Engineering Visualization

1. Course Details

1.1 Course Code: ME121

1.2 Contact Hours: 0-1-3; Credits: 05

1.3 Semester offered: 1st Year - Even

1.4 Prerequisite: Basic knowledge of geometry, drawing instruments, visualization skills, and spatial understanding from secondary school mathematics and physics.

1.5 Syllabus Committee Members: Dr. Tushar Sharma and Dr. Naveen Mani Tripathi

2. Objective of the Course: The course objective is to introduce students to method of visualizing engineering objects and simple assemblies. It imparts fundamental skills in technical drawing, including orthographic and isometric projections, sectioning, dimensioning, and CAD tools, enabling students to communicate engineering designs accurately and effectively in accordance with industry standards.

3. Course Content

Week	Topic	Lecture Sub-Topics	Lab Practice
1	Introduction & graphical representation	Role of Engineering Graphics/Visualization in CSE, CSD, IT, and M&C departments, product development, types of drawings, drawing standards ISO and BIS, drawing instruments and sheet layout, Types of lines (thick/thin, centre, hidden, section), lettering types and sizes	**Drawing Sheet (3 hrs):** Types of lines, lettering, dimensioning styles, Title block, - Construction of plain, diagonal
2		BIS dimensioning rules, scale types (Representative Fraction, plain, diagonal), Application of scales to real-world dimensions, Basic dimensioning rules (Scale up & scale down)	**AutoCAD (3 hrs):** AutoCAD UI, workspace, command line- Basic draw commands: line, circle, arc, rectangle- using units, limits, grid, dimensioning

3	Projection basics & orthographic projections	First vs third angle projection, quadrants, reference planes (HP, VP), concept of projectors	**Drawing Sheet (3 hrs):** First angle and third angle projections- Projection of points in all four quadrants- Projection of lines (inclined to one plane), Orthographic projection of simple solids (cube, prism, cylinder), Identifying views and hidden lines
4		Need for multiple views, view selection, front/top/side definitions	**AutoCAD (3 hrs):** Drawing reference planes- Projecting points/lines using construction lines- Using text and symbols for plane labels, Draw front/top/side views from 3D objects, Use of hidden lines, centrelines, layers, Template setup for orthographic sheets
5	Auxiliary and sectional projections & isometric projections	Why and when to use section views, cutting plane concept, types of sections (full/half), auxiliary view for inclined surfaces	**Drawing Sheet (3 hrs):** Full, half, and offset sections- Auxiliary projections of inclined surfaces- Hatching and conventions
6		Difference between pictorial and orthographic, isometric axis, foreshortening, isometric scale, representing circles	**AutoCAD (3 hrs):** HATCH, SECTIONPLANE, XLINE usage, Creation of auxiliary views, Section views from 3D models
7	Working drawings & layout	What makes a drawing manufacturable: title block, notes, fits/tolerances, surface finish, part numbering	**Drawing Sheet (3 hrs):** Creating manufacturing drawings- Adding tolerances, notes, material specs- Standard parts and conventions, Revision of previous CAD tools, Use of Modify tools: TRIM, EXTEND, FILLET, CHAMFER, Blocks and attributes
8		Coordinate systems (absolute, relative, polar), layers, snapping, blocks, layout plotting	**AutoCAD (3 hrs):** TOLERANCE symbol insertion, TEXT, MTEXT, BOM table creation, border & title block in layout, templates, printing layout, Working drawing plotting
9	Part modelling 1 & 2 (Solid modelling fundamentals, feature-based modelling and design intent)	Sketch-based modelling, base feature logic, CAD modelling history, parametric design	**Drawing Sheet (3 hrs):** Sketch 2D profiles for 3D solids- Manual exploded views (if needed)- Plan for simple 3D objects, Create drawings of parts with features- Show sectional and auxiliary views from 3D shape
10		Fillet, hole, shell, chamfer features, parent-child relationships, editing features, design intent and constraints	**AutoCAD (3 hrs):** 3D workspace introduction: EXTRUDE, PRESSPULL, REVOLVE- UCS control, 3DORBIT, VIEWCUBE-

			Creating solid features
11	Assembly (Assembly theory and visualization & design thinking & engineering communication)	Assembly constraints, exploded views, degrees of freedom, interferences, fits (clearance, transition, interference)	**Drawing Sheet (3 hrs):** Exploded view (manual), part numbering, fit indication- Basic tolerance and clearance understanding and Students create a complete drawing set manually, Covering orthographic, isometric, sectional, assembly views
12		Interpreting design briefs, visual drawings, standards, CAD documentation	**AutoCAD (3 hrs):** INSERT, CONSTRAINTS, MOVE, ROTATE in assembly- Assembly views and exploded view from parts, Annotation for parts list, Digital version of design project- Includes drawing sheet, title block, 2D & 3D views, Printing & submission
13	Computational engineering visualization & 3D modelling applications	Extend engineering graphics knowledge to computational tools and concepts used in programming, simulation, UI/UX, game development, and 3D modelling.	Programming based visualization concepts, real world applications in CSE (Gaming, AR/VR & game development), 3D web visualization and simulation tools
14	**Design Project**		

4. Readings

Textbooks & Reference Books:

1. Engineering Drawing, N.D. Bhatt

2. A Textbook of Machine Drawing by P.S. Gill

3. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics by Warren Luzadder & Jon Duff

4. A First Year Engineering Drawing by AC Parkinson

5. AutoCAD for Practical Purposes

6. Engineering Graphics with AutoCAD: SC Sharma and Naveen Kumar

5. Course Outcome:

- The student will be capable to produce geometric construction, dimensioning and curves and detail drawings.
- Compile projections of points, lines, planes and solids will improvise the student visualization skills.
- Understand and visualize the 3D view of engineering objects, elaborate the conversions of 2D to 3D and vice versa.
- The students will be familiarizing with basic computer aided design skills in graphical communication.

Fluid Machinery

2. Course Details

1.1 Course Code: ME211

1.2 Contact Hours: 3-0-0; Credits: 09

1.3 Semester offered: 2nd Year - Odd

1.4 Prerequisite: Basic knowledge of fluid mechanics, physics, thermodynamics, and engineering mathematics with problem-solving skills.

1.5 Syllabus Committee Members: Dr. Tushar Sharma, Dr. Sidharth Gautam, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas

2. Objective of the Course: The course aims to provide a comprehensive understanding of the principles, construction, and operation of various fluid machines such as pumps, turbines, etc. It equips students with analytical and practical skills to evaluate the performance, efficiency, and application of fluid machinery in mechanical and industrial systems.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	Understand the application of mass and momentum conservation laws for fluid flows.	Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Incompressible flow, Bernoulli's equation and its applications - Pitot tube, orifice meter, and venturi meter.	8
II	Understand the importance of	Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows,	8

	dimensional analysis	rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, subcritical, critical and supercritical flows, one, two- and three-dimensional flows, streamlines, continuity equation for 3D and 1D flows.	
III	Evaluate the velocity and pressure variations in various types of simple flows.	Equation of motion for laminar flow through pipes resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer. 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.	8
IV	Mathematically analyse the flow in water pumps and turbines	Introduction to hydrodynamic thrust of jet on a fixed and moving surface, Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel. Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency Selection of water turbines	8
V	Understand about the functioning of centrifugal and reciprocating pumps	Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Cavitation & separation, reciprocating pump theory, Slip, Indicator diagram, Effect of acceleration, air vessels, Comparison of centrifugal and reciprocating pumps.	8
Total			40

4. Readings

Textbooks & Reference Books:

1. Introduction to fluid mechanics and Fluid machines by S.K Som, Gautam Biswas, S Chakraborty.
2. Fluid mechanics and machines by R.K Bansal.
3. F. M. White, Fluid Mechanics, 6th Ed., Tata McGraw-Hill, 2008.
4. Fluid Mechanics and Its Applications by V.K. Gupta et.al.
5. Fluid Mechanics by Yunus Cengel.
6. Batchelor, G. K. (1999). Introduction to fluid dynamics. New Delhi, India: Cambridge University Press.
7. Acheson, D. J. (1990). Elementary fluid dynamics. New York, USA: Oxford University Press.
8. R.W. Fox, A.T. McDonald and P.J. Pritchard, Introduction to Fluid Mechanics, 6th Ed., John Wiley, 2004.
9. Fluid Mechanics and Hydraulic Machines, 5/ed by Mahesh Kumar, Pearson Education
10. Fluid Mechanics, 2e in SI Units, by R.C Hibbeler, Pearson Education

5. Course Outcome:

- Understand the working principles and classifications of various fluid machines.
- Analyze the performance characteristics and efficiency of hydraulic machines.
- Evaluate the suitability of fluid machines for specific industrial and engineering applications.
- Understand the governing mechanisms and control systems of hydraulic machines.
- Design and select appropriate fluid machinery based on system requirements and performance criteria.

Engineering Mechanics

1. Course Details

1.1 Course Code: ME212

1.2 Contact Hours: 3-0-0; Credits: 09

1.3 Semester offered: 2nd Year - Odd

1.4 Prerequisite: Basic Physics, Mathematics, and problem-solving skills with understanding of forces and motion.

1.5 Syllabus Committee Members: Dr. Tushar Sharma, Dr. Sidharth Gautam, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas

2. Objective of the Course: The objective of this course is to develop a clear understanding of the principles of statics and dynamics, enabling students to analyse forces, moments, and motion in mechanical systems. It builds foundational skills essential for solving real-world engineering problems involving structures, machines, and mechanical components.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	Introduction To Engineering Mechanics	Force Systems, Basic concepts, Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant Moment of Forces and its Applications; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems. Friction: Types of friction, Limiting friction, Laws of Friction, Static & Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.	10

II	Centroid and Centre of Gravity	Centroid and Centre of Gravity, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.	10
III	Basic Structural Analysis	Basic Structural Analysis, Equilibrium in three dimensions; Analysis of simple trusses by method of sections & method of joints, zero force members, Simple beams, and support reactions Review of particle dynamics- rectilinear motion, Plane curvilinear motion (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact Direct and oblique).	10
IV	Kinetics Of Rigid Bodies	Introduction to Kinetics of Rigid Bodies, Types of Rigid Body Motion, Kinetic Energy of Translating and Rotating Bodies, Work-Energy Principle for Rigid Body Motion, Power and Mechanical Efficiency in Rotational Systems	10
Total			40

4. Readings

Textbooks & Reference Books:

1. Basic Mechanical Engineering, G Shanmugam, S Ravindran, McGraw Hill
2. Basic Mechanical Engineering, M P Poonia and S C Sharma, Khanna Publishers
3. H. Shames, Engineering Mechanics: Statics and dynamics, 4th Ed, PHI, 2002.

4. F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, 9th Ed, Tata McGraw Hill, 2011.
5. J. L. Meriam and L. G. Kraige, Engineering Mechanics, Vol I – Statics, Vol II – Dynamics, 6th Ed, John Wiley, 2008.
6. R. C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press, 2006.
7. Andy Ruina and Rudra Pratap, Introduction to Statics and Dynamics, Oxford University Press, 2011

5. Course Outcome:

- Analyze force systems and apply equilibrium conditions using free body diagrams for 2D and 3D problems/system.
- Understand and apply laws of friction in mechanical systems like wedges and screw jacks.
- Perform structural analysis of trusses and beams using method of joints and sections.
- Apply principles of kinetics and energy methods to analyze the motion of particles and rigid bodies.
- Construct and interpret free body diagrams for various mechanical systems.

Applied Thermodynamics

2. Course Details

1.1 Course Code: ME213

1.2 Contact Hours: 3-0-0; Credits: 09

1.3 Semester offered: 2nd Year - Odd

1.4 Prerequisite: Basic knowledge of engineering thermodynamics, fluid mechanics, and mathematics with understanding of energy, heat, and work.

1.5 Syllabus Committee Members: Dr. Tushar Sharma, Dr. Sidharth Gautam, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas

2. Objective of the Course: The course aims to provide in-depth knowledge of the practical application of thermodynamic principles in power generation systems. It covers steam properties, boilers, condensers, nozzles, steam and gas turbines, and jet propulsion systems, enabling students to analyze, design, and evaluate thermal devices and cycles used in mechanical and aerospace engineering.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	Properties of steam	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 it's measurement.	10
II	Boilers & Condenser	Boilers: Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre-	10

		heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance. Condenser: Classification of condenser, air leakage, condenser performance parameters.	
III	Steam and Gas Nozzles & Steam Turbines	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, Shock waves stationary normal shock waves, Effect of friction on nozzle, Super saturated flow. 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, Comparison with steam engine.	10
IV	Gas Turbine & Jet Propulsion	Gas Turbine: 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.	10
Total			40

4. Readings

Textbooks & 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 for Engineering Technologists by Eastop, Pearson Education.

4. Applied Thermodynamics by Venkanna and Swati, PHI.

5. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.

6. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India

7. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

8. Theory of Stream Turbine by WJ Kear

9. Thermal Engineering by R.K. Rajput

5. Course Outcome:

- Understand the properties of steam and use steam tables, Mollier charts, and thermodynamic diagrams effectively.
- Evaluate performance parameters of condensers and understand the effects of air leakage.
- Understand the working principles and velocity diagrams of impulse and reaction steam turbines.
- Evaluate gas turbine cycles and enhance performance using intercooling, reheating, and regeneration techniques.
- Explain the principles and working of jet and rocket propulsion systems used in aerospace applications.

Materials Science

1. Course Details

1.1 Course Code: ME214

1.2 Contact Hours: 3-0-0; Credits: 09

1.3 Semester offered: 2nd Year - Odd

1.4 Prerequisite: Basic knowledge of physics, chemistry, mathematics, and engineering fundamentals with interest in material behaviour and properties.

1.5 Syllabus Committee Members: Dr. Tushar Sharma, Dr. Sidharth Gautam, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas

2. Objective of the Course: The course aims to provide fundamental knowledge of the structure, properties, processing, and performance of engineering materials. It enables students to understand the relationship between material behavior and atomic structure, and to select appropriate materials for various mechanical, thermal, and electrical applications in engineering design and manufacturing.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	Introduction	Historical Perspective of Materials, Classification of Materials, Engineering Materials, Advanced Materials and Future Materials like ceramics, polymers, composites etc. Atomic Structure, Bonding and Crystal Structure of Solids: Atomic Structure, Atomic Bonding in Solids, Bravais Lattices, Crystal Structures, Crystalline, Quasi Crystalline and Non-Crystalline Materials, Miller Indices, Miller-Bravais Indices for Planes and Directions of Cubic and	10

		Noncubic Structures, structure of ceramics, polymers, and composites materials.	
II	Diffusion	Diffusion Mechanisms, Steady & Non-steady State Diffusion. Phase Diagrams: Phase Rule, Equilibrium Phase Diagrams, Phase Systems - Isomorphous, Eutectic with No and Limited Solid Solubility and Peritectic, Iron-Carbon Phase Diagram, TTT Diagram. Imperfections in Solids and Strengthening.	10
III	Mechanical Behaviour of Metals and Alloys	Types of Loading, Stress-Strain Curves for Brittle and Ductile Materials, Theoretical and Observed Shear Stress, Critical Resolved Shear Stress, Deformation – Elastic, Anelastic, Plastic and Super Plastic, Yield Criteria, Macroscopic Aspects of Plastic Deformation, Toughness Measurements by – S-S Curve, Impact Testing and Fracture Toughness Testing, material behavior in micro-Nano regime. Types of Mechanical Loading and Failures: Ductile and Brittle Fracture.	10
IV	Properties Alteration of Materials	Alteration of properties by heat treatment, Heat treatment method, Quantification of altered material properties by heat treatments.	10
Total			40

4. Readings

Textbooks:

1. Materials Science, V. Raghavan, PHI Learning Private Ltd., 2010.
2. Materials Science, G.K. Narula, K.S. Narula, V.K. Gupta, Tata McGraw Hill, 2010.

Reference Books:

1. Engineering Materials: Polymers, Ceramics and Composites, A.K. Bhargava, PHI Learning (P) Ltd.
2. Callister's Materials Science and Engineering, W.D.Callister, Jr, R. Balasubramaniam Wiley India, 2010

5. Course Outcome:

- Understand the atomic and crystal structure of materials and their influence on material properties.
- Identify and classify engineering materials based on their mechanical, thermal, electrical, and magnetic properties.
- Analyse phase diagrams and understand phase transformations in materials.
- Understand heat treatment processes and their effects on microstructure and material behavior.
- Evaluate material failure mechanisms such as fatigue, creep, and corrosion.
- Select suitable materials for engineering applications based on performance and environmental considerations.
- Gain basic knowledge of advanced materials like composites, polymers, ceramics, and smart materials.

Theory of Machines

1. Course Details

1.1 Course Code: ME221

1.2 Contact Hours: 3-0-0; Credits: 09

1.3 Semester offered: 2nd Year - Even

1.4 Prerequisite: Basic knowledge of engineering mechanics, physics, mathematics, and fundamentals of kinematics, dynamics, and mechanical systems.

1.5 Syllabus Committee Members: Dr. Tushar Sharma, Dr. Sidharth Gautam, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas, Prof. Amit Ranjan

2. Objective of the Course: The course aims to provide fundamental knowledge of the kinematics and dynamics of machines. It enables students to analyse mechanisms, understand motion transmission, and study the forces acting on machine components, preparing them for the design and analysis of mechanical systems such as gears, cams, flywheels, governors, etc.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	Introduction	Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain. Velocity analysis: Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, instantaneous centre. Acceleration analysis.	9

II	Cams & Gears	Cams: Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration, Gears and gear trains: Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.	9
III	Force analysis	Force analysis: Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link in plane motion, dynamic force analysis of planar mechanisms, piston force and crank effort. Turning moment on crankshaft due to force on piston, Turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi-cylinder engines, Fluctuation of speed, Flywheel.	8
IV	Balancing & Governors	Balancing: Introduction, static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of reciprocating masses, Governors: Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors.	8
V	Brakes & dynamometers	Brakes and dynamometers: Introduction, Law of friction and types of lubrication, types of brakes, effect of braking on rear and front wheels of a four-wheeler, dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic	8

		dynamometer.	
Total			42

4. Readings

Reference/Textbooks book:

1. Kinematics and dynamics of machinery: Wilson and Sadler, Third edition, Pearson.
2. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press.
3. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford University Press.
4. Kinematics and dynamics of machinery: R L Norton, McGraw Hill.
5. Theory of Machines: S.S. Rattan, McGraw Hill 6. Theory of Machines: Thomas Bevan, CBS Publishers.

5. Course Outcome:

- Evaluate velocity and acceleration in planar mechanisms using graphical and analytical methods.
- Analyze various types of gears, gear trains, cams, and followers.
- Study the dynamic forces acting on machine elements and evaluate their effects.
- Understand balancing of rotating and reciprocating masses in machinery.
- Understand the function and operation of governors, flywheels, and their role in speed regulation.

Refrigeration and Air Conditioning

1. Course Details

1.1 Course Code: ME222

1.2 Contact Hours: 3-0-0; Credits: 09

1.3 Semester offered: 2nd Year - Even

1.4 Prerequisite: Basic knowledge of thermodynamics, heat transfer, fluid mechanics, and engineering mathematics with analytical problem-solving skills.

1.5 Syllabus Committee Members: Dr. Tushar Sharma, Dr. Sidharth Gautam, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas

2. Objective of the Course: The course aims to impart fundamental and applied knowledge of refrigeration and air conditioning systems. It enables students to understand thermodynamic cycles, components, refrigerants, and psychrometrics, and to analyze, design, and evaluate the performance of cooling systems used in industrial, commercial, and domestic applications.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	Refrigeration & Air Refrigeration cycle	Refrigeration: Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P. Air Refrigeration cycle: Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated	9

		temperature (DART).	
II	Vapour Compression System	Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage system, Cascade system.	9
III	Vapour Absorption system & Refrigerants	Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison. Three fluid system. Refrigerants: Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants, and CFC-free refrigerants. Ozone layer depletion and global warming considerations of refrigerants.	9
IV	Air Conditioning	Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration &	7

		ventilation, Internal heat gain.	
V	Refrigeration Equipment & Application	Elementary knowledge of refrigeration & air conditioning equipments e.g compressors, condensers, evaporators & expansion devices, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.	8
Total			42

4. Readings

Textbooks & Reference Books:

1. Refrigeration and Air conditioning by C.P Arora, McGraw-Hill

2. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd.

3. Refrigeration and Air conditioning by R. C. Arora, PHI

4. Principles of Refrigeration by Roy J. Dossat. Pearson Education

5. Refrigeration and Air conditioning by stoecker& Jones. McGraw-Hill

6. Refrigeration and Air conditioning by Arora&Domkundwar. DhanpatRai

7. Thermal Environment Engg. byKuhen, Ramsey &Thelked.

5. Course Outcome:

- Understand the fundamental principles and thermodynamic cycles used in refrigeration and air conditioning systems.
- Select and evaluate refrigerants based on environmental and thermodynamic properties.

- Understand and analyze the working of components like compressors, condensers, evaporators, and expansion devices.
- Design basic refrigeration and air conditioning systems for various applications.
- Evaluate energy efficiency, environmental impact, and operational characteristics of refrigeration and air conditioning systems.

Strength of Materials

1. Course Details

1.1 Course Code: ME223

1.2 Contact Hours: 3-0-0; Credits: 09

1.3 Semester offered: 2nd Year - Even

1.4 Prerequisite: Basic understanding of engineering mechanics, physics, mathematics, and material properties with analytical and problem-solving skills.

1.5 Syllabus Committee Members: Dr. Tushar Sharma, Dr. Sidharth Gautam, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas, Prof. Amit Ranjan

2. Objective of the Course: The course aims to develop a fundamental understanding of how materials respond to external loads, including stress, strain, deformation, and failure. It equips students with the ability to analyze and design structural and mechanical components subjected to various loading conditions, ensuring safety, stability, and functionality in engineering applications.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	COMPOUND STRESS AND STRAINS	Introduction, normal stress and strain, Shear stress and strain, Stresses on inclines sections, Strain energy, Impact loads and stresses, State of plane stress, Principal stress and strain, Maximum shear stress, Mohr's circle for plane stress, Three dimensional states of stress & strain, Equilibrium equations, Generalized Hook's law, Theories of failure. Thermal Stresses.	8
II	BEAMS	Stresses in Beams: Pure Bending, Normal stresses	8

	AND TORSION	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 & torsion of solid & hollow shafts, Torsion of thin walled tubes.	
III	SPRINGS, COLUMNS & STRUTS	Helical & Leaf Springs: Deflection of springs by energy method, Helical springs under axial load & under axial twist (respectively for circular & square cross sections) axial load & twisting moment acting simultaneously both for open and dosed coiled springs, Laminated springs. Columns & Struts: Buckling and stability, Slenderness ratio, Combined bending & direct stress, Middle third & middle quarter rules, Struts with different end conditions, Euler's theory for pin ended columns, Effect of end conditions on column buckling, Ranking Gordon fomulae, examples of columns in mechanical equipment and machines.	8
IV	CYLINDERS AND SPHERES	Thin cylinders & spheres: Introduction, Difference between thin walled and thick walled pressure vessels, Thin walled spheres and cylinders, Hoop and axial stresses and strain, Volumetric strain. Thick cylinders: Radial, Axial & circumferential stresses in thick cylinders subjected to internal or external pressures, Compound cylinders, Stresses in rotating shaft and cylinders, Stresses due to interference fits.	8

V	CURVED BEAM	Curved Beams: Bending of beams with large initial curvature, Position of neutral axis for rectangular, Trapezoidal & circular cross sections, Stress in crane hooks, Stress in circular rings subjected to tension or compression. Unsymmetrical Bending: Properties of beam cross-section, Slope of neutral axis, Stress and deflection in unsymmetrical bending, Determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.	8
Total			40

4. Readings

Textbooks & Reference Books:

1. Strength of materials by Sadhu Singh, Khanna Book Publishing Co. (P) Ltd.
2. Strength of Material by Rattan, MC GRAW HILL INDIA
3. Mechanics of Materials by B.C. Punmia, Laxmi Publications (P) Ltd.
4. Mechanics of Materials by Hibbeler, Pearson.
5. Mechanics of material by Gere, Cengage Learning
6. Mechanics of Materials by Beer, Jhonston, DEwolf and Mazurek, MC GRAW HILL INDIA
7. Strength of Materials by Pytel and Singer, Harper Collins
8. Strength of Materials by Ryder, Macmillan.
9. Strength of Materials by Timoshenko and Yσungs, East West Press.
10. Introduction to Solid Mechanics by Shames, Pearson
11. Mechanics of material by Pytel, Cengage Learning
12. An Introduction to Mechanics of Solids by Crandall, MC GRAW HILL INDIA
13. Strength of Materials by Jindal, Pearson Education

5. Course Outcome:

- Understand stress-strain relationships and mechanical behavior of materials under various loading conditions.
- Analyze axial, shear, and bending stresses in structural elements.
- Apply concepts of torsion in circular shafts and combined loading analysis.
- Evaluate the stability of columns and analyze critical buckling loads.
- Use analytical methods to design safe and efficient load-bearing mechanical components.

Manufacturing Processes - I

1. Course Details

1.1 Course Code: ME224

1.2 Contact Hours: 3-0-0; Credits: 09

1.3 Semester offered: 2nd Year - Even

1.4 Prerequisite: Basic knowledge of physics, engineering materials, thermodynamics, and mechanics with interest in production technologies.

1.5 Syllabus Committee Members: Dr. Tushar Sharma, Dr. Sidharth Gautam, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas

2. Objective of the Course: The course aims to provide fundamental knowledge of various manufacturing processes including casting, forming, machining, welding, and non-traditional methods. It enables students to understand process principles, equipment, material behavior, and process parameters to analyze, select, and apply appropriate manufacturing techniques in engineering production and product development.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	Conventional Manufacturing processes	Casting and moulding: Metal casting processes and equipment, Types of Patterns and Pattern Allowance, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending), principles of powder	8

		metallurgy.	
II	Metal cutting	Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining, Additive manufacturing, Rapid prototyping and rapid tooling	8
III	Grinding & Super finishing	Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centreless grinding. Super finishing: Honing, lapping and polishing	8
IV	Metal Joining (Welding)	Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes, Survey of welding and allied processes., Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Weld decay in HAZ.	9
V	Unconventional Machining Processes	Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. Electrical Discharge Machining, principle and	9

		processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electrochemical machining (ECM), Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.	
Total			42

4. Readings

Textbooks & 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.

5. Course Outcome:

- Understand the principles and equipment used in metal casting, forming, and joining processes.
- Analyze pattern design, solidification, riser design, and identify casting defects and their remedies.
- Understand fundamentals of machining processes, tool geometry, chip formation, tool wear, and machinability.
- Apply knowledge of manufacturing processes to select appropriate techniques for specific engineering applications.

Heat and Mass Transfer

1. Course Details

1.1 Course Code: ME232

1.2 Contact Hours: 3-1-0; Credits: 11

1.3 Semester offered: 2nd Year - Even

1.4 Prerequisite: Basic knowledge of thermodynamics, fluid mechanics, engineering mathematics, and physics with strong analytical problem-solving skills..

1.5 Syllabus Committee Members: Dr. Tushar Sharma, Dr. Sidharth Gautam, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas

2. Objective of the Course: The course aims to provide fundamental understanding of heat and mass transfer mechanisms—conduction, convection, and radiation. It equips students with analytical skills to solve engineering problems involving thermal energy exchange and mass diffusion in various systems, and to design efficient thermal systems for industrial and real-world applications.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	Introduction to Heat Transfer	Thermodynamics and Heat Transfer. Modes of Heat Transfer: Conduction, convection and radiation. Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. 2 Conduction: General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems. Initial and boundary conditions. 3 Steady State one-dimensional Heat conduction: Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with	8

		and without energy generation; Concept of thermal resistance. Analogy between heat and electricity flow; Thermal contact resistance and over all heat transfer coefficient; Critical radius of insulation.	
II	Fins & Transient Conduction	Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts.	8
III	Forced Convection & Natural Convection	Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Thermal entrance region, Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer. 5 Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere, Combined free and forced convection.	8
IV	Thermal Radiation	Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse nonblack bodies in an enclosure; Radiation shields; Radiation	9

		combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Greenhouse effect.	
V	Heat Exchanger And Mass Transfer	Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers. Condensation and Boiling: Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convection boiling. Introduction to Mass Transfer: Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.	9
Total			42

4. Readings

Textbooks & Reference Books:

1. Fundamentals of Heat and Mass Transfer, by Incroperra& DeWitt, John Wiley and Sons
2. Heat and Mass Transfer by Cengel, McGraw-Hill
3. Heat Transfer by J.P. Holman, McGraw-Hill
4. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education
5. Heat Transfer by Ghoshdastidar, Oxford University Press
6. A text book on Heat Transfer, by Sukhatme, University Press.
7. Heat Transfer by Venkateshan, Ane Books Pvt Ltd

8. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill
9. Heat and Mass Transfer by R Yadav, Central Publishing House

5. Course Outcome:

- Understand the fundamental modes of heat transfer: conduction, convection, and radiation.
- Apply concepts of forced and natural convection to various thermal systems.
- Evaluate radiation heat transfer between surfaces.
- Understand basic principles of mass transfer.
- Design and optimize thermal systems for industrial and engineering applications.

Measurement, Metrology, and Control System

1. Course Details

1.1 Course Code: ME225

1.2 Contact Hours: 3-0-0; Credits: 09

1.3 Semester offered: 2nd Year - Even

1.4 Prerequisite: Basic understanding of physics, instrumentation, mathematics, mechanics, and electrical fundamentals with analytical and problem-solving skills.

1.5 Syllabus Committee Members: Dr. Tushar Sharma, Dr. Sidharth Gautam, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas

2. Objective of the Course: The course aims to provide foundational knowledge of measurement techniques, standards, and control systems. It enables students to understand precision measurement, metrological instruments, error analysis, and control system fundamentals, equipping them to evaluate and ensure quality, accuracy, and system performance in mechanical engineering applications.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	MECHANICAL MEASUREMENTS-I	Introduction: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static performance characteristics and elementary idea of dynamic performance characteristics of measurement devices, calibration, concept of error. Sensors and Transducers: Types of sensors, types of transducers and their characteristics. Signal	6

		Transmission and Processing: Signal transmission and processing devices and systems. Signal display & recording devices.	
II	MECHANICAL MEASUREMENTS-II	Time Related Measurements: Stroboscope, frequency measurement by direct comparison. Measurement of displacement. Measurement of Pressure: Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures (high vacuum). Strain Measurement: Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration. Temperature Measurement: Measurements of Force, Torque, Acceleration, and Vibration: Different types of load cells, elastic transducers, pneumatic & hydraulic systems.	8
III	Metrology-I	Standards of linear measurement, line and end standards. Limit fits and tolerances. Interchangeability and standardisation. Linear and angular measurements devices and systems Comparators: Sigma, Johansson's Microkrator. Limit gauges classification, Taylor's Principle of Gauge Design.	8
IV	Metrology-II	Measurement of geometric forms like straightness, flatness, roundness. Tool makers microscope, profile project autocollimator. Interferometry: principle and use of interferometry, optical flat. Measurement of screw threads and gears.	6
Total			28

4. Readings

Textbooks & Reference Books:

1. Experimental Methods for Engineers by Holman, TMH
2. Mechanical Measurements by Beckwith, Pearson
3. Principles of Measurement Systems by Bentley, Pearson
4. Metrology of Measurements by Bewoor and Kulkarni, TMH
5. Measurement Systems, Application Design by Doeblein, TMH
6. Hume K.J., “Engineering Metrology”, MacDonald and Co
7. Jain, R.K., “Engineering Metrology” Khanna Publishers
8. Jain, R.K., “Mechanical Measurement” Khanna Publishers

5. Course Outcome:

- Understand fundamental concepts of measurement systems, accuracy, precision, and error analysis.
- Use various metrological instruments to measure dimensions, surface finish, and geometric features.
- Understand standards of measurement and calibration techniques.
- Select appropriate measurement and control techniques for industrial and quality assurance applications.