynamic memory allocations.	**12**
Unit-3	**(Linear Data Structures): 2-d arrays, linked lists, stacks, and queues.**	**10**
Unit-4	**(Searching and Sorting):** Linear and binary search, bubble sort, insertion sort, merge sort, quick sort.	**8**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Learn the syntax and semantics of C programming language.
2. Test and execute the programs and correct syntax and logical errors.
3. Implement conditional branching, iteration and recursion.
4. Use basic data-structures (arrays, link lists, stacks, and queues) to formulate algorithms and programs.
5. Understand and analyse different searching sorting techniques.

Text Books/ Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
4. Seymour Lipschutz, Data Structures, Schaum's Outlines Series, Tata McGraw-Hill.
5. Ellis Horowitz, Satraj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, W. H. Freeman and Company.
6. R. G. Dromey, How to Solve it by Computer, Prentice-Hall of India.

HS11001/11002	**English for Technical Communication** Ist / IInd Semester (Professional Core)	L-T-P-C 2-0-2-3

	Course Content	**Hour**
Unit 1	**Organizational Communication:** Introduction to the Course Importance and Relevance of the Course Why Communicative English? What is Communication? Barrier to Communication Non-verbal/Oral/(In)Formal Communication	6
Unit II	**Reading Comprehension** **Ignited mind** (Two Chapters) by APJ Abdul Kalam Essay: **Religion of the forest** by Rabindranath Tagore Essay: **Is Google Making Us Stupid?** by Nicholas Carr **The Story of My Sanskrit** (A chapter) by Kumud Pawde	**8**
Unit III	**Written Communication:** Letter Writing Cover Letter CV/Resume Writing Précis writing Essay Writing Report Writing Email Etiquettes Idioms and Phrases One Word Substitution Technical Communication Documentation and Minutes of Meeting Debate	**12**
Unit IV	**Oral Communication:** Job interviews (Process, stages in job interviews, types of interviews, preparation, use of verbal and non-verbal cues, mock interview sessions) Group Discussion (Features, uses-recruitment, selection, stages, positive and negative roles, organizational GD's (Brain Storming, Normal Group techniques, Delphi Technique)) Pictorial Essays.	**6**

Course Outcomes:

6. Students will recall the content and make inferences on organizational communication setup
7. Students will be able to read faster and comprehend better
8. Students will be able to express their ideas and thoughts clearly and systematically in the form of essays and reports
9. Students will be able to conduct short meetings with the skill to draft simple and short minutes of the meeting.
10. Students will demonstrate the ability to face the employment selection and answer interview questions, and they will be able to participate in group discussions confidently and assertively

Reference Books:

7. Barun K. Mitra & Basundhara Mitra, *Personality Development and Soft Skills.* Oxford University Press, 2024.

8. Meenakshi Raman & Sangeeta Sharma. *Technical Communication: Principles and Practice*. Oxford University Press, 2015. https://d.docs.live.net/0af95281db477321/Desktop/question%20papers%20NITS/Technical%20Communication.pdf

9. Michael Swan. *Practical English Usage*. Oxford University Press, 2016.

10. Nilanjana Gupta. *English for All*. Macmillan Publishers India Ltd, 2011.

11. S. Miglani & S. Goyal. *English for Professionals- A Practical Book of Communication Skills in English*. Vayu Education of India, 2010.

12. Sanjay Kumar & Pushp Lata. *Communication Skills*. Oxford University Press, 2015.

ME11003	Fundamentals of Mechanical Engineering	L-T-P-C
	B.Tech (Mechanical Engg.)	3-0-0-3
	First Semester (Professional Core)	

Prerequisites: N/A

	Course Content	Hours
Unit-1	**Introduction to Mechanical Engineering:** Basic areas and concepts of Mechanical Engineering, Role of mechanical engineers in industries and society.	**6**
Unit-2	**Thermal Science & Its Applications:** Thermodynamic systems and processes; Temperature and Zeroth law of thermodynamics; Thermodynamic concept of energy; Modes of work and heat transfer; Statements of zeroth, first, second and third law of thermodynamics and their applications; Fluid properties.	**8**
Unit-3	**Design Elements in Mechanical Engineering :** Mechanical Properties, Stress and strain, elastic constants, thermal stresses, beams; mechanisms and linkages, degree of freedom, cam, gear, gyroscope; Introduction to machine elements: riveted and welded joints, shafts and coupling, rolling and sliding contact bearings, pressure vessel.	**6**
Unit-4	**Materials & Manufacturing :** Engineering materials, classification of materials, engineering applications of materials, material properties, selection of materials. Introduction to manufacturing, the need for manufacturing, the basics of various manufacturing processes: casting, welding, forming, machining, etc., selection of manufacturing processes, and application to industries.	**8**
Unit-5	**Recent Trends in Mechanical Engineering :** Basics of additive manufacturing, micro and nano fabrication, Mechatronics, microelectromechanical systems (MEMS), robotics and automation, CAD CAM, CIM, and smart manufacturing.	**6**
	Total	**34**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Define the role of mechanical engineers towards industry and society.
2. Explain various topics in thermal engineering.
3. Interpret design ideas in mechanical engineering.
4. Identify various manufacturing processes and correlate it with different engineering materials.
5. Infer about various recent developments in mechanical engineering.

Text Books/ Reference Books:

1. Shigley, Joseph, Charles Mischke, and Richard Budynas. Mechanical Engineering Design. Boston, MA: McGraw-Hill, 2003. ISBN: 9780072921939.
2. Norton, Robert L. Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines. Boston, MA: McGraw-Hill, 2007. ISBN: 9780073290980.
3. Oberg, Erik, Franklin D. Jones, Holbrook L. Horton, and Henry H. Ryffel. Machinery's Handbook. 28th ed. New York, NY: Industrial Press, 2008. ISBN: 9780831128005.
4. Shackelford James, Introduction to Material Science for Engineers, Pearson, 8th Edition, 2014, ISBN: 9780133826654
5. Hajra Choudhury S. K. , Hajra Choudhury A. K. Roy N. Elements of Workshop Technology: Vol.1 & 2, Media Promoters, 2008, ISBN: 978-8185099149
6. Kalpakjian Serope, Schimid Steven R, Manufacturing Engineering and Technology, Pearson Education, 7th Edition, 2018, ISBN: 9789332587908

7. Ghosh Amitava, Mallik Ahsok Kumar, Manufacturing Science, Affiliated East West Press, New Delhi, 2nd Edition, 1985, ISBN: 9788176710633
8. Erian A. Baskharone, Thermal Science: Essentials of Thermodynamics, Fluid Mechanics, and Heat Transfer, 1st Edition, 2012, McGraw-Hill Companies, ISBN: 9780071772341
9. C. Boegnakke and R. E. Sonntag. Fundamentals of Thermodynamics: 10th Edition, 2022, Wiley ISBN 978-93-5464-221-0
10. S. K. Som, G. Biswas and S. Chakraborty. Introduction to Fluid Mechanics and Machines. 3rd Edition, 2012, McGraw Hill Higher Education, ISBN 978-0-07-132919-4.

CE12001	Computer Aided Drawing and Graphics	L-T-P-C
	B.Tech (CE, CSE and ME)	1-0-2-2
	First Semester (Professional Core)	

Prerequisites: None

	Course Content	Hours
Unit-1	**Introduction to Engineering Drawing:** Importance and application in engineering, general instruction regarding instruments, dimensions and lettering, types of lines, concept of scales, geometrical constructions.	**9**
Unit-2	**Orthographic Projections:** Introduction to orthographic projections, elements and angles of projections, projection of points, projection of straight lines, projection of planes, conversion of pictorial views of objects into orthographic projections.	**6**
Unit-3	**Projections of Solids:** Orthographic projection of regular solids: Cubes, prisms, pyramids, cylinders, cones, tetrahedrons. Projections of frustum of solids.	**6**
Unit-4	**Isometric View:** Principles of isometric view, isometric view of simple objects, conversion of orthographic projections into isometric views.	**3**
Unit-5	**Introduction to CAD:** Introduction to CAD and advantage of CAD in engineering field, windows and system of AutoCAD, drawing area, command line, model space, layout space and work space. Drawing settings - Unit and limits, pan and zoom. Drafting settings - Grid, object snap, ortho on/off.	**3**
Unit-6	**Drafting Tools in CAD:** Tools and short commands for line, polyline, circle, polygon, arc, rectangle, ellipse, elliptical arc, hatch, spline, construction line, multiline, multiline style, point. Isometric drawing in AutoCAD.	**3**
Unit-7	**Modifying Tools in CAD:** Tools and short commands for move, rotate, trim, extend, copy, mirror, fillet, chamfer, erase, explode, offset, lengthen, edit polyline (fill on/off), edit hatch, edit array, edit multiline, align, break, point break and join. Object properties – Properties of windows, colour, linetype, linetype scale, line weight and match properties.	**6**
	Total	**36**

Course Outcomes (COs):

After completion of the course, students will be able to

9. Produce geometric constructions with appropriate scale and dimension.
10. Apply the skill for preparing detail 2D drawing of engineering objects.
11. Visualize and develop the 3D view of engineering objects.
12. Create basic 2D drawings using AutoCAD software.

Text Books/Reference Books:

9. Bhatt, N. D., Engineering Drawing: Plane and Solid Geometry, 54th Edition, Charotar Publishing House Pvt. Limited, 2023.
10. Venugopal, K., and Prabhu Raja, V., Engineering Drawing and Graphics + AutoCAD, 6th Edition, New Age International, New Delhi, 2022.
11. Narayana, K. L., and Kannaiah, P., Text book on Engineering Drawing, 2nd Edition, Scitech Publishers, 2011.
12. Gopalakrishna, K. R., and Gopalakrishna, S., Textbook of Computer Aided Engineering Drawing, 39th Edition, Subash Stores, Bangalore, 2017.

PH12001	Physics Laboratory	L-T-P-C
	B.Tech (CE, CSE and ME)	0-0-2-1
	First Semester (Common)	

Prerequisites: None

List of Experiments

10. To calibrate an ammeter with the help of a potentiometer.
11. To study the twist in the thin rod by statical method using Barton's horizontal apparatus and thus to determine the modulus of rigidity of the material of the rod.
12. To study the bending of a beam supported at its ends and loaded at the middle and thus to determine the Young's modulus of the material of the beam.
13. To determine the refractive index of the material of a given prism using a spectrometer.
14. To determine frequency of a transverse waves and mass per unit length of given wire by using sonometer apparatus.
15. To study the charging and discharging of a capacitor and hence to determine it's time constant.
16. To study the variation of magnetic field with distance along the axis of a circular coil carrying current by plotting a graph.
17. To determine the wavelength of sodium light using single slit diffraction.
18. Comparison of two low resistances by using Meter Bridge.

Course Outcomes (COs):

After completion of the course, students will be able to

6. Apply the various experimental procedures and techniques for physics related experiments.
7. Use the different measuring devices and setups to record the data with precision.
8. Apply the underlying physical concepts/theories to obtain quantitative results.
9. Evalute and analyze the error in the experiment with respect to the standard values of physical quanties.
10. Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.

Text Books/ Reference Books:

1. University Practical Physics, D. C. Tayal, HPH Publisher
2. B.Sc. Practical Physics, Samir Kumar Ghosh, New Central Book Agency

Numerical and Mathematical Methods for Differential Equations

MA11002

B. Tech. (For CE, CSE and ME)

Second Semester (Professional Core)

L -T-P- C

3- 0 - 0 - 3

Pre-requisites*: Linear Algebra and Calculus.*

	Course Content	**Hours**
Unit-1	**Ordinary Differential Equation:** Exact differential equation of first order, integrating factors. Second & higher order linear differential equations with constant coefficients, Homogeneous (Cauchy's) linear differential equation, Method of variation of parameters.	**8**
Unit-2	**Partial Differential Equation:** Formation of partial differential equations (PDE), Solution of PDE by direct integration, Lagrange's linear equation & its solution, Non-linear PDE of first order, Charpit's method of solution, Homogeneous and Non-homogeneous linear equations with constant coefficients. Second-order PDE with constant coefficients, solution by the method of separation of variables.	**9**
Unit-3	**Laplace and Fourier Transform:** Basic idea of Integral Transform, Laplace and inverse Laplace transforms & their properties, Convolution Theorem, Solution of ODE by Laplace transform method. Periodic functions, Fourier series representation of a function, half-range series, and the Fourier integral formula. Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting, and time shifting properties. Convolution theorem.	**10**
Unit-4	**Numerical Analysis:** Finite difference, Interpolation: Newton's forward and backward interpolation formulae, Lagrange's formula. Solution of algebraic and transcendental equations: Fixed point Iteration method, Bisection, Secant, Newton-Raphson Method. Solution of a system of linear equations by Iterative Methods: Gauss-Jacobi's method & Gauss-Seidel method. Solution of ODE: Picard's method, Taylor series method, and Runge-Kutta method (Fourth order).	**9**
		Total: 36

Course Outcomes:

On completion of this course

5. The students will be able to apply ordinary differential equations in engineering and real-life problems.
6. The students will be capable of applying partial differential equations in engineering and real-life problems.
7. The students will be able to apply the Laplace/Fourier transform in engineering problems.

8. The students will be able to apply numerical techniques in engineering problems.

Course Objectives:

5. To enable the students to understand the basic ideas of ordinary differential equations and their solutions, and also the application of series in solving ordinary linear differential equations.
6. To enable the students to understand the basic ideas of partial differential equations and their solutions, and also the applications in IVP & BVP.
7. To enable the students to solve ODE/PDE by using Laplace and Fourier transforms.
8. To enable students to clear their basic concept of solutions of algebraic/transcendental equations and ODE by numerical techniques.

Text Books:

3. E. Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley India Pvt. Ltd., 2015.
4. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2017

Reference Books:

5. M.D. Raisinghania, Ordinary and Partial Differential Equations, S.Chand & Company Ltd, 2020.
6. G.F. Simmons, Differential Equations, Tata McGraw-Hill, 2nd edition, 2017.
7. M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical Method for Scientific and Engineering Computation, 2022.
8. S. Sreenadh, Fourier Series and Integral Transforms, S. Chand Publication, 2014.

CY11002	Engineering Chemistry	L-T-P-C
	B.Tech (CE, CSE and ME)	3-0-0-3
	Second Semester	

Prerequisites: None

	Course Content	Hours
Unit-1	**Polymer & Composite materials:** Classification of polymers, methods of polymerization, thermosetting and thermoplastic polymers, conducting and biodegradable polymers, synthesis, properties and applications of polyethylene, chloropolyvinyl chloride (CPVC), Composite materials: Classification and basic requirement of composite materials, applications.	**6**
Unit-2	**Fuel & Petroleum:** Fuel: Introduction, classification of fuel, calorific value (HCV and LCV), determination of calorific value by bomb calorimetry, bio-fuels. Petroleum, knocking, octane number and cetane number, petrochemical.	**6**
Unit-3	**Nanomaterials & Green Chemistry:** Nanomaterials: Introduction; synthesis, characterization and applications of nanomaterials. Principles and application of Green Chemistry.	**6**
Unit-4	**Electrochemistry & Corrosion:** Electrode potentials and its relevance to oxidation and reduction, types of electrodes, galvanic cell, measurement of EMF and application of EMF, types of reference electrodes, determination of pH. Dry Cells, lead acid cell and Fuel Cells: Construction, reaction, advantages and applications. Corrosion: Types of corrosion, factors affecting corrosion and corrosion control.	**6**
Unit-5	**Water & its treatment:** Sources of impurities in water; hardness in water and its disadvantages; boiler scale and its prevention; caustic embrittlement; boiler corrosion: treatment of water at industrial and domestic level; biological oxygen demand (BOD) and chemical oxygen demand (COD) and their significance.	**6**
Unit-6	**Spectroscopy:** Basics of spectroscopy, electromagnetic spectrum, Basic principles of IR, UV-Visible and NMR spectroscopy, Application of IR, UV-Visible and NMR spectroscopy in structure elucidation and material characterization.	**6**
	Total	**36**

Course Outcomes (COs):

After completion of the course, students will be able to

5. Explain the properties and applications of polymers, composites, petroleum-based fuels for engineering and industrial use.
6. Apply the concepts of nanomaterials and green chemistry in the development of sustainable engineering solutions.
7. Analyze electrochemical processes and corrosion mechanisms to propose suitable mitigation techniques.
8. Assess water quality and treatment methods, and interpret spectroscopic data for material analysis.

Text Books/ Reference Books:

6. Jain, P.C., and Jain, M., Engineering Chemistry (2025), Dhanpat Rai Publishing Company
7. Chawla, S., Engineering Chemistry (2019), Dhanpat Rai Publishing Company
8. Glasstone, S., Physical Chemistry (1948), McMillan India
9. Dey, A. K., Environmental Chemistry (2003), New Age International
10. Rao, C. N. R., Müller A., Cheetham, A. K. (Editor), The Chemistry of Nanomaterials Synthesis, Properties and Applications, Chemistry of Nanomaterials (2004) (Wiley-VCH)

ME11002	Engineering Mechanics	L-T-P-C
	B.Tech (CE,CSE and ME)	2-1-0-3
	Second Semester (Professional Core)	

Prerequisites: N/A

	Course Content	Hours
Unit-1	Equivalent Force System, Equilibrium of Rigid Bodies, Law of Coulomb friction: Applications of dry friction in wedge and belt.	**9**
Unit-2	Equilibrium of simple plane trusses. Analysis of trusses by the method of joints and method of section. Principle of virtual work, Simple applications of Principle of virtual work for rigid bodies in static equilibrium.	**9**
Unit-3	Centroid of simple and composite plane figures. Pappus theorem and its applications. Area moment of inertia of simple and composite figures, Perpendicular axis theorem. Parallel axis theorem, Polar moment of inertia.	**6**
Unit-4	*Kinematics of particles:* Rectilinear motion of particles, plane curvilinear motion of particles in different coordinate systems, constrained motion of connected particles. *Plane kinematics of rigid bodies:* Translation of a rigid body in plane motion, rotation of rigid bodies about a fixed axis. *Kinetics of particles:* Applications of Newton's laws of motion, D'Alembert's principle, Principle of work-energy and Impulse-momentum in particle dynamics, Direct central impact and oblique central impact. *Plane kinetics of rigid bodies:* Equation of plane motion of a rigid body, Principle of work-energy in plane motion of a rigid body.	**12**
	Total	**36**

Course Outcomes (COs):

Upon the completion of this course, the students are expected

11. To build a fundamental understanding of static equilibrium in particles, rigid bodies, and friction, and apply it to solve related engineering problems.
12. To develop the ability to analyze simple plane trusses and apply the principle of virtual work to systems in static equilibrium.
13. To apply the theorem of Pappus. Parallel axis theorem and Perpendicular axis theorem.
14. To apply the concept of centroid and moment of inertia in analyzing the simple and composite figures.
15. To develop the ability to apply for solving the practical problems on kinematics and kinetics of motion of particles and rigid bodies.

Text Books:

11. J. L. Meriam & L.G. Kraige. Engineering Mechanics -Statics, John Wiley & Sons, Inc; 3/e.
12. J. L. Meriam & L.G. Kraige. Engineering Mechanics -Dynamics, John Wiley & Sons, Inc; 3/e.
13. F. P. Beer, Jr., E. R. Johnston, E. R. Eisenberg, P. J. Cornwell, D. Mazurek. Vector Mechanics for Engineers- Statics & Dynamics, McGraw-Hill Higher Education; 9/e.
14. 1. H. Shames, Engineering Mechanics - Statics and Dynamics, 4lh edition, Prentice-Hall of India.
15. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati. Engineering Mechanics, McGraw Hill Education; 5/e.

Reference Books:

5. S. Timoshenko, D.H. Young, Engineering Mechanics, 4th edition, McGraw- Hill.
6. R.C. Hibbeler. Engineering Mechanics - Statics & Dynamics, Pearson Education, 4/e.

EE11002	Electrical and Electronics Science	L-T-P-C
	B.Tech (CE, CSE and ME)	3-0-0-3
	Second Semester (Professional Core)	

Prerequisites: Nil

	Course Content	Hours
Unit-1	Electrical safety: Definition, precautions D.C. Circuit & Networks: KVL and KCL, Superposition Theorem, Thevenin's and Norton's Theorems, Maximum power transfer theorem	**4**
Unit-2	A.C. Circuit: A.C. Fundamentals, phasor representation and algebra, Series R-L, R-C and R-L-C circuits, power calculations in A.C. circuit, phasor diagrams. Balanced Star-Delta connections, phase and line currents and voltages and their relations	**6**
Unit-3	Measuring instruments: Ammeter, voltmeter, wattmeter, energy meter – types & connection, concepts of grounding and earthing	**3**
Unit-4	Electrical Machines: D.C machine fundamentals and Transformer (Brief construction, types, working principle, voltage equation and application), 3-phase induction motor (Brief construction, principle, types, applications).	**5**
Unit-5	Introduction to Electronic devices, **Diode:** Basic structure and operating principle, **Diode Applications:** rectifier circuits (half-wave and full-wave rectifier), voltage regulator using Zener diode, clipper circuits, clamper circuits	**5**
Unit-6	**BJT:** Basic structure, operation of transistor in active and saturation mode, DC analysis. **MOSFET:** Introduction to MOSFET Operation and characteristics.	**5**
Unit-7	**Operational Amplifier (Op-Amp):** Ideal op-amp, inverting amplifier, non-inverting configuration, transfer characteristics, op-amp applications like difference amplifier, summing amplifier, integrator, and differentiator.	**3**
Unit -8	**Basic Digital Electronics:** Logic gates, Boolean algebra, De-Morgan's theorem, K-Map, combinational circuits like adder, multiplexer, and demultiplexer.	**5**
	Total	**36**

Course Outcomes (COs):

After completion of the course, students will be able to

5. Understand the basic structure and operating principle of electronics devices and analyse DC and AC networks.
6. Measure different electrical quantities in simple 1-phase and 3-phase circuits.
7. Classify the electrical machines and the electronics devices; explain their working principles, characteristics and applications.
8. Design and implement simple analog and digital electronic circuits.

Text Books/ Reference Books:

5 Gupta, J. B., *Basic Electrical Engineering*, S. K. Kataria & Sons.
6 Husain, A., and Ashfaq, H., *Basic Electrical Engineering*, Dhanpat Rai & Co.
7 Nashelsky, L., and Boylestad, R., *Electronic Devices and Circuit Theory*, 10th Edition, Pearson India.
8 Kumar, A. Anand, *Fundamentals of Digital Circuits*, 4th Edition, PHI.

ME11004	Engineering Thermodynamics	L-T-P-C
	B.Tech (Mechanical Engg.)	3-0-0-3
	Second Semester (Professional Core)	

Prerequisites: N/A

	Course Content	Hours
Unit-1	**Introduction :** Concepts and Applications of Thermodynamics; Systems and Control Volumes; Processes and Cycles; Temperature and the Zeroth law of Thermodynamics	**3**
Unit-2	**Properties of Pure Substance**; Phase-Change Processes; Property Diagrams; Property Tables; Ideal-Gas Equation of State, Behavior of Real Gases.	**3**
Unit-3	**First Law of Thermodynamics :** First law referred to cyclic and non-cyclic processes, concept of internal energy of a system, conservation of energy for simple compressible closed systems; Definitions of enthalpy and specific heats; Conservation of energy for a control volume (or open system), steady and transient processes.	**6**
Unit-4	**Second Law of Thermodynamics:** Directional constraints on natural processes; Statements of Second law of Thermodynamics and their equivalence, Heat Engines; Refrigerators and Heat Pumps; Reversible and Irreversible Processes; Carnot Cycle and Carnot Principles; Absolute thermodynamic temperature scale; Carnot Heat Engine; Carnot Refrigerators and Heat Pumps; Clausius inequality, Entropy, increase of entropy principle, change in entropy in various thermodynamic processes, Tds relations, Entropy balance for closed and open systems, Entropy principle, Entropy generation, and concept of Third law of Thermodynamics; Entropy change of liquids and solids, Isentropic efficiencies of steady-flow devices.	**8**
Unit-5	**Exergy:** Work Potential of Energy; Reversible Work and Irreversibility; Second-law Efficiency; Exergy change of a System; Exergy Transfer by Heat, Work and Mass, Decrease of Exergy Principle and Exergy Destruction. exergy Destruction.	**6**
Unit-6	**Thermodynamic Property Relations:** Maxwell relations; Clausius-Clapeyron equation; Difference in heat capacities; Ratio of heat capacities; Joule Thompson coefficient.	**8**
	Total	**34**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Calculate properties of pure substances and analyze behaviour of ideal and real gases.
2. Apply first law of thermodynamics to various closed and open systems.
3. Apply second law of thermodynamics to closed and open systems to calculate specified parameters such as work, heat transfer, or entropy.
4. Calculate exergy destruction for various processes carried out on various thermal devices.
5. Develop fundamental relations between commonly encountered thermodynamic properties and express the properties that cannot be measured directly in terms of easily measurable properties.
6. Identify and formulate elementary level engineering problems related to thermodynamics and energy transformation in a conceptual form as well as in terms of mathematical/physical models.

Text Books/ Reference Books:

1. Cengel and Boles. Thermodynamics: An Engineering Approach, 7/e. Tata McGraw Hill.
2. Moran, Shappiro, Boettner and Bailey. Principles of Engineering Thermodynamics, 8e. Wiley.
3. P.K. Nag. Engineering Thermodynamics, 5/e. McGraw Hill.
4. Boegnakke and Sonntag. Fundamentals of Thermodynamics: 10e. Wiley.
5. Rogers and Mayhew. Engineering Thermodynamics, 4e. Pearson Education.

ME12002	Workshop Practice	L-T-P-C
	B.Tech. (CE, CSE and ME)	0-0-3-1
	Second Semester (Professional Core)	

Prerequisites: N/A

	Course Content	Hours
Unit-1	General safety precautions in workshop and introduction.	**3**
Unit-2	**Carpentry Shop:** Safety precaution, Kinds of wood and timber, Application of timber as per their classification, Carpentry hand tools and machines, Different types of carpentry joint, Demonstration of wood working machine like, band saw, circular saw, thickness planner, wood working lathe, surface planners, etc.	**6**
Unit-3	**Welding Shop:** Safety precaution in welding shop, Introduction to gas and arc welding, Soldering and brazing etc. Welding equipment and welding material.	**6**
Unit-4	**Fitting Shop:** Safety precaution, Introduction to fitting shop tools, equipment, Operation and their uses, Marking and measuring practice.	**6**
Unit-5	**Machine Shop:** Safety precautions, Demonstration and working principles of some of the general machines, like lathe, shaper, milling, drilling, grinding, slotting etc., General idea of cutting tools of the machines.	**6**
	Total	**27**

Course Outcomes (COs):

After completion of the course, students will be able to

7. Know the importance of general safety precautions on different shop floors.
8. Identify the basics of tools and equipments used in fitting, carpentry, sheet metal, machine, welding and smithy.
9. Do fabrication of wooden joints and understand joining of metals.
10. Make metal joints and sheet metal work.
11. Understand the basics of removal of material from work piece surface to attain specific shape.
12. Familiarize with the production of simple models in fitting, carpentry, sheet metal, machine, welding and smithy trades.

Text Books/ Reference Books:

3. S K Hajra Choudhury, A K Hajra Choudhury, N. Roy. Workshop Technology Vol I & II, Media Promoters & Publishers Pvt. Ltd; 9/e.
4. H S Bawa. Workshop Practice, McGraw Hill Education; 2nd edition, 2/e.

EE12002	Electrical and Electronics Science Laboratory	L-T-P-C
	B.Tech (CE, CSE and ME)	0-0-2-1
	Second Semester (Professional Core)	

Prerequisites: Nil

Sl. No.	Experiments
1	Verification of Thevenin's and Norton's Theorems in a DC circuit.
2	Verification of Superposition Theorem in DC circuits.
3	Measurement of power in single phase AC circuit using three ammeter method
4	Measurement of three phase power in an AC circuit with star and delta connected variable loads.
5	Familiarization with the components and instruments.
6	Design of a clipper and clamper circuits (both positive and negative)
7	Plot the VI characteristics of a PN junction diode and Zener diode and compare their difference
8	Implement Boolean functions using logic gates.
9	Design of circuits using operational amplifier

Course Outcomes (COs):

After completion of the course, students will be able to

1. Develop practical skills using electrical and electronic components and measuring equipment.
2. Demonstrate and justify results of Network theorems in DC circuits.
3. Compute and verify power consumptions for single and three phase loads.
4. Understand the characteristics of various electronics devices.
5. Design and analyze simple analog and digital circuits.

CY12002	Chemistry Laboratory	L-T-P-C
	B.Tech (CE, CSE and ME)	0-0-2-1
	Second Semester	

Prerequisites: None

List of Experiments:

Experiment 1: To determine the total hardness of pond water/ supplied water using the standard EDTA solution
Experiment 2: Estimation of magnesium from the supplied solution using standard EDTA
Experiment 3: Estimation of calcium from the supplied solution using standard EDTA
Experiment 4: Determination of dissolved oxygen (DO) of lake water
Experiment 5: Determination of total alkalinity of supplied aqueous solution.
Experiment 6: To determine the strength of the $KMnO_4$ solution using a standard oxalic acid solution
Experiment 7: To determine the amount of Fe(II) present in the supplied solution using the standard $KMnO_4$ solution
Experiment 8: To determine the amount of Fe(III) present in the supplied solution using the standard $K_2Cr_2O_7$
Experiment 9: Quantitative determination of Copper (II) using standard HYPO ($Na_2S_2O_3$) solution
Experiment 10: Estimation of calcium in milk powder using standard EDTA solution
Experiment 11. Detection of special elements in supplied organic compounds.
Experiment 12: Determination of functional groups in the supplied organic compounds
Experiment 13: Preparation of Copper (II) glycinato complex
Experiment 14: Determination of the relative viscosity of the given organic compound by Ostwald Viscometer
Experiment 15: Determination of the surface tension of the given organic compound by the stalagmometer

Course Outcomes (COs): After completion of the course, students will be able to

1. Know about the methods for the determination of water quality parameters. They can assess the quality of water for drinking purposes, etc., by performing experiments such as determining total hardness, Ca^{2+}, Mg^{2+}, total alkalinity, and dissolved oxygen.
2. Determine presence of Fe^{3+}, Fe^{2+}, Cu^{2+} ions in water
3. Determine the physical properties of liquids by performing experiments, such as viscosity. They will also be able to determine the viscosity of the lubricating oil. The generated knowledge can be used for industrial product development, like detergent formulation.
4. Determine the surface tension of liquids
5. Synthesise coordination complexes of biologically important transition metal ions.
6. To perform the chemical reactions to find out different elements, functional groups or nonmetals present in the organic compounds. This will also help them to understand the role of different functional groups in chemical reactivity.

Text Books/ Reference Books:

1. Das, S. C., Advanced Practical Chemistry (2024), The World Press Private Limited
2. Laboratory Manual, Dept. of Chemistry, NIT Silchar

MA21001

Applied Mathematical Analysis and Statistics
B.Tech.(For CE,CSE,ME)
Third Semester (Professional Core)

L -T-P- C
3- 0 - 0 - 3

Prerequisites: Ordinary & Partial differentiation, Elementary integration, Vector operations.

	Course Content	Hours
Unit-1	**Vector Integral Calculus:** Line integral, Double integral, Surface integral, Triple integral, Green's theorem, Stokes' theorem and Gauss Divergence theorem and their applications.	**10**
Unit-2	**Complex Analysis:** Limit, continuity, differentiability and analyticity of functions, Cauchy-Riemann equations, line integrals in complex plane, Cauchy's integral theorem, Cauchy's integral formula, derivatives of analytic functions, Taylor's series, Laurent's series, Zeros and singularities, Residue theorem, evaluation of real integrals.	**10**
Unit-3	**Probability & Statistics:** Introduction to probability, Additive & multiplicative Laws of probability, Conditional probability, Independent events, Baye's theorem, Random variable, Probability mass function, Probability density function, Cumulative distribution function, Binomial, Poisson & Normal distributions. Curve fitting: Fitting of straight lines & parabolas by the method of least squares. Correlation & Regression analysis: Coefficient of correlation, Coefficient of regression, Lines of regression.	**12**
Unit-4	**Stochastic Process:** Definition of Stochastic process, Classification and properties of stochastic processes, Simple Markovian stochastic processes, Gaussian processes, Stationary processes.	**6**
	Total	**38**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Apply concepts of Vector Calculus to solve multivariable integration and field problems.
2. Analyze complex functions using methods of Complex Analysis.
3. Use techniques of Probability and Statistics for data analysis and uncertainty modelling.
4. Model random systems using Stochastic Processes and related probabilistic methods.

Text Books:

1. E. Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley India Pvt. Ltd., 2015.
2. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publisher, 2017.
3. J. Ravichandran, Probability and Statistics for Engineers. Wiley India Pvt. Ltd., New Delhi, 2010.
4. A. Papoulis, S. U. Pillai, Probability Random Variables and Stochastic Processes, CBS Publishers and Distributors Pvt. Ltd, 2025.

Reference Books:

1. M.D. Raisinghania, Vector Analysis, S.Chand & Company Ltd, 2020.
2. S. Lipschutz and J. J. Schiller, Complex Variables, Schaum's Outline series, 2009.
3. S. Lipschutz and J. J. Schiller. Introduction to Probability and Statistics. Schaum's Outline Series, 2011.
4. Sheldon M. Ross, Stochastic Processes, Wiley, 2008.

HS21001/21002	Engineering Economics	L-T-P-C
	IIIrd / IVth Semester (Professional Core)	3-0-0-3

Prerequisites: None

	Course Content	Hours
Unit-1	**Introduction:** Definition and scope of Economics; Engineering Economics and the role of engineers in economic decision-making; Theory of Consumer Behaviour: Cardinal and Ordinal Utility analysis.	**4**
Unit-2	**Demand Analysis:** Demand: meaning, law, determinants; Supply: meaning, law, determinants; Market equilibrium and price determination; Elasticity of demand; Demand Forecasting techniques.	**4**
Unit-3	**Theory of Cost and Production:** Meaning and classification of costs; Short-run cost concepts; Fixed cost; Variable cost; Total, average, and marginal cost; Long-run cost curves; Law of Variable Proportion and Returns to scale.	**3**
Unit 4:	**Theory of Product Pricing:** Market Structure: Perfect Competition-Characteristics; Price Determination; Monopoly- Characteristics, Price and Output Determination.	**6**
Unit 5	**National Income Determination**: Concepts and Measurement of National Income; Components of National Income; Methods of National Income Calculation; Problems in Measuring National Income.	**3**
Unit 6	**Macroeconomic issues and International Market:** Unemployment: Definition, types, and causes; Inflation: types, causes, and social costs of inflation; Business Cycle; Schumpeter theory of innovation.	**6**
Unit-7	**Project Evaluation and Management:** Meaning of Project Cycle, Project selection and planning; Project Appraisal; Means of financing and financial appraisal tools; Qualitative Methods for Project Evaluation, Social Cost Benefit Analysis; Externalities and environmental concerns.	**6**
	Total	**32**

Course Outcomes (COs):

After completion of the course, students will be able to

1. To introduce economic principles relevant to engineering decision-making
2. To analyse consumer behaviour, cost functions and producer behaviour for Engineering Decisions
3. To understand national income and macroeconomic issues
4. To apply project evaluation techniques and social and environmental cost-benefit analysis

Text Books/ Reference Books:

1. H. G. Thuesen, W. J. Fabrycky, and G. J. Thuesen (1993), Engineering Economy, Prentice Hall International.
2. F. C. Jelen (1970), Cost and Optimisation Engineering, McGraw-Hill Book Co., New York.
3. Hal R. Varian. Intermediate Microeconomics, 8th Edition, W. W. Norton and Company.
4. N. Gregory Mankiw. Principles of Microeconomics. Cengage Learning
5. N. Gregory Mankiw, Ronald D. Kneebone, Kenneth J McKenzie (2023). Principles of Macroeconomics, 9th Edition. Cengage Canada.
6. Salvatore, D. International Economics (11th ed.). John Wiley & Sons.

ME21001	Engineering Materials	L-T-P-C
	B.Tech (Mechanical Engg.)	3-0-0-3
	Third Semester (Professional Core)	

Prerequisites: PH-11001, ME-11003

	Course Content	Hours
Unit-1	**Introduction:** Classification of materials, Atomic structure, Atomic bonding in solids, Crystal structure, Crystal systems, Crystallographic directions, Miller-Bravais scheme, Polycrystalline Materials.	**6**
Unit-2	**Imperfections in Solids:** Crystal defects, Critical nucleus size and Critical free energy, Nucleation and growth, Strengthening mechanisms, Recovery-recrystallization and grain growth.	**6**
Unit-3	**Phase Diagrams:** Gibbs phase rule, Binary phase diagram, Iron-carbon phase diagram, Phase transformations in metals, Kinetics of phase transformations, Isothermal transformation (TTT) diagrams, CCT diagram, Heat treatments, Surface hardening, Hardenability.	**8**
Unit-4	**Testing and Failures of materials:** Concepts of stress-strain, Interpretation of tensile stress-strain curves, Tensile properties, Hardness, Fracture, Fracture mechanics, Ductile-to-brittle transition, Fatigue, Creep, Stress and temperature effects.	**8**
Unit-5	**Polymers and Composite:** Polymer types and Polymer synthesis & processing, crystallization, Mechanical behavior of polymers, Mechanisms of deformation and strengthening of polymers, Characteristics and typical applications, Particle-reinforced composites, Fiber-reinforced composites, Structural composites, Economic, Environmental and social issues of material usage.	**8**
	Total	**36**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Explain the atomic structure and crystal arrangement in metals and alloys.
2. Interpret phase diagrams and analyse the effects of heat treatment processes on material properties.
3. Evaluate mechanical properties and identify common failure modes of engineering materials.
4. Perform standard material testing methods and analyse experimental results.
5. Examine structure–property relationships and processing effects in polymers and composite materials.

Text Books/ Reference Books:

1. Sidney H Avner, Introduction to Physical Metallurgy, McGraw Hill Education – 2nd edition, ISBN978-0074630068, 2017
2. George E Dieter, Mechanical Metallurgy, McGraw Hill Education – 3rd edition, ISBN- 978-1259064791, 2017.
3. Callister. Material Science and Engineering. John Wiley & Sons. Inc.
4. Askeland & Fulay. The Science and Engineering of Materials. Nelson Engineering,
5. A.V.K. Suriyanarayana, Testing of metallic materials, BS Publications, ISBN- 978-8178001340, 2007.

ME21003	Mechanics of Solids	L-T-P-C
	B.Tech (Mechanical Engg.)	3-0-0-3
	Third Semester (Professional Core)	

Prerequisites: Nil

	Course Content	Hours
Unit-1	Principal Stresses, strain, plane; Mohr's Circle; Transformation of stress and strain in a plane. Strain energy, Concept of stress and strain tensor, generalized Hooke's law; Different types of failure theories for ductile and brittle material.	**7**
Unit-2	Theory of bending, Theory of torsion, Application of theory bending and torsion in different sections; Relationship between rate of loading, Shear Force and Bending Moment; SF and BM diagrams for different types of Beam.	**10**
Unit-3	Relationship among curvature, slope and deflections, slope and deflection for different types of beam with application of different types of theories.	**7**
Unit-4	Derivation and solution of differential equations of equilibrium, stresses produced by shrink fit, compound cylinders.	**7**
Unit-5	Definition, basic structures, Euler's Equation and Rankine's formula. Winkler Back theory. Application of different theories in beams.	**6**
	Total	**37**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Understand, comprehend and analyze stresses, strains and its transformation, stress-strain relations for linearly elastic members using theories of failures.
2. Analyze mechanical structures using Shear force and bending moment.
3. Determine and analyze the deflection of beams, combined stresses, torsion for engineering problems.
4. Understand and analyse thick cylinders, columns and struts, and the basics of fracture mechanics.

Text Books/ Reference Books:

1. Timoshenko and Gere, Mechanics of Materials, 4th Edition, CBS Publishers.
2. E.P.Popov, Engineering Mechanics of Solids, 2nd Edition, Pearson.
3. S. B. Junarkar, Mechanics of Structures, Vol. 2, Charotar Publishers.
4. S. S. Rattan. Strength of Material. 3rd Edition, McGraw-Hill.
5. Pytel & Singer, Strength of Materials, 4th Edition, Harper & Row Publishers.
6. L.S Srinath, Advanced Mechanics of Solids, 3rd Edition, McGraw-Hill Education.
7. Beer and Johnston, Mechanics of Materials, 7th Edition, McGraw-Hill India Pvt. Ltd.
8. NPTEL Course on 'Strength of Materials' by Prof. Ramesh K and Prof Hariprasad. nptel.ac.in/courses/112106319;
9. NPTEL Course on 'Strength of Materials' by Prof. MS Sivakumar -nptel.ac.in/courses/112106141
10. NPTEL Course on 'Mechanics of Solids' by Prof. Priyanka Ghosh: nptel.ac.in/courses/105104160

ME21005	Fluid Mechanics	L-T-P-C
	B.Tech (Mechanical Engg.)	3-0-0-3
	Third Semester (Professional Core)	

Prerequisites: Nil

	Course Content	Hours
Unit-1	**Introduction**: Fluids and continuum, Properties of fluids, Pressure and stress tensor, Classification of fluids	**4**
Unit-2	**Fluid Statics:** Hydrostatic Pressure, Pressure variation in a static fluid, Pressure measurement, Forces on submerged surfaces, Buoyancy and stability, Fluids under rigid body motion	**6**
Unit-3	**Fluid Kinematics**: Lagrangian and Eulerian description, Types of fluid flow, streamline, streakline and pathline, Velocity field, Acceleration in fluid flow, Deformation of fluid elements, rotation and vorticity, Continuity equation, Stream function and velocity potential	**6**
Unit-4	**Fluid Dynamics**: Euler equation, Bernoulli's equation and its applications; Reynolds transport theorem - conservation of mass, linear and angular momentum, Stokes law of viscosity and Navier-Stokes equations - some exact solutions Internal flows - pipe flow, friction factor, Moody's diagram, minor and major losses, pipe networks	**16**
Unit-5	**Dimensional analysis**: Fundamental concepts, Buckingham π-Theorem, Model analysis and similarity	**4**
	Total	**36**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Identify fundamental fluid properties and statics principles.
2. Understand fluid kinematics, dynamics, and flow regimes.
3. Apply fluid flow principles inflow measurement devices and pipe systems
4. Analyze forces, losses, and applications of momentum and energy equations.
5. Evaluate relevant fluid flow problems.

Text Books/ Reference Books:

1. S.K. Som, G. Biswas and S. Chakraborty. Introduction to Fluid Mechanics and Fluid Machines. Tata McGraw Hill
2. Cengel and Cimbala, Fluid Mechanics. Tata McGraw Hill.
3. R.W. Fox, P.J. Pritchard and A. T. McDonald. Introduction to Fluid Mechanics. Wiley
4. Frank M. White. Fluid Mechanics. McGraw Hill.
5. James E. A. John and William L. Haberman. Introduction to Fluid Mechanics. Prentice Hall.

ME21007	Applied Thermal Engineering	L-T-P-C
	B.Tech (Mechanical Engg.)	4-0-0-4
	Third Semester (Professional Core)	

Prerequisites: Engineering Thermodynamics

	Course Content	Hours
Unit-1	**Air Standard Cycles**: Ideal cycle, hot gas engine cycles, Otto, Diesel and dual cycles, Brayton cycle and its performance improvement techniques, aircraft engines.	**14**
Unit-2	**Fuels & Combustion:** Different types of IC engine fuels and their characteristics, Combustion in SI and CI Engines, Air Fuel ratio, Fuel thermochemistry, Engine emission	**4**
Unit-3	**Vapour Power cycle:** Ideal and actual vapour power cycles, Reheat, Regenerative, and intercooling cycle, and Cogeneration and Combined cycle.	**8**
Unit-4	**Nozzles and Steam Turbines**: Types and Shapes of nozzles, Isentropic and non-isentropic flow through nozzles, Choking of Nozzles. Impulse and reaction steam turbines, velocity diagrams and performance	**8**
Unit-5	**Reciprocating Compressors:** Single stage and multistage air compressors, Performance characteristics and improvement measures, different efficiency metrics; Surging and stalling, slip.	**5**
Unit-6	**Refrigeration & Air-conditioning systems:** Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic air conditioning processes.	**9**
	Total	**48**

Course Outcomes (COs):

After completion of the course, students will be able to

Text Books/ Reference Books:

1. Cengel and Boles. Thermodynamics: An Engineering Approach, 7/e. Tata McGraw Hill.
2. Moran, Shappiro, Boettner and Bailey. Principles of Engineering Thermodynamics, 8/e. Wiley

1. P.K. Nag. Engineering Thermodynamics, 5/e. McGraw Hill
2. Boegnakke and Sonntag. Fundamentals of Thermodynamics: 7e. Wiley
3. Rogers and Mayhew. Engineering Thermodynamics, 4e. Pearson Education

ME22001	Thermo-Fluid Lab-I	L-T-P-C
	B.Tech (Mechanical Engg.)	0-0-3-1.5
	Third Semester (Professional Core)	

	Name of Experiment	Hours
Exp-1	Verification of Bernoulli's Theorem.	**3**
Exp-2	Calibration of Different Flow Meters.	**3**
Exp-3	Determination of the Coefficient of Discharge for Rectangular and V-Notches.	**3**
Exp-4	Determination of Metacentric Height of a Floating Body.	**3**
Exp-5	Determination of Various Losses in Pipe Flow.	**3**
Exp-6	Calibration of Thermocouple.	**3**
Exp-7	Estimation of air-fuel ratio in a 4-Stroke Diesel/Petrol Engine.	**2**
Exp-8	Determination of Volumetric Efficiency of a Two-stage Reciprocating Air Compressor.	**2**
Exp-9	Determination of Viscosity of Liquids.	**2**
	Total	**24**

**** No of experiments may vary**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Correlate Bernoulli's theorem with its practical implications and validation.
2. Understand and calibrate flow and temperature measurement devices, and analyse their performance characteristics.
3. Correlate theoretical knowledge on pipe losses, equilibrium of floating bodies, viscosity and estimation of metacentric height.
4. Understand and analyse the working principles and performance parameters of IC engines and reciprocating air compressors.

ME22003	Machine Drawing Lab	L-T-P-C
	B.Tech (Mechanical Engg.)	0-0-3-1.5
	Third Semester (Professional Core)	

Pre-Requisites: Engineering Drawing / Engineering Graphics

	Name of Experiment	Hours
Exp-1	Orthographic projection of machine components (first-angle projection) on drawing sheet with proper dimensioning.	**2**
Exp-2	Sectional views (full, half and offset sections) of simple machine parts on drawing sheet.	**2**
Exp-3	Detailed drawing of standard machine elements (bolt, nut, key, shaft coupling) on drawing sheet.	**2**
Exp-4	Assembly drawing from given part details with bill of materials (BOM) on drawing sheet.	**2**
Exp-5	Introduction to AutoCAD/CATIA/SolidWorks: 2D drafting commands, layers, dimensioning and plotting.	**2**
Exp-6	Creation of detailed 2D part drawings with tolerances and surface finish symbols using CAD software.	**2**
Exp-7	3D solid modeling of simple machine components (shaft, flange, bracket) using solid modeling software.	**2**
Exp-8	Assembly modeling of multiple components and generation of exploded view.	**2**
Exp-9	Generation of orthographic views and sectional views from 3D models.	**2**
Exp-10	Preparation of assembly drawing with automatic Bill of Materials (BOM) using CAD software.	**2**
Exp-11	Modeling and drafting of a machine element assembly (e.g., coupling or bearing housing) using CAD software.	**2**
Exp-12	Complete modeling, assembly and production drawing generation of a small mechanical system using CAD software.	**2**
	Total	**24**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Apply engineering drawing standards and conventions in preparing working drawings.
2. Prepare orthographic and sectional drawings of machine components.
3. Develop assembly drawings with bill of materials (BOM).
4. Create 2D drafting and 3D solid models using CAD software (AutoCAD/CATIA/ SolidWorks).
5. Generate production-ready drawings from 3D models with tolerances and surface finish symbols.

Text Books/ Reference Books:

1. N. D. Bhatt and V. M. Panchal, Machine Drawing, 48th ed. Anand, India: Charotar Publishing House Pvt. Ltd., 2019.
2. K. L. Narayana, P. Kannaiah, and K. Venkata Reddy, Machine Drawing, 3rd ed. New Delhi, India: New Age International (P) Ltd., 2017.
3. P. S. Gill, Machine Drawing, Rev. ed. New Delhi, India: S. K. Kataria & Sons, 2012.
4. Bureau of Indian Standards, IS 696: Engineering Drawing Practice and relevant IS/ISO standards on dimensioning and tolerancing. New Delhi, India: BIS.

5. International Organization for Standardization, ISO 128: Technical Drawings — General Principles of Presentation and related ISO standards.

Online Resources:

1. NPTEL, “Engineering Drawing and Computer Graphics,” IIT Kharagpur. https://onlinecourses.nptel.ac.in/noc21_me125/preview
2. NPTEL, “Engineering Graphics and Design,” IIT Delhi. https://onlinecourses.nptel.ac.in/noc21_me128/preview
3. NPTEL, “Engineering Drawing,” IIT Guwahati. https://nptel.ac.in/courses/112103019
4. NPTEL/SWAYAM, “Computer Aided Design and Manufacturing (CAD/CAM).” https://onlinecourses.swayam2.ac.in/nou25_me10/preview
5. Autodesk, “AutoCAD Learning Resources.” https://www.autodesk.com/learning
6. Dassault Systèmes, “SOLIDWORKS Training.” https://www.solidworks.com/sw/learning.htm
7. Dassault Systèmes, “CATIA Resources.” https://www.3ds.com/products-services/catia/resources/

ME22005	Soft Skill Development	L-T-P-C
	B.Tech (Mechanical Engg.)	0-0-3-1
	Third Semester (Professional Lab)	

Prerequisites: N/A

	Course Content	Hours
Unit-1	Communication Skills	**3**
Unit-2	Spoken English and Accent Neutralization Skills	**3**
Unit-3	Public Speaking and Presentation Skills	**3**
Unit-4	Interpersonal Skills	**3**
Unit-5	Group Discussion and Teamwork skills	**3**
Unit-6	Leadership development Skills	**3**
Unit-7	Interview and Employability Skills	**3**
Unit-8	Business Etiquette Skills	**3**
Unit-9	Career Readiness	**4**
Unit-10	Comprehensive Laboratory Assessment	**4**
	Total	**32**

Course Outcomes (COs):

After completion of the course, students will be able to possess the requisite soft skills to become a successful professional.

Text Books/ Reference Books: N/A

ME22007	Do-It-Yourself Lab	L-T-P-C
	B.Tech (Mechanical Engg.)	0-0-3-1.5
	Third Semester (Professional Lab)	

Prerequisites: N/A

	Course Content	Hours
Unit-1	Introduction & Safety Orientation	**3**
Unit-2	Mechanical Do-it-Yourself (DIY) Fabrication	**3**
Unit-3	Robotics & Automation Projects	**3**
Unit-4	Arduino-Based Projects	**3**
Unit-5	IoT and Smart Systems (Advanced DIY)	**3**
Unit-6	Engineering Problem-Solving Projects	**6**
Unit-7	Documentation & Presentation	**6**
Unit-8	Final DIY Project (Pinnacle)	**6**
	Total	**33**

Course Outcomes (COs):

After completion of the course, students will be able to possess the requisite skills to practice and implement engineering know-hows in solving real life problems.

Text Books/ Reference Books: N/A

CE21001/21002	Environmental Science	L-T-P-C
	3rd / 4th Semester (Professional Core)	2-0-0-2

Prerequisites: None

	Course Content	Hours
Unit-1	**Introduction and Natural Resources:** Environment, Definition, scope and importance, multidisciplinary nature of environmental studies, Forest Resources –use and over-exploitation of forests, deforestation, water, mineral, land, food resource and energy resources	**5**
Unit-2	**Ecosystem and Biodiversity:** Ecosystem-Concept of an ecosystem, structure and function of an ecosystem, Food chain, food webs and ecological pyramids, Energy flow in ecosystem producers and consumers Ecological Succession, Biodiversity and its Conservation – introduction, definition, genetic species and ecosystem diversity, value of biodiversity, hotspots of biodiversity, threats to biodiversity- habitat loss, poaching of wildlife conflicts, endangered and endemic species in India, conservation of biodiversity	**6**
Unit-3	**Environmental Pollution:** Causes, effects and control measures of air pollution, scales of defining pollutants, various air pollution control equipment, water pollution, wastewater management, primary, secondary and tertiary treatment techniques, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear radiation hazards, Solid waste management, sources of solid waste effects and control measures of urban industrial wastes, hierarchies of solid waste management techniques	**9**
Unit-4	**Environment and society:** Role of an individual prevention of pollution, consumerism and waste products, unsustainable to sustainable development, Environmental Laws, Environmental Impact Assessment, issue involved in enforcement of environmental legalizations, Environment and human health, epidemics, Women and child welfare, Role of information technology in environment and human health.	**4**
	Total	**24**

Course Outcomes (COs):

After completion of the course, students will be able to

13. Understand scope of environmental science and brief knowledge about natural resources
14. Realize the importance of ecosystem and biodiversity in growth of human civilization.
15. Understand the effects of environmental pollution and different strategies to mitigate it
16. Understand various environmental laws and societal issues related to the environment for the benefit of the community

Text Books/ Reference Books:

16. Henry J.G. and Heinke G.W. ***Environmental Science and Engineering.*** Prentice Hall of India. New Delhi.
17. Chandrasekhar M. ***Environmental Science.*** Hi-Tech Publishers.
18. Masters G.M. ***Environmental Engineering and Science.*** Prentice Hall of India, New Delhi.
19. Garg S.K. and Garg R. ***Ecological and Environmental Studies.*** Khanna Publishers, Delhi.
20. Chawla S. ***Environmental Studies.*** Tata McGraw-Hill Publishers, New Delhi.

ME21002	**Mechanisms and Machines** B.Tech (Mechanical Engg.) **Fourth** Semester (Professional Core)	**L-T-P-C** 3-1-0-4

Prerequisites: ME21002 (Engineering Mechanics), ME 11003 (Fundamentals of Mechanical Engineering), MA21001 (Mathematics-III)

	Course Content	**Hours**
Unit-1	**Introduction and Force Analysis:** Basics of Mechanisms, Inversions of four-bar, single slider-crank, and double slider-crank chains, Static Force Analysis: Equilibrium of members under two, three, and four forces; free body diagrams, Velocity and Acceleration Analysis: Graphical Methods, Instantaneous Centre Method. Detailed study of the Coriolis component of acceleration in mechanisms. Dynamic Force Analysis: D'Alembert's Principle, inertia forces, and analysis of the slider-crank mechanism). Balancing: Static and dynamic force diagram, Inertia forces and their balancing for rotating and reciprocating machines, Identification of inertia forces for reciprocating masses in engine mechanisms, Partial primary balance of single cylinder engines and uncontrolled locomotives, Balancing of multi cylinder in line engines, V- twin engines, Radial engines – direct and reverse crank methods.	**9**
Unit-2	**Flywheel Dynamics:** Fluctuation Analysis: Definition and calculation of fluctuation of energy (maximum difference in kinetic energy) and fluctuation of speed (difference between max and min angular velocity), Flywheel Function: Role of the flywheel in stabilizing engine speed; calculating the coefficient of fluctuation of speed and the coefficient of steadiness. Turning Moment Diagram for single-cylinder, double-acting steam engines, four-stroke IC engines, and multi-cylinder engines, calculating work done per cycle and mean torque from these diagrams. Gyroscope: Gyroscopic Principles, Analyzing the gyroscopic effects on the stability and maneuvering of aircraft, naval ships and automobiles. (steering, pitching, rolling)	**9**
Unit-3	**Cam and Follower:** Classification of followers and cams, motion of the follower, displacement, velocity and acceleration diagrams, construction of cam profiles.	**5**
Unit-4	**Gears:** Friction wheels, gear drives and classifications, gear terminology, law of gearing, velocity of sliding of teeth, forms of teeth: cycloidal and involute, centre distance, length of path of contact, length of arc of contact, contact ratio, interference in involute gears, minimum number of teeth on the pinion, minimum number of teeth on the wheel, minimum number of teeth on a pinion for involute rack in order to avoid interference, spur gears, helical gears, spiral gears.	**6**
Unit-5	**Gear Trains:** Introduction, types of gear trains, simple gear train, compound gear train, design of spur gears, reverted gear train, epicyclic gear train, velocity ratio of epicyclic gear train, compound epicyclic gear train (sun and planet wheel), epicyclic gear train with bevel gears, torques in epicyclic gear trains, analytical and tabular method for solving the problems on gear trains.	**4**
Unit-6	**Fundamental of Vibration:**Free Vibrations: Undamped and damped free vibrations of Single and Multi-Degree of Freedom systems; determining natural frequency, Whirling of Shafts: Critical speeds of shafts with and without damping.	**6**
	Total	**39**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Analyze the given machine/mechanism for their type and mobility and balancing.
2. Determine the velocity and acceleration of links in the mechanism using graphical and analytical methods.
3. Students will comprehend the concepts and applications for the dynamics of rigid body, engine flywheel, cam and follower analysis and will be able to solve related problems.

4. Learn to formulate the equations for kinematic and dynamic analysis of gear and gear trains for a given gear arrangement.
5. To learn basic aspects of vibration with deriving governing equations – free and forced vibrations.

Text Books/ Reference Books:

1. Rattan, S. S., (2009). Theory of Machines 3rd Edition Tata McGraw Hill Publication.
2. Ghosh, A. & Mallik, A. K., (2009), Theory of Mechanisms, and Machines, 3rd Edition, East West Press.
3. Uicker, J. J., Pennock, G. R. & Shigley, J. E., (2009), Theory of Machines and Mechanisms,3rd Edition, Oxford University Press.
4. Rao, J. S., & Dukkipati, R.V., (2007) Mechanism & Machine Theory, New Age International Publication.
5. Norton, R. L., (2009), Kinematics and Dynamics of Machinery, Tata McGraw Hill.
6. Myszka David H., (2012), Machines and Mechanisms, Fourth Edition, Pearson Education, Inc., publishing as Prentice Hall, One Lake Street, Upper Saddle River, New Jersey.

Online Resources:

1. NPTEL Theory of machine and Machine Dynamics (IITs)
2. SWAYAM Theory of machine and Machine Dynamics

ME21004	Mechatronics	L-T-P-C
	B.Tech (Mechanical Engg.)	3-0-0-3
	Fourth Semester (Professional Core)	

Prerequisites: ME11001

	Course Content	Hours
Unit-1	**Introduction to mechatronics:** Introduction, examples of mechatronic systems, electric circuits and components, review of fundamentals of electronics and its applications, number systems: binary, hexadecimal and overview of mechatronics systems in CNC machines and industrial robots.	**3**
Unit-2	**Mechatronics elements:** Sensors and transducers, displacement, position & proximity sensors, force, fluid pressure, liquid flow sensors, temperature, light sensor, acceleration and, performance terminology of sensors, semiconductor sensors and micro-electromechanical systems (MEMS).	**6**
Unit-3	**Mechanical measurement:** Introduction to instruments and its characteristics, motion, force and torque measurement, temperature measurement, pressure measurement, vibration measurement	**5**
Unit-4	**Signal conditioning:** Introduction to signal processing, op-amp as a signal conditioner, analogue to digital converter, and digital to analogue converter.	**3**
Unit-5	**Actuators, drives, and mechanisms:** Stepper motors, actuators, motor sizing, power transmission: gears and belt drives; ball screws, linear motion bearings, and cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems, torque, speed, and power equations, efficiency, and inertia.	**5**
Unit-6	**Hydraulic and pneumatic system:** Flow, pressure, direction control valves, actuators, and supporting elements, hydraulic power packs, pumps, and design of hydraulic circuits, pneumatic system production, distribution and conditioning of compressed air, system components and graphic representations, design of systems.	**6**
Unit-7	**Modelling and system response:** Mechanical, electrical, fluid system modelling, dynamic response, transfer function and frequency response.	**4**
Unit-8	**Microprocessors, microcontrollers, and Closed-loop controllers:** Digital circuits, microprocessors, microcontrollers, programming of microcontrollers, P, I, PID controllers, digital controllers, program logic controllers, input/output & communication systems, fault finding.	**4**
	Total	**36**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Identify different mechatronics elements and systems
2. Design instrument and perform measurement of mechanical parameters
3. Select suitable signal conditioning techniques and microprocessor based systems
4. Analyse various actuators, drives, mechanisms and mechatronics systems
5. Perform modelling and analysis of various industrial systems

Text Books/ Reference Books:

1. Bolton, William. Mechatronics: electronic control systems in mechanical and electrical engineering. Pearson Education
2. Nakra, B. C., and Choudhury, K. K., Instrumentation, Measurement and Analysis, TMH
3. Mahalik, Nitaigour Premchand. Mechatronics. Tata McGraw-Hill.
4. Bishop, Robert H. Mechatronics: an introduction. CRC Press.
5. Shetty, D., and Kolk, R. A., Mechatronics system design, Cengage Learning.
6. R. Iserman, Mechatronic Systems: Fundamentals, Springer.
7. Musa Jouaneh, Fundamentals of Mechatronics, Cengage Learning.

ME21006	Casting and Joining Processes	L-T-P-C
	B.Tech (Mechanical Engg.)	3-0-0-3
	Fourth Semester (Professional Core)	

Prerequisites: ME11001

	Course Content	Hours
Unit-1	**Fundamentals of casting and moulding:** Classification of casting processes; steps involved in the casting process; foundry terminologies; foundry furnaces; patterns and allowances; moulding sand; moulds and moulding processes, solidification of metals and alloys.	**6**
Unit-2	**Gating system:** Gating system and its design; melting and pouring practices; Chvorinov's rule; shrinkage and solidification behaviour.	**6**
Unit-3	**Casting defects, inspection, and special processes:** Casting defects—classification, causes, and prevention; inspection of castings; non-destructive testing; special casting processes.	**6**
Unit-4	**Fundamentals of joining:** Introduction and classification of joining technologies, Nomenclature and symbol of welding joints, Power sources in welding.	**6**
Unit-5	**Various joining processes:** Physics and principle of joining processes, different types of joining methods and their details, advanced joining and welding processes.	**8**
Unit-6	**Welding defects and inspection:** Various types of welding defects, causes and remedies, inspection techniques for welding defect identification.	**4**
	Total	**36**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Select appropriate casting processes, mould materials, patterns, and core systems.
2. Design and optimise gating and riser systems.
3. Analyse casting defects and apply non-destructive testing methods.
4. Select suitable welding processes and process parameters for different materials and joint configurations.
5. Evaluate weld quality, identify defects, and propose corrective measures to ensure the structural integrity and service performance of welded joints.

Text Books/ Reference Books:

1. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems – Mikell P. Groover, John Wiley & Sons.
2. Manufacturing Engineering and Technology – Serope Kalpakjian and Stephen Schmid, SI Edition, Pearson / Digital Designs
3. Manufacturing Technology, Vol. 1 – P. N. Rao, Tata McGraw-Hill Education.
4. Manufacturing Science – Amitabha Ghosh and Asok Kumar Mallik, Ellis Horwood.
5. Welding Engineering: An Introduction – David H. Phillips, John Wiley & Sons Inc.
6. Welding and Welding Technology – Richard L. Little, McGraw-Hill.
7. Principles of Welding: Processes, Physics, Chemistry, and Metallurgy – Robert W. Messler Jr., Wiley.

ME21008	Forming Technology	L-T-P-C
	B.Tech (Mechanical Engg.)	2-0-0-2
	Fourth Semester (Professional Core)	

Prerequisites: ME11001

	Course Content	Hours
Unit-1	Introduction of metal forming as a manufacturing process, and its relation with other processes, Metal Forming from a systems point of view, Advantages of metal forming as a manufacturing process, Classifications of metal forming processes, Forming equipment, Presses (mechanical, hydraulic, pneumatic).	**4**
Unit-2	Theoretical analysis (theory of plasticity), Material incompressibility, Work of plastic deformation, Work hardening, Yield criteria and flow rules, Forming limit diagrams, Failure mechanisms, Formability tests.	**4**
Unit-3	Forging; open-die forging, closed-die forging, coining, nosing, upsetting, heading, extrusion and tooling, wire, rod and tube drawing, Rolling; flat rolling, shape rolling and tooling, Sheet forming; blanking, piercing, press bending, deep drawing, stretch forming, spinning, hydroforming, rubber-pad forming, Specialized forming operations: High energy rate forming.	**12**
Unit-4	Powdered metals and fabrication procedures, Preparation of powders, Compacting and sintering, Cold isostatic pressing and Hot isostatic pressing, Industrial applications & challenges.	**4**
	Total	**24**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Classify the various metal forming processes and apply the appropriate process for required engineering applications.
2. Apply theories of plasticity and flow rules to analyse deformation behaviour and predict material response under forming conditions.
3. Apply the mechanism of plastic deformation for metals and alloys to convert them into useful shapes for intended engineering applications.
4. Integrate knowledge of powder metallurgy and advanced forming techniques to provide a successful solution to industrial manufacturing challenges.

Text Books/ Reference Books:

1. Principles of Industrial Metal working Processes by G.W. Rowe.
2. Technology of Metal Forming Processes by S. Kumar.
3. Mechanical Metallurgy by G.E. Dieter.
4. Metal Forming: Mechanics and Metallurgy by W.F. Hosford and R.M. Caddell.
5. Metal Forming Handbook (Schuler GmbH)

ME21010	Applied Fluid Mechanics & Machineries	L-T-P-C
	B.Tech (Mechanical Engg.)	3-0-0-3
	Fourth Semester (Professional Core)	

Prerequisites: Fluid Mechanics

	Course Content	Hours
Unit-1	**Ideal Fluid Flows:** Elementary flows, Superposition of elementary flows.	**4**
Unit-2	**Boundary Layer Theory:** Boundary layer growth over a flat plate, Boundary layer thickness: displacement, momentum and energy thicknesses, Prandtl's boundary layer equations, Von Kármán momentum integral equation, Boundary layer separation and form drag, Methods of drag reduction, Lift and drag on submerged bodies and aerofoils, Stalling of aerofoils.	**6**
Unit-3	**Turbulent Flow:** Nature and characteristics of turbulence, Reynolds decomposition and time-averaged flow quantities, Reynolds-averaged Navier–Stokes (RANS) equations, Closure problem of turbulence, Mixing length concept and eddy viscosity, Velocity distribution in turbulent boundary layers and pipe flow.	**4**
Unit-4	**Compressible Flow:** Basic concepts of compressible flow and thermodynamic relations, Compressibility effects and isentropic flow relations, One-dimensional compressible flow, Flow through nozzles and diffusers, Choked flow and critical conditions.	**4**
Unit-5	**Fluid Machines:** Euler equation for turbomachines, velocity triangles, Hydraulic turbines – impulse and reaction turbines, cavitation, centrifugal and axial flow pumps, Air compressors, fans and blowers.	**18**
	Total	**36**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Identify concepts of ideal flow, boundary layer, turbulence, compressible flow, and fluid machinery.
2. Understand flow behaviour in boundary layers, turbulent and compressible flows.
3. Analyze ideal, viscous, turbulent, and compressible flow systems.
4. Apply fluid flow principles in turbomachinery and compressible flow devices.
5. Evaluate performance parameter of fluid flow systems

Text Books/ Reference Books:

1. S.K. Som, G. Biswas and S. Chakraborty. Introduction to Fluid Mechanics and Fluid Machines. Tata McGraw Hill
2. Cengel and Cimbala, Fluid Mechanics. Tata McGraw Hill.
3. R.W. Fox, P.J. Pritchard and A. T. McDonald. Introduction to Fluid Mechanics. Wiley
4. Frank M. White. Fluid Mechanics. McGraw Hill.
5. G.K. Batchelor. An Introduction to Fluid Dynamics. Cambridge University Press.
6. James E. A. John and William L. Haberman. Introduction to Fluid Mechanics. Prentice Hall.

ME22002	**Dynamics of Machines and Control Lab**	L-T-P-C
	B.Tech (Mechanical Engg.)	0-0-3-1.5
	Fourth Semester (Professional Core)	

Pre-Requisites: Theory of Machines, Dynamics of Machines and Control

	Name of Experiment	**Hours**
Exp-1	Study of mechanism models (four-bar, slider-crank) and verification of kinematic relations.	**2**
Exp-2	Determination of the mass moment of inertia of a flywheel or a compound pendulum.	**2**
Exp-3	Static and dynamic balancing of rotating masses using a balancing apparatus.	**2**
Exp-4	Study of gyroscopic effect and measurement of gyroscopic couple.	**2**
Exp-5	Study of governor characteristics (Watt/Porter/Hartnell governor).	**2**
Exp-6	Whirling of the shaft experiment and determination of critical speed.	**2**
Exp-7	Cam profile analysis and follower motion study.	**3**
Exp-8	Experiment on single degree of freedom (SDOF) vibration system to determine natural frequency and damping ratio.	**3**
Exp-9	Determination of transmissibility and resonance in forced vibration setup.	**3**
Exp-10	Simulation Assignment: Experimental validation or MATLAB-based dynamic response comparison.	**3**
	Total	**24**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Demonstrate practical understanding of mechanisms and machine dynamics experiments.
2. Perform experiments related to balancing, gyroscopic motion and governor characteristics.
3. Analyze vibration response and determine dynamic parameters experimentally.
4. Use instrumentation and data acquisition systems for dynamic testing and validation.
5. Demonstrate practical understanding of mechanisms and machine dynamics experiments.

Text Books/ Reference Books:

1. S. S. Rattan, Theory of Machines, 3rd ed. New Delhi, India: Tata McGraw-Hill Education, 2014.
2. S. S. Rao, Mechanical Vibrations, 6th ed. Noida, India: Pearson Education, 2017
3. Dynamics of Machines Laboratory Manual (Institute specific).
4. Equipment user manuals for balancing machine, gyroscope, governor and vibration apparatus.

Online Resources:

1. National Programme on Technology Enhanced Learning, "Dynamics of Machines," offered by Indian Institute of Technology Kharagpur / Indian Institute of Technology Bombay, NPTEL Online Courses.
2. Indian Institute of Technology Guwahati, "Mechanical Vibrations," NPTEL Online Courses. Available: nptel.ac.in/courses/112103111
3. National Programme on Technology Enhanced Learning (NPTEL), "Control Engineering," offered by Indian Institute of Technology Kharagpur. Available: https://nptel.ac.in/
4. MathWorks, "MATLAB Onramp," MATLAB Academy. Available: https://matlabacademy.mathworks.com/details/matlab-onramp/gettingstarted
5. MathWorks, "Simulink Onramp," MATLAB Academy. Available: https://matlabacademy.mathworks.com/details/simulink-onramp/simulink

ME22004	Material Testing Lab	L-T-P-C
	B.Tech (Mechanical Engg.)	0-0-2-1
	Fourth Semester (Professional Core)	

Pre-Requisites: PH 11001, ME 11001, ME 21001

	Name of Experiment	Hours
Exp-1	Study of heat treatment of mild steel	**1.5**
Exp-2	Brinell hardness testing of bare mild steel, fast quenched mild steel, annealed mild steel and normalized mild steel	**1.5**
Exp-3	Rockwell hardness testing of bare mild steel, fast quenched mild steel, annealed mild steel and normalized mild steel	**1.5**
Exp-4	Tensile test of bare mild steel	**1.5**
Exp-5	Tensile test of Annealed mild steel	**1.5**
Exp-6	Tensile test of Normalized mild steel	**1.5**
Exp-7	Tensile test of fast quenched mild steel	**1.5**
Exp-8	Compression test of polymer specimen	**1.5**
Exp-9	Flexural test of polymer specimen	**1.5**
Exp-10	Charpy and IZOD impact test of mild steel specimen	**1.5**
Exp-11	Metallographic investigation of bare mild steel	**1.5**
Exp-12	Metallographic investigation of Annealed mild steel	**1.5**
Exp-13	Metallographic investigation of Normalized mild steel	**1.5**
Exp-14	Metallographic investigation of fast quenched mild steel	**1.5**
Exp-15	Bending Fatigue Test on mild steel rod	**1.5**
Exp-16	Torsion Test on mild steel rod	**1.5**
	Total	**24**

**** No of experiments may vary**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Perform standard mechanical testing procedures and interpret the results as per relevant standards.
2. Conduct heat treatment experiments and evaluate their effects on mechanical properties and microstructure.
3. Prepare metallographic specimens, examine microstructures, and correlate structural features with mechanical behaviour.
4. Analyse experimental data using appropriate tools and prepare structured technical reports demonstrating structure–property relationships.
5. Select and justify suitable material testing and characterization techniques based on material type, service requirements, and performance criteria.

ME22006	Manufacturing Lab	L-T-P-C
	B.Tech (Mechanical Engg.)	0-0-2-1
	Fourth Semester (Professional Core)	

Pre-Requisites: ME11001, ME21006

	Name of Experiment	Hours
Exp-1	Introduction to furnaces for melting iron and aluminium.	**2**
Exp-2	Moulding sand preparation using manual methods and sand muller.	**2**
Exp-3	Permeability test of moulding sand using a permeability meter.	**2**
Exp-4	Grain fineness test of moulding sand.	**2**
Exp-5	Moisture content test of moulding sand using a rapid moisture tester.	**2**
Exp-6	Clay content test of moulding sand using a clay washer.	**2**
Exp-7	Testing of moulding sand strength: compressive, tensile, and shear strength (green and dry).	**2**
Exp-8	Mould making, casting, and post-casting operations.	**2**
Exp-9	Introduction to welding equipment and safety precautions in the welding laboratory.	**2**
Exp-10	Preparation of joints and welding using TIG/MIG/SAW processes.	**2**
Exp-11	Fabrication of welded joints using Friction Stir Welding (FSW).	**2**
Exp-12	Surface preparation, etching techniques, heat treatment, and metallographic studies.	**2**
	Total	**24**

**** No of experiments may vary**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Design patterns, gating, runner and riser systems for metal casting processes
2. Prepare moulds, produce cast components, and evaluate casting quality using appropriate testing methods.
3. Perform arc and solid-state welding processes following safety standards and select suitable welding techniques based on material and application requirements.
4. Fabricate components using appropriate welding processes.
5. Prepare metallographic specimens and examine microstructural characteristics of metals and alloys, correlating them with mechanical and physical properties.

ME22008	**Thermo-Fluid Lab-II**	**L-T-P-C**
	B.Tech (Mechanical Engg.)	0-0-3-1.5
	Fourth Semester (Professional Core)	

	Name of Experiment	**Hours**
Exp-1	Performance Characterization of Wind Tunnel Using Pitot Static Probe and Multichannel Manometric System.	**3**
Exp-2	Determination of Boundary Layer Thickness in Flow Over a Flat Plate.	**3**
Exp-3	Determination of Aerodynamic Parameter of a Circular Cylinder/Airfoil.	**3**
Exp-4	Experiment on Reynold Apparatus	**3**
Exp-5	Determination of Impact of Jet on Vanes	**2**
Exp-6	Determination of Performance Characteristics of Hydraulic Turbines	**2**
Exp-7	Determination of the Performance Characteristics of a Centrifugal Pump.	**2**
Exp-8	Determination of Performance Characteristics of a Centrifugal Blower	**2**
Exp-9	Determination of Performance Characteristics of a HAWT/VAWT.	**2**
Exp-10	Determination of Energy Conversion Losses (Mechanical to Electrical) in a Mini-hydro Turbine.	**2**
	Total	**24**

**** No of experiments may vary**

Course Outcomes (COs):

After completion of the course, students will be able to

1. Apply and analyse flow measurement techniques to correlate pressure, velocity, and flow characteristics in internal and external flows.
2. Understand and experimentally correlate boundary layer behaviour and aerodynamic parameters with theoretical predictions.
3. Analyse and compute performance characteristics of hydraulic machines and wind energy systems.
4. Understand and evaluate energy conversion processes and quantify associated mechanical and hydraulic losses.