Malaviya National Institute of Technology Jaipur
Department of Mechanical engineering

Course Details
Engineering Thermodynamics | 26MET101 | 3 1 0 0

PREREQUISITE:
NIL

COURSE OBJECTIVE(S):
This course aims to provide students with a fundamental understanding of the principles of engineering thermodynamics and their applications to engineering systems. It develops the ability to analyze thermodynamic systems, properties, and processes using the First and Second Laws of Thermodynamics, evaluate the properties of pure substances and ideal gases, and analyze the performance of common engineering devices and basic power and refrigeration cycles. The course also prepares students for advanced thermal engineering subjects such as Heat Transfer, Internal Combustion Engines, Power Plant Engineering, and Refrigeration & Air Conditioning.

COURSE OUTCOMES:

CO1 : Explain thermodynamic concepts, systems, properties and processes.
CO2 : Apply the First and Second Laws to engineering systems.
CO3 : Analyze energy conversion devices using thermodynamic principles.
CO4 : Evaluate the performance of gas power, vapour power and refrigeration cycles.

SYLLABUS:

UNIT I (7 Lectures): Fundamentals of Thermodynamics: systems, properties, equilibrium, Zeroth Law, temperature, pressure, heat, work, forms of energy.

UNIT II (7 Lectures): Properties of Pure Substances: phase change, property diagrams, steam tables, ideal gas equation, specific heats, compressibility factor.

UNIT III (10 Lectures): First Law of Thermodynamics: closed systems, boundary work, enthalpy, SFEE, applications to nozzles, turbines, compressors, pumps, heat exchangers and throttling devices

UNIT IV (11 Lectures): Second Law of Thermodynamics: heat engines, refrigerators, Carnot cycle, entropy, reversible and irreversible processes, Clausius inequality.

UNIT V (6 Lectures): Gas Power Cycles: Otto, Diesel, Dual and Brayton cycles, thermal efficiency and mean effective pressure.

UNIT VI (4 Lectures): Vapour Power and Refrigeration Cycles: Rankine cycle, vapour compression refrigeration cycle, COP.

EVALUATION
Final grades will be weighted average of performance in

Course Work	20%
Midterm Exam	30%
Endterm Exam	50%

depending on the institute's academic policy.

Textbook(s):

1. Y. A. Çengel and M. A. Boles, Thermodynamics: An Engineering Approach
2. P. K. Nag, Engineering Thermodynamics.

Reference book(s):

1. Moran, Shapiro, Boettner and Bailey, Fundamentals of Engineering Thermodynamics.
2. Sonntag, Borgnakke and Van Wylen, Fundamentals of Thermodynamics.

Online/E-Resourses:

1. NPTEL courses, MIT OpenCourseWare

Malaviya National Institute of Technology Jaipur
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Course Details
Experiential Learning Lab | 26MEP101 | 0 0 2 0

PREREQUISITE:
NIL

COURSE OBJECTIVE(S):
1 Develop engineering thinking through systematic disassembly and reassembly of mechanical products.
2 Understand product construction, material selection and working principles.
3 Develop the ability to critically evaluate existing designs and recommend improvements.
4 Promote experiential learning and design-oriented thinking through disassembling and assembling .

COURSE OUTCOMES:

CO1 : Demonstrate safe engineering practices while using appropriate tools for assembly, disassembly and reassembly of engineering products.

CO2 : Investigate engineering products to identify components, materials, manufacturing processes and prepare a Bill of Materials (BOM).

CO3 : Analyze the construction, working principle and interaction of components in mechanical and mechatronic systems.

CO4 : Evaluate engineering products from functional, manufacturing and maintenance perspectives, and recommend feasible design improvements.

SYLLABUS:

EXPERIMENT I (2 Hours): 1. Introduction to experiential learning in engineering. 2. Engineering observation and product-function relationship. 3. Laboratory safety practices. 4. Identification and safe use of engineering hand tools. 5. Engineering documentation, systematic disassembly, inspection, reassembly and functional validation.

EXPERIMENT II (10 Hours): Experiential Learning through Basic Mechanical Assemblies and Everyday Engineering Products 1. Bicycle (DIY Type) 2. Pull Back Car 3. Electric Iron 4. Pedestal Fan with Swing Mechanism 5. Mechanical Odometer 6. WC Flushing Mechanism 7. Differential Mechanism 8. Water Meter

EXPERIMENT III (8 Hours): Experiential Learning through Intermediate Mechanical and Mechatronic Systems 1. Bicycle Gear-Shifting Mechanism and Planetary Mechanism in EV Hub Motor 2. Sphygmomanometer (Manual and Automatic) 3. Automotive Air-Conditioning Compressor 4. Window Air Conditioner

EXPERIMENT IV (4 Hours): Experiential Learning through Multi-Subsystem Engineering Products 1. Four-Stroke Internal Combustion Engine 2. Semi-Automatic Washing Machine

EXPERIMENT V (2 Hours): Investigate an unfamiliar engineering product/system and demonstrate their understanding through engineering analysis.

EVALUATION
Final grades will be weighted average of performance in

Course Work	60%

Midterm Exam	20%
Endterm Exam	20%

depending on the institute's academic policy.

Textbook(s):

Reference book(s):

1. Otto & Wood, Product Design: Techniques in Reverse Engineering and New Product Development.

Online/E-Resourses:

1. Manufacturer service manuals, product datasheets

Malaviya National Institute of Technology Jaipur
Department of Mechanical engineering

Course Details
Engineering Mechanics | 26MET151 | 2 1 0 0

PREREQUISITE:
NIL

COURSE OBJECTIVE(S):
This course aims to develop a strong foundation in engineering mechanics by introducing the fundamental principles governing the equilibrium and motion of particles and rigid bodies. It enables students to analyze force systems, engineering structures, and mechanical components using the principles of statics, virtual work, and energy methods, while providing an introduction to the kinematics and dynamics of rigid bodies for solving practical engineering problems.

COURSE OUTCOMES:

CO1 : Explain the fundamental concepts, laws, and principles of engineering mechanics.

CO2 : Apply the principles of equilibrium and free-body diagrams to analyze particles and rigid bodies.

CO3 : Analyze engineering structures, beams, and trusses to determine reactions and internal forces

CO4 : Evaluate the stability and equilibrium of engineering systems using virtual work and energy methods.

SYLLABUS:

UNIT I (3 Lectures): Introduction to Mechanics and Laws of Mechanics. Statics of Particles: Forces in a Plane- Force on a Particle, Resultant of Two Forces. Resolution of a Force. Equilibrium of a Particle, Free-Body Diagrams. Forces in Space, Force.

UNIT II (8 Lectures): Rigid Bodies: Principle of Transmissibility. Equivalent Forces, Moment of a Force about a Point, Varignon's Theorem, Moment of a Force about a Given Axis. Equilibrium of Rigid Bodies, Free-Body Diagram, Equilibrium in Two Dimensions, Statically Indeterminate Reactions. Equilibrium of a Two-Force Body, Equilibrium in Three Dimensions.

UNIT III (5 Lectures): Force Analysis of Rigid Bodies Structures: Plane Trusses, Methods of Joints, Method of Section, Space Trusses, Frames and Machines, Internal Forces Developed in various Structural Members (such as rod, beam, shaft), Shear and Moment Equations and Diagrams (SFD and BMD).

UNIT IV (5 Lectures): Distributed Forces: Moments of Inertia of Areas, Second Moment,, Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia. Moments of Inertia of Composite Areas, Product of Inertia, Principal Axes and Principal Moments of Inertia. Moments of Inertia of a Mass. Moments of Inertia of Thin Plates.

UNIT V (5 Lectures): Methods of Virtual Work and Total Potential Energy: Work- Work of a Force and Couple, Virtual Work- Principle of Virtual Work for a Particle and Rigid Bodies, Potential Energy and Stability.

UNIT VI (4 Lectures): General plane motion

EVALUATION

Final grades will be weighted average of performance in

Course Work	20-30%
Midterm Exam	20-40%
End term Exam	30-50%

depending on the institute's academic policy.

Textbook(s):

1. Vector Mechanics for Engineers: Statics and Dynamics, Ferdinand P. Beer, E. Russell Johnston, David Mazurek, Phillip J. Cornwell, Brian Self. McGraw Hill Education, 13th Edition, 2026
2. Engineering Mechanics: Statics & Dynamics, Hibbeler, R.C., Pearson Education Asia Pvt. Ltd., 15th Edition, 2025
3. Engineering Mechanics – Statics and Dynamics, Irving H. Shames, Pearson Education Asia Pvt. Ltd., 2005.
4. Engineering Mechanics: Statics and Dynamics, Meriam, J. L., Kraige, L. G., & Bolton, J. N., Wiley-India, 9th Edition, 2021.

Reference book(s):

Online/E-Resourses:

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Department of Mechanical engineering

Course Details
Material Science and Engineering | 26MET152 | 3 0 0 0

PREREQUISITE:
NIL

COURSE OBJECTIVE(S):
1. Understand the classification, crystal structure, and structure–property relationship of engineering metals and alloys.
2. Apply diffusion, phase diagrams, phase transformations, and heat treatment concepts to predict microstructural evolution.
3. Analyse the effect of crystal defects on the mechanical behaviour of engineering metals and alloys.
4. Understand strengthening mechanisms and annealing processes for engineering metals and alloys.
5. Apply mechanical testing methods to evaluate the properties and behaviour of engineering metals and alloys.

COURSE OUTCOMES:

CO1 : Explain the classification of engineering metals and alloys, crystallography, crystal structures, and the structure–property relationships of metallic materials.

CO2 : Apply the principles of diffusion, alloy formation, phase diagrams, and phase transformations to interpret microstructural evolution and heat treatment of steels.

CO3 : Analyse the influence of crystal defects, strengthening mechanisms, and microstructure on the mechanical behaviour of engineering metals and alloys.

CO4 : Evaluate the suitability of heat treatment processes and hardening techniques to achieve the desired microstructure and mechanical properties of steels.

CO5 : Apply standard mechanical testing and non-destructive testing methods to determine and evaluate the mechanical behaviour and properties of engineering metals and alloys.

SYLLABUS:

UNIT I (4 Lectures): Engineering Materials: Classification, material selection, and the processing–structure–properties–performance relationship. Crystal Structure: Crystal systems, Bravais lattices, FCC/BCC/HCP structures, crystallographic directions and planes, Miller and Miller–Bravais indices, symmetry, interplanar spacing, densities, Weiss Zone Law, and basics of X-ray diffraction. Crystal Packing and Microstructure: Atomic packing factor, coordination number, theoretical density, interstitial sites, and microstructure of single-crystal, polycrystalline, and amorphous materials.

UNIT II (4 Lectures): Crystal Defects: Point, line, surface, and volume defects, dislocations, dislocation density, Frank–Read source, slip systems in FCC, BCC, and HCP crystals, and the role of defects in plastic deformation. Strengthening and Annealing: Plastic deformation, strain hardening, solid solution, grain size (Hall–Petch), and precipitation strengthening, annealing of cold-worked metals (recovery, recrystallization, and grain growth) and their effects on microstructure and mechanical properties.

UNIT III (4 Lectures): Elastic and plastic deformation, tensile behaviour (stress–strain curve, true stress–true strain, ductility and toughness), hardness (Brinell, Rockwell, and Vickers), impact behaviour (Charpy and Izod), fatigue (S–N curve and endurance limit), creep, ductile and brittle fracture, fundamentals of non-destructive testing (visual, liquid penetrant, magnetic particle, ultrasonic, and radiographic testing).

UNIT IV (8 Lectures): Structure of Alloys: Solid solutions and intermetallic compounds, Hume–Rothery rules, substitutional and interstitial solid solutions. Phase Diagrams: Gibbs phase rule, binary phase diagrams (Cu–Ni, Pb–Sn, Fe–Fe_3C), lever rule, microstructural evolution, steels and cast irons. Phase Transformations and Heat Treatment: Nucleation and growth, TTT diagrams, annealing, normalizing, quenching, tempering, austempering, hardenability and the effect of alloying elements. Diffusion in Solids: Ficks laws, diffusion mechanisms and types, factors affecting diffusion, applications in heat treatment and case hardening.

EVALUATION

Final grades will be weighted average of performance in

Course Work	20%
Midterm Exam	30%
Endterm Exam	50%

depending on the institute's academic policy.

Textbook(s):

1. Materials Science, GK Narula, KS Narula, and VK Gupta, Mc Graw Hill Eduction (India) Private Ltd.
2. Engineering Materials: Polymers, Ceramics and Composites, AK Bhargava, PHI Learning Private Ltd.
3. Mechanical Behaviour of Materials, Thomas H Courtney, Mc Graw Hill Eduction (India) Private Ltd.
4. Mechanical Behaviour and Testing of Materials, AK Bhargav and CP Sharma, PHI Learning Private Ltd.
5. Materials Science and Engineering: An Introduction, William D. Callister Jr. and David G. Rethwisch, 11th Edition, Wiley, 2020.
6. Foundations of Materials Science and Engineering, William F. Smith and Javad Hashemi, 6th Edition, McGraw-Hill Education, 2021.
7. Materials Science and Engineering, V. Raghavan, 7th Edition, Prentice Hall India (PHI).

Reference book(s):

Online/E-Resourses: