

INSTITUTE OF ENGINEERING AND TECHNOLOGY LUCKNOW

(An Autonomous Constituent Institute of Dr. A.P.J. Abdul Kalam Technical University, Lucknow)



Scheme & Syllabus

For

**B. Tech. Second Year
(Mechanical Engineering)**

[Effective from the Session: 2023-24]

B.Tech. Mechanical Engineering Second Year

SEMESTER-III

Sl. No.	Subject Code	Subject Name	Type of Course	Periods			Evaluation Scheme				End Semester		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	IOE031-39/ IAS302	Inter Departmental Course /Maths III	ES/BS	3	1	0	20	10	30		70		100	4
2	IAS301/ IVE301	Technical Communication /Universal HumanValues	HS/VE	3	0	0	20	10	30		70		100	3
3	IME301	Thermodynamics	PC	3	1	0	20	10	30		70		100	4
4	IME302	Fluid Mechanics	PC	3	1	0	20	10	30		70		100	4
5	IME303	Materials Engineering	PC	3	1	0	20	10	30		70		100	4
6	IME351	Fluid Mechanics Lab	PL	0	0	2				50		50	100	1
7	IME352	Material Testing Lab	PL	0	0	2				50		50	100	1
8	IME353	Machine Drawing Lab	PL	0	0	2				50		50	100	1
9	IME354	Mini Project-I or Internship Assessment*	PL	0	0	2			50	50		50	100	1
10	INC301/ INC302	Computer System Security/Python Programming	VA	3	0	0	20	10	30		70		100	0
		Total											900	23

*The Mini Project or internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester.

Abbreviation Used:

BS: Basic Science Course
ES: Engineering Science Course
HS: Humanities and Social Science Course
PC: Program Course
PL: Program Lab
VE: Value Education Course
VA: Value Added Course

B.Tech. Mechanical Engineering Second Year

SEMESTER-IV

Sl. No.	Subject Code	Subject Name	Type of Course	Periods			Evaluation Scheme				End Semester		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	IOE041-49/ IAS402	Inter Departmental Course / Maths IV	ES/BS	3	1	0	20	10	30		70		100	4
2	IAS401/ IVE401	Technical Communication /Universal HumanValues	HS/VE	3	0	0	20	10	30		70		100	3
3	IME401	Applied Thermodynamics	PC	3	1	0	20	10	30		70		100	4
4	IME402	Mechanics of Materials	PC	3	1	0	20	10	30		70		100	4
5	IME403	Manufacturing Processes	PC	3	1	0	20	10	30		70		100	4
6	IME451	Applied Thermodynamics Lab	PL	0	0	2				50		50	100	1
7	IME452	Manufacturing Processes Lab	PL	0	0	2				50		50	100	1
8	IME453	Computer Aided Machine Drawing Lab	PL	0	0	2				50		50	100	1
9	IME454/ IME455	Mini Project-II/ Measurement and Metrology Lab	PL	0	0	2			50	50		50	100	1
10	INC401/ INC402	Computer System Security/Python Programming	VA	3	0	0	20	10	30		70		100	0
		Total											900	23

Abbreviation Used:

BS: Basic Science Course
ES: Engineering Science Course
HS: Humanities and Social Science Course
PC: Program Course
PL: Program Lab
VE: Value Education Course
VA: Value Added Course

Syllabus

IME 301	THERMODYNAMICS	3L:1T:0P	4 Credits
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Unit	Topics	No. of Hours
I	Fundamental concepts and definition Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle Reversibility Quasi – static Process, Irreversible Process, Causes of Irreversibility Energy and its forms, Work and heat (sign convention), Gas laws, Ideal gas, Real gas, Law of corresponding states, Property of mixture of gases, electrical, magnetic, gravitational, spring and shaft work. Zeroth law of thermodynamics: Concept of Temperature and its' measurement, Temperature scales.	8
II	First law of thermodynamics First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume. Limitations of first law of thermodynamics, PMM-I. Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. Analysis of unsteady process such as filling and evacuation of vessels.	10
III	Second Law of Thermodynamics Thermal reservoirs, Energy conversion, Heat engines, Efficiency, reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics, Equivalence of the two statements. Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, Thermodynamic Temperature Scale, PMM-II. Entropy: Clausius inequality, Concept of Entropy, Entropy changes of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics	10
IV	Available and unavailable energy Available and unavailable energy, Helmholtz & Gibb's function, Dead state, Exergy of heat input in a cycle, exergy of a finite body, Quality of energy, Law of degradation of energy, exergy of a closed system, exergy of a steady flow system, Gouy-Stodola theorem, Second law efficiency Thermodynamic Relations: Conditions for exact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility.	8

V	Properties of pure substance Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Sub-cooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T, P-V and P-h diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Moller chart, Dryness factor and its measurement, processes involving steam in closed and open systems.	8
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Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	To learn about work and heat interactions, and balance of energy between system and its surroundings.
CO2	Apply the first law of thermodynamics for steady and unsteady flow processes.
CO3	Analysis of thermal system using second law of thermodynamics and entropy principle.
CO4	Understand the concept of exergy and the thermodynamic relations
CO5	To evaluate the changes in properties of substance in various thermodynamic process.

Reference Books:

1. Basic and Applied Thermodynamics by PK Nag, MCGRAW HILL INDIA.
2. Thermodynamics for Engineers by Kroos & Potter, Cengage Learning.
3. Thermodynamics by Shavit and Gutfinger, CRC Press.
4. Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL INDIA.
5. Basic Engineering Thermodynamics, Joel, Pearson.
6. Fundamentals of Engineering Thermodynamics by Rathakrishnan, PHI.
7. Engineering Thermodynamics by Dhar, Elsevier.
8. Engineering Thermodynamics by Onkar Singh, New Age International.
9. Engineering Thermodynamics by CP Arora.
10. Engineering Thermodynamics by Rogers, Pearson.
11. Fundamentals of Engineering Thermodynamics by Moran, Shapiro, Boettner, & Bailey, John Wiley.
12. Engineering Thermodynamics by Mishra, Cengage Learning.
13. Refrigeration and Air Conditioning by C P Arora, MCGRAW HILL INDIA.

IME 302	FLUID MECHANICS	3L:1T:0P	4 Credit
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Unit	Topics	No. of Hours
I	Basic Concepts and Properties of Fluids: Fluid properties, viscosity, types of fluids, surface tension, capillarity, compressibility and bulk modulus, vapour pressure, cavitation. Pressure and Fluid Statics: Pressure and pressure gradient, pressure force on a fluid element, pressure measurement, hydrostatic forces on plane and curved surfaces, buoyancy and stability.	8
II	Fluid Kinematics: Lagrangian and Eulerian description of a fluid flow, acceleration and substantial derivative, steady and unsteady, uniform, and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two- and three-dimensional flows, streamlines, continuity equation, circulation, stream function and velocity potential.	8
III	Fluid Dynamics: Equations of motion, Bernoulli's equation, and its applications - Venturi meter, Orifice meter, Pitot tube, kinetic energy and momentum correction factors, impulse-momentum equation, forces on a pipe bend, flow over notches and weirs. Dimensional Analysis: Dimensions and units, dimensional homogeneity, Buckingham's Pi theorem, important dimensionless numbers, and their significance.	9
IV	Viscous Flow: Reynolds experiments, equation of motion for laminar flow in circular pipes, laminar flow between two parallel plates, power absorbed in bearings, measurement of viscosity. Turbulent Flow: Turbulent flow in pipes, Darcy-Weisbach equation, characteristics of turbulent flow, shear stresses in turbulent flow, velocity distribution equation, hydrodynamically smooth and rough boundaries. Flow through Pipes: Energy losses, hydraulic gradient and total energy line, pipe in series and parallel, siphon, power transmission through a pipe, flow through nozzles, water hammer.	9
V	Boundary Layer Theory: Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sublayer, separation and its control. Drag and Lift on Submerged Body: Drag and lift, Stoke's law, terminal velocity, drag on cylinder, circulation and lift on an Airfoil. Introduction to Computational Fluid Dynamics (CFD): Equation of motion, solution procedure, grid generation and grid independency, boundary conditions, steps involved in a typical CFD analysis. Engineering software packages: CFD software, Engineering Equation Solver (EES).	10

Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	Get knowledge about fluid flow properties and analyze hydrostatic forces on different surfaces, buoyancy, stability of submerged and floating body.
CO2	Understand various type of fluid flow and apply the conservation equation for the flow regimes of practical interest.
CO3	Explain various applications of Bernoulli's equations, notches and weirs and apply dimensional analysis for practical prototyping.
CO4	Examine energy losses in pipe flow problems and evaluate velocity distribution and pressure drop in Laminar and Turbulent flow.
CO5	Analyze engineering problem involving fluid flow using Computational Fluid Dynamics.

Reference Books:

1. F. M. White, Fluid Mechanics, 6th Ed., Tata McGraw-Hill, 2008.
2. Fluid Mechanics by Yunus A. Cengel, John M. Cimbala.
3. Introduction to fluid mechanics and Fluid machines by S.K Som, Gautam Biswas, S Chakraborty.
4. Fluid mechanics and machines by R.K. Bansal.
5. Fluid Mechanics and Hydraulic machines by R. K. Rajpoot.
6. Fluid Mechanics & Hydraulic Machines by Mahesh Kumar.

IME 303	MATERIALS ENGINEERING	3L:1T:0P	4 Credit
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Unit	Topics	No. of Hours
I	Crystal Structure: Unit cells, Metallic crystal structures. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. Methods of determining various mechanical properties-Tensile test, Impact test, hardness test, fatigue test and creep test, types of fracture.	8
II	Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-carbon phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.	9
III	TTT diagram and various heat treatment processes of steel: Annealing, tempering, normalizing and spheroidising, Austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening. Isothermal transformation diagrams for Fe-C alloys and microstructural development, Continuous cooling curves	9
IV	Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminum and Al-Cu – Mg alloys- Nickel based super alloys and Titanium alloys.	8
V	Mechanical properties and application of ceramics, Structure and mechanical properties of polymers, concept of crystallinity and glass transition temperature, Introduction to composites, types and fabrication methods of composites, Smart materials and their applications, Different characterization techniques: SEM, EDS, FTIR and XRD.	9

Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	Analysis of crystal structure and defects of the materials. Apply various methods for determining mechanical properties of materials.
CO2	Understand various phase diagrams to analyze the microstructural evolution of materials.
CO3	Apply heat treatment process to achieve desired set of mechanical properties
CO4	To understand the applications of different ferrous and non-ferrous alloy.
CO5	Select various non-metallic materials like ceramics, polymers, and their intended applications.

Reference Books:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering", Prentice Hall of India Private Limited, 1999.
4. Mechanics of materials by James M. Gere.
5. Introduction to engineering materials by B.K. Agarwal.
6. Physical metallurgy and advanced materials by R.E. Smallman.
7. Engineering mechanics of composite materials by Isaac M. Daniel.
8. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011

IME 351	FLUID MECHANICS LAB	0L:0T:2P	1 Credit
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S. No.	List of Experiments: (At least 8 of the following)
1	To determine the coefficient of impact for vanes.
2	To determine coefficient of discharge of an orifice meter.
3	To determine the coefficient of discharge of Notch (V and Rectangular types).
4	To determine the friction factor for the pipes. machines.
5	To determine the coefficient of discharge of venturi meter.
6	To determine the coefficient of discharge, contraction & velocity of an orifice
7	To verify the Bernoulli's Theorem.
8	To find critical Reynolds number for a pipe flow.
9	To determine the minor losses due to sudden enlargement, sudden contraction and bends.
10	To show the velocity and pressure variation with radius in a forced vortex flow.
11	To show the velocity and pressure variation with radius in a forced vortex flow.

Course Outcomes:

At the end of this course, the students will be able to:

COs	COs Statement
CO1	To know about the measurement of the fluid properties.
CO2	To understand the principles and performance characteristics of different flow
CO3	To understand the coefficient of discharge for various devices
CO4	To evaluate different dimensionless number
CO5	Applications of fluid statics

IME 352	MATERIAL TESTING LAB	0L:0T:2P	1 Credit
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S. No.	List of Experiments: (At least 8 of the following)
1	Strength test of a given mild steel specimen on UTM with full details and stress versus strain plot on the machine.
2	Other tests such as shear, bend tests on UTM
3	Impact test on impact testing machine like Charpy, Izod or bot
4	Hardness test of given specimen using Rockwell and Vickers/Brinell testing machines.
5	Spring index test on spring testing machine.
6	Fatigue test on fatigue testing machine.
7	Creep test on creep testing machine.
8	Experiment on deflection of beam, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam.
9	Torsion test of a rod using torsion testing machine.
10	Study of NDT (non-destructive testing) methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.

Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	To understand the principles and performance characteristics different materials
CO2	To understand about different mechanical properties
CO3	To understand about deflection of different beams
CO4	To understand about fatigue and creep properties of different materials
CO5	To study about different NDT test methods

IME 353	MACHINE DRAWING LAB	0L:0T:2P	1 Credit
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S. No	Topics
I	Introduction (1 drawing sheets) Introduction, classification of machine drawings, principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioning types, lines and rules of dimensioning. Orthographic Projections (3 drawing sheets) Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing line problems, principle of visualization of objects, sectional views, full and half sectional views, auxiliary views.
II	Fasteners (2 drawing sheets) Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints.
III	Riveted joints (1 drawing sheet) Introduction, rivets and riveting, types of rivets, types of riveted joints, drawing of boiler joints etc. Free hand sketching (1 drawing sheet) Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc
IV	Assembly drawing (2 drawing sheets) Introduction to assembly drawing, drawing assembly drawing of simple machine elements like rigid or flexible coupling, muff coupling, Plummer block, footstep bearing, bracket etc.
V	Computer aided drafting (1 drawing) Introduction to computer aided drafting; advantages and applications of CAD, concepts of computer aided 2D drafting using any drafting software like AutoCAD, Solid Edge, Draft Sight etc., basic draw and modify commands, making 2D drawings of simple machine parts.

Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	To understand and draw Orthographic Projections
CO2	To study about different fasteners
CO3	To understand Riveted joints
CO4	To provide an overview of how computers can be utilized in mechanical component design.
CO5	To understand CAD software for modelling Mechanical components.

Reference Books:

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1. Fundamentals of Machine Drawing by Sadhu Singh & Shah, PHI.
 2. Engineering Drawing by Bhat, & Panchal, Charotar Publishing House.
 3. Machine Drawing with AutoCAD by Pohit and Ghosh, Pearson.
 4. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age.
 5. Machine Drawing, N. Siddeshwar, P Kannaiah, VVS Shastry, Tata McGraw Hill.
 6. Engineering Drawing, Pathak, Wiley.
 7. Textbook of Machine Drawing, K C John, PHI.
 8. AutoCAD 2014 for Engineers & Designers, Bhatt, WILEY

IME 401	APPLIED THERMODYNAMICS	3L:1T:0P	4 Credit
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Unit	Topics	No. of Hours
I	Review of laws of thermodynamics, Combustion analysis, Stoichiometry, heating values, air requirement, Air/Fuel ratio, first law analysis of combustion reactions- Heat calculations using enthalpy tables, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature, Introduction to Otto, Diesel and Dual cycles.	8
II	Properties of steam, Steam table and mollier chart, Carnot vapour cycle, simple Rankine cycle, effect of pressure and temperature on Rankine cycle, modified Rankine cycle, reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, ideal working fluid for Rankine cycle, Combined cycles, Cogeneration, problem solving.	9
III	Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre-heater, feed water heater, super heater, Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance. Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Effect of friction on nozzle, Super saturated flow.	8
IV	Steam Turbines: Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Condenser: Classification of condenser, air leakage, condenser performance parameters.	9
V	Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles. Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine. Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.	10

Course Outcomes:

At the end of this course, the students will be able to:

COs	Statement
CO1	Carry out calculations related to Air standard cycles, calculation related to combustion of fuels, apply first law analysis to combustion, explain the standard heat of reaction, formation. Adiabatic flame temperature.
CO2	Analyze Vapour Power cycles, explain the performance improvement of vapour power cycle, explain the concept of combined cycle and cogeneration.
CO3	Classify Boiler, explain working of boilers and its components, carry out calculations related to boiler performance and draught. explain construction and working of nozzles and related calculations.
CO4	Compare steam turbines, explain the working of steam turbines and condenser, understand losses in steam turbine, able to do calculations related to steam turbine
CO5	Explain the working of gas turbine and jet propulsion, analyze the Brayton cycles and its performance improvement, analyze reciprocating compressors.

Reference Books:

1. Basic and Applied Thermodynamics by P.K. Nag, McGraw hill India.
2. Applied thermodynamics by Onkar Singh, New Age International.
3. Applied Thermodynamics By D S Kumar, S.K. Kataria & sons
4. Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education.
5. Applied Thermodynamics by Venkanna and Swati, PHI.
6. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
7. Thermodynamics: An Engineering Approach, Yunus A Cengel, Michael A Bose, McGraw Hill
7. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
8. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
9. Theory of Stream Turbine by WJ Kearton.

IME 402	MECHANICS OF MATERIALS	3L:1T:0P	4 Credit
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Unit	Topics	No. of Hours
I	Introduction: Review of two-dimensional force systems, free body diagram, equilibrium of force systems, laws of friction, equilibrium analysis of simple systems involving friction. Trusses: Introduction, simple truss and solution of a simple truss, methods of joints, methods of sections. Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.	8
II	Centroid and moment of inertia: Centroid of plane, curve, area, volume and composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, concept and importance of principal moment of inertia. Compound stress and strains: Introduction, normal stress and strain, shear stress and strain, stress on inclines sections, state of plane stress, principal stress and strain, maximum shear stress, Mohr's circle for plane stress, theories of failure, strain energy, impact loads and stresses, thermal Stresses, introduction to three-dimensional stresses.	8
III	Stresses in Beams: Pure Bending, normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams. Deflection of Beams: Differential equation of the elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams. Torsion: Torsion, combined bending and torsion of solid and hollow shafts, torsion of thin-walled tubes.	9
IV	Helical and Leaf Springs: Deflection of springs, helical springs under axial load and under axial twist (for circular cross sections), axial load and twisting moment acting simultaneously both for open and closed coiled springs, concept of laminated springs. Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin-ended columns, effect of end conditions on column buckling, Ranking Gordon formulae.	9

V	Thin cylinders & spheres: Introduction, difference between thin-walled and thick-walled pressure vessels, thin-walled spheres and cylinders, hoop and axial stresses and strain, and volumetric strain. Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shafts and cylinders, stresses due to interference fits.	8
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Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	Understand the force systems and application of force equilibrium to various two-dimensional problems.
CO2	Understand the concept of stress and strain under different loading conditions.
CO3	Determine the principal stresses and strains in structural members
CO4	Understand and determine the stresses, slope, and deflection of the transversely loaded members
CO5	Apply the concepts of stresses and strain in solving problems related to springs, buckling of columns and thin and thick cylinders.

Reference Books:

1. Bansal, A Textbook of Engineering Mechanics, Laxmi Publications.
2. Bhavikatti and Rajashekarappa, "Engineering Mechanics", New Age International (P) Limited Publishers.
3. Meriam and Kraige, "Engineering Mechanics- Statics - Volume 1, 3ed., John Wiley & Sons.
4. Gupta S C, Strength of Materials, Pearson Education
5. Jindal, Strength of Materials, Pearson Education
6. Hibbeler, Mechanics of Materials, Pearson education.
7. Gere, Mechanics of Materials, Cengage learning.
8. Bere, Johnston, Mechanics of Materials, McGraw Hill.
9. Pytel, Mechanics of Materials, Cengage learning

IME 403	MANUFACTURING PROCESSES	3L:1T:0P	4 Credit
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Unit	Topics	No. of Hours
I	Foundry Introduction, patterns; types, allowances, molding materials and its properties, molding methods, core, core print, chills, padding, gating system design, riser design and its calculation, casting defects and their causes with remedies, casting cleaning, types of casting process and its applications, metal casting processes and equipment, special casting processes	8
II	Cutting/machining operation Introduction, single and multi-point cutting tool; cutting tool materials, orthogonal and oblique cutting, chip formation, shear angle and its relevance, tool wear and tool life, Merchant force circle diagram and its analysis, cutting fluids, economics of machining Lathe and its types, construction feature of center lathe, operation performed in center lathe; turning, facing, knurling, drilling, boring, parting, Turning, Drilling, Milling, Shaper and Planar	10
III	Metal forming processes Introduction to metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes, rolling, forging, extrusion, wire drawing, swaging, tube making, load estimation for bulk forming Sheet metal operation: press tool operation, shearing operation, punching, blanking, deep drawing, bending, spinning, stretch forming, embossing and coining	8
IV	Joining Process Physics of welding and allied processes. Types of welding, weld joint, Gas welding and cutting, process and equipment. Arc welding: Power sources and electrodes. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Weld decay in HAZ. Advanced welding process: Explosive welding, submerged arc, electroslog, friction welding. Soldering & Brazing. Adhesive bonding, laser beam welding, electron beam welding	9
V	Grinding and other finishing operation Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification, Dressing and Truing, grinding wheel wear, type of grinding machines, grinding process parameters, Surface and cylindrical grinding. Centerless grinding. Honing, lapping, buffing, polishing and super finishing operation	8

Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	Apply the various casting processes in manufacturing to develop a product
CO2	Understand the basics of metal cutting and working of different types of machine tools.
CO3	Apply the various metal forming processes in manufacturing to develop a product
CO4	Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application.
CO5	To understand the different finishing operations.

Reference Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and systems.
3. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.
4. Materials and Manufacturing by Paul Degarmo.
5. Manufacturing Processes by Kaushish, PHI.
6. Principles of Foundry Technology, Jain, MCGRAW HILL INDIA
7. Production Technology by RK Jain.
8. Degarmo, Black & Kohser, Materials and Processes in Manufacturing.

IME 451	APPLIED THERMODYNAMICS LAB	0L:0T:2P	1 Credit
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S. No.	List of Experiments: (At least 8 of the following)
1	Study of Fire Tube boiler.
2	Study of Water Tube boiler.
3	Study and working of Two stroke petrol Engine.
4	Study and working of Four stroke petrol Engine.
5	Determination of Indicated H.P. of I.C. Engine by Morse Test.
6	Prepare the heat balance sheet for Diesel Engine test rig.
7	Prepare the heat balance sheet for Petrol Engine test rig.
8	Study and working of two stroke Diesel Engine.
9	Study and working of four stroke Diesel Engine.
10	Study of Velocity compounded steam turbine.
11	Study of Pressure compounded steam turbine.
12	Study of Impulse & Reaction turbine.
13	Study of steam Engine model.

Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	To understand the working principle of boiler, draught, steam nozzle and reciprocating air compressor.
CO2	To understand the working principles of two stroke and four stroke Petrol engines
CO3	To understand the working principles of two stroke and four stroke Diesel engines
CO4	To understand the working principles of gas turbine
CO5	To understand the working principles of steam turbine

IME 452	MANUFACTURING PROCESS LAB	0L:0T:2P	1 Credit
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S. No.	List of Experiments: (At least 8 of the following)
1	Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2	Bolt (thread) making on Lathe machine.
3	Tool grinding (to provide tool angles) on tool-grinder machine.
4	Gear cutting on Milling machine.
5	Machining a block on shaper machine.
6	Finishing of a surface on surface-grinding machine.
7	Drilling holes on drilling machine and study of twist-drill.
8	Study of different types of tools and its angles & materials.
9	Experiment on tool wear and tool life.
10	Experiment on jigs/Fixtures and its uses.
11	Gas welding experiment.
12	Arc welding experiment.
13	Resistance welding experiment.
14	Soldering & Brazing experiment.
15	Perform different operations on metal components using CNC machines

Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	To understand and apply the principles and science of various basic manufacturing processes
CO2	Acquire knowledge about the various tools, equipment, and machinery
CO3	Understand the application, advantages and limitations of various welding processes
CO4	To perform various machining operation in different machines
CO5	Study of different measurement devices

IME 453	COMPUTER AIDED MACHINE DRAWING LAB	0L:0T:2P	1 Credit
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S. No	Topics
I	Conventional representation of machine components and materials, Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints. Classification of Drawings: Machine drawings, Production drawing, part drawing and assembly drawing. Introduction to detail drawing and bill of materials (BOM).
II	Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, commonly used holes and shafts. List of Standard Abbreviation used.
III	Part Modelling: Introduction to part modelling of simple machine components using any 3D software (like CATIA, PRO E, UGNX, Autodesk Inventor or SOLIDWORKS) covering all commands/ features to develop a part model (<i>Minimum 24 machine components need to be developed</i>).
IV	Part Modelling & Assemblies of: Plummer Block Bearing, Machine Vice, Screw Jack, Engine Stuffing box, Lathe Tailstock, Feed Check Valve and Rams Bottom Safety Valve.

Note: All drawing conforms to BIS Codes.

Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	Understand various principles of drawing
CO2	Design various types of fasteners and joints
CO3	Design of riveted joints and need for free hand sketching
CO4	Understand assembly drawing of simple machine elements
CO5	Use computer and CAD software for modelling mechanical components.

Reference Books:

1. Textbook of Machine Drawing, K C John, PHI.
2. Machine Drawing by K.R. Gopalakrishna, Subhas Stores.
3. A Textbook of Machine Drawing by PS Gill from S.K. Kataria & Sons.
4. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age publications.
5. Engineering Graphics with AutoCAD, Bethune, PHI.
6. Machine Drawing, N. Siddeshwar, P Kannaiah, VVS Shastry, Tata McGraw Hill.
7. Fundamentals of Machine Drawing, Dr Sadhu Singh & P L Shah, Prantice Hall India.
8. Autodesk Inventor by Examples, Sam Tikoo, Wiley.

IME 455	Measurement & Metrology Lab	0L:0T:2P	1 Credits
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List of Experiments

Minimum 08 experiments out of following (or such experiment) are to be performed:

1. Measurement of effective diameter of a screw thread using 3 wire method.
2. Measurement of angle using sine bar & slip gauges.
3. Study of limit gauges.
4. Study & angular measurement using Bevel protector.
5. Study of different types of Comparators.
6. Study of important parameters of surface finish.
7. Study of principle and operation of coordinate-measuring machine (CMM).
8. Use of dial indicator and V Block to check the circularity and plot the polar Graph.
9. Study and understanding of limits, fits & tolerances in assembly of machine components.
10. Study and understanding of different methods of measurement of pressure.
11. Study and understanding of different methods of measurement of temperature.
12. Study and understanding of measurement of strain using strain gauges.
13. Study and understanding of measurement of displacement using LVDT

Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	Understand the basic principles of instrumentation for measurement of surface finish, strain, temperature, pressure and flow.
CO2	Understand the principle and operation of Coordinate Measuring Machine (CMM).
CO3	Apply Sine Bar, Slip Gauges, Bevel Protractor, Stroboscope, Dial Indicator etc. for measurement of different attributes.
CO4	Apply the basic concepts of limits, fits & tolerances for selective assembly.
CO5	Understand the principle of Strain gauges and LVDT

**Inter departmental course offered for B.Tech. 2nd year from
Mechanical Engineering Department**

S. No.	Subject Codes	Subject	Evaluation Scheme						End Semester			Total	Credit
			L	T	P	CT	TA	Total	P S	TE	PE		
1	IOE032/ IOE042	Engineering Mechanics	3	1	0	20	10	30	-	70	-	100	4
2	IOE033/ IOE043	Material Science	3	1	0	20	10	30	-	70	-	100	4

IOE 032/042	ENGINEERING MECHANICS	3L:1T:0P	4 Credit
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Unit	Topics	No. of Hours
I	Two-dimensional force systems: Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, distribution of force systems, free body diagrams, equilibrium and equations of equilibrium. Friction: Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction.	8
II	Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams. Trusses: Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections.	10
III	Centroid and moment of inertia: Centroid of plane, curve, area, volume and composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principle moment of inertia, mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.	7
IV	Kinematics of rigid body: Introduction, plane motion of rigid body, velocity and acceleration under translational and rotational motion, relative velocity. Kinetics of rigid body: Introduction, force, mass and acceleration, work and energy, impulse and momentum, D'Alembert's principle and dynamic equilibrium.	8
V	Simple stress and strain: Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy. Pure bending of beams: Introduction, simple bending theory, stress in beams of different cross sections. Torsion: Introduction, torsion of shafts of circular cross sections, torque and twist, shear stress due to torque.	10

Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.
CO2	Analysis of forces on beams and trusses
CO3	To evaluate centroid for different geometries
CO4	To implement the concept of Kinematics and Kinetics of rigid body
CO5	To understand about stress and strain

Reference Books:

1. Beer, F.P and Johnston Jr. E.R., “Vector Mechanics for Engineers (In SI Units): Statics and Dynamics”, 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, “Engineering Mechanics”, Oxford University Press (2010).
3. A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications.
4. Engineering Mechanics, R.S. Khurmi, S.Chand Publishing.
5. Meriam J.L. and Kraige L.G., “Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2” Third Edition, John Wiley & Sons (1993).
6. Rajasekaran S and Sankarasubramanian G., “Engineering Mechanics Statics and Dynamics”, 3rd Edition, Vikas Publishing House Pvt. Ltd., (2005).
7. Bhavikatti, S.S and Rajashekarappa, K.G., “Engineering Mechanics”, New Age International (P) Limited Publishers, (1998).
8. Engineering mechanics by Irving H. Shames, Prentice-Hall.

IOE 033/043	MATERIALS SCIENCE	3L:1T:0P	3 Credit
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Unit	Topics	No. of Hours
I	Phase Diagrams: Solid solutions – Hume Rothery’s rules – the phase rule – single component system – one-component system of iron – binary phase diagrams – isomorphous systems – the tie-line rule – the lever rule – application to isomorphous system – eutectic phase diagram – peritectic phase diagram – other invariant reactions – free energy composition curves for binary systems – microstructural change during cooling.	8
II	Ferrous Alloys: The iron-carbon equilibrium diagram – phases, invariant reactions – microstructure of slowly cooled steels – eutectoid steel, hypo and hypereutectoid steels – effect of alloying elements on the Fe-C system – diffusion in solids – Fick’s laws – phase transformations – T-T-T-diagram for eutectoid steel – pearlitic, bainitic and martensitic transformations – tempering of martensite – steels – stainless steels – cast irons.	10
III	Mechanical Properties: Tensile test – plastic deformation mechanisms – slip and twinning – role of dislocations in slip – strengthening methods – strain hardening – refinement of the grain size – solid solution strengthening – precipitation hardening – creep resistance – creep curves – mechanisms of creep – creep-resistant materials – fracture – the Griffith criterion – critical stress intensity factor and its determination – fatigue failure – fatigue tests – methods of increasing fatigue life – hardness – Rockwell and Brinell hardness – Knoop and Vickers microhardness.	7
IV	Magnetic, Dielectric & Superconducting Materials: Ferromagnetism – domain theory – types of energy – hysteresis – hard and soft magnetic materials – ferrites – dielectric materials – types of polarization – Langevin-Debye equation – frequency effects on polarization – dielectric breakdown – insulating materials – Ferroelectric materials – superconducting materials and their properties.	8
V	New Materials: Ceramics – types and applications – composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics – metallic glasses: types, glass forming ability of alloys, melt spinning process, applications – shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, applications – nanomaterials: preparation (bottom up and top-down approaches), properties and applications – carbon nanotubes: types.	10

Course Outcomes:

At the end of this course, the students will be able to:

COs	Statements
CO1	To understand phase diagrams and explain the phenomenon of microstructure development.
CO2	To understand different ferrous alloy and its microstructure.
CO3	To understand in detail about various mechanical properties.
CO4	To study about different Magnetic, Dielectric & Superconducting Materials.
CO5	Study about composites and its different types.

Reference Books:

1. Balasubramanian, R. —Callister's Materials Science and Engineering. Wiley India Pvt. Ltd., 2014.
2. Raghavan, V. —Physical Metallurgy: Principles and Practice. PHI Learning, 2015.
3. Raghavan, V. —Materials Science and Engineering: A First course. PHI Learning, 2015.
4. Askeland, D. —Materials Science and Engineering. Brooks/Cole, 2010.
5. Smith, W.F., Hashemi, J. & Prakash, R. —Materials Science and Engineering. Tata McGraw Hill Education Pvt. Ltd., 2014.
6. Wahab, M.A. —Solid State Physics: Structure and Properties of Materials. Narosa Publishing House, 2009.