MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF MECHANICAL ENGINEERING

B.Tech. (Mechanical Engineering)
Semester III

Syllabus

DUGC Convener | Curriculum Committee Convener | SUGB Chairman

Date:

UG/PG: UG	Department: Mechanical
Course Code: MET 201	Course Name: Engineering Thermodynamics
Credit: 4	L-T-P: 3-1-0

Syllabus

Introduction: Introduction to the course, its application and utility; important terms used in thermodynamics; thermodynamic properties; state postulate; concept of temperature and absolute temperature.

Energy: Energy; Macroscopic and microscopic forms of energy; location of energy; flow of energy.

First Law of Thermodynamics: Introduction – origin, importance and application; statement of the law; corollaries of 1st law; application of first law to closed systems and steady and unsteady flow open systems; application of first law to equipments such as boiler, turbine, compressor, nozzle, expander, pump and condenser.

Second Law of Thermodynamics: Introduction - origin, implications and importance of the second law; statement of the law; reversible and irreversible processes - definitions of reversible, irreversible, internally, externally and totally reversible systems; causes of irreversibility; examples of irreversibility. Corollaries of 2nd law - efficiency of a reversible and irreversible engines; Carnot cycle, thermodynamic temperature scale.

Entropy: Clausius's inequality and thermodynamic definition of entropy; physical concept of entropy; flow of entropy; calculation of entropy for reversible / irreversible closed systems and steady and unsteady flow open systems; statistical definition of entropy.

Energy: Its concept, origin and necessity; exergy of closed and open systems; first law and second law efficiency.

Miscellaneous: Zeroth and Third Law of Thermodynamics: Introduction, statement and necessity; Maxwell's relations; Clapeyron equation; Joule-Thomson effect; P-v-T surfaces for ideal and real gases.

Books for Reference:

1. Y. A. Cengel& M. A. Boles; Thermodynamics-An Engineering Approach; McGraw-Hill Inc.
2. P. K. Nag; Engineering Thermodynamics; Tata McGraw-Hill, New Delhi.
3. G. Van Wylen, R. Sounting& C Borgnakke; Fundamentals of Classical Thermodynamics; John Wiley & Sons/New Age International, Delhi
4. J. P. Holman; Thermodynamics; McGraw-Hill Book Co. New Delhi.

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Date:

Program: UG	**Department: Mechanical Engineering**
Course Code: MET-202	**Course Name: Fluid Mechanics & Machines**
Credit: 4	**L-T-P: 3-1-0**

Syllabus

Properties of fluids, Pressure variation in fluids, Hydrostatic forces on surfaces, Buoyancy and stability, Pressure measurement.

Fluid flow concepts, Classification of flow, Basic flow-analysis techniques, Equations in integral form for a control volume, Equations in differential form for a fluid particle, applications of continuity, linear momentum, angular momentum, and energy equations to internal and external flow of fluids, Dimensional analysis and similarity, Model testing, Two-dimensional ideal flow, Viscous incompressible fluid flow in bounded systems, Boundary layer concepts, Incompressible fluid flow around a body, Steady incompressible fluid flow in pipe and duct systems.

Analysis and design of rotodynamic pumps and turbines, Specific speed, Performance characteristic curves and selection of pumps and turbines, Single and multi-stage machines, Various head losses and respective efficiencies, Cavitations, Governing of turbines and priming of rotodynamic pumps, Analysis and design of reciprocating pumps and other machines such as hydraulic accumulator, coupling and torque converter, Performance characteristics and efficiencies.

Reference Books:

1. Fluid Mechanics by A.K. Jain
2. Fluid Mechanics by Victor L. Streeter & E. Benjamin Wylie.
3. Fluid Mechanics by P.N.Modi& S.M. Seth
4. Fluid Mechanics by K.R. Arora.
5. 5. Introduction to Fluid Mechanics by I.E.A. John & W.C. Haberman

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Date:

UG/PG: UG	Department: ME
Course Code: MET-203	Course Name: Engineering Mechanics
Credit: 4	L-T-P: 3-1-0

Syllabus

Statics:

(i) Statics of Particles: Introduction -Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equations of Equilibrium of a particle – Forces in space –Equilibrium of Rigid Bodies:Free body diagram – Types of supports and their reactions – requirements/conditions of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodiesStructures: Plane Trusses, Methods of Joints, Method of Section, Space Trusses, Frames and Machines, Internal Forces Developed in Structural Members, Shear and Moment Equations and Diagrams, Relations between Distributed Load, Shear, and Moment.

(ii) Friction: Types of friction, Dry Friction- Static Friction- Kinetic Friction, Factors Affecting Friction, Application of Friction in Machines- Wedges, Screws, Belt Friction, Rolling Resistance.

(iii) 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- Elastic

Dynamics:

(iv) Dynamics of Particles:Introduction to Dynamics, Kinematics and Kinetics of Particles-Displacements, Velocity and acceleration, their relationship – Relative motion – Rectilinear and Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies, Kinetics of Systems of Particles.

(v) Dynamics of Rigid Bodies: Plane Kinematics of Rigid Bodies- Introduction-Rotation-Absolute Motion-Relative Motion-Instantaneous Centre of Zero Velocity- Relative Acceleration, Plane Kinetics of Rigid Bodies- General Equations of Motions-Translation-Fixed Axis Rotation- General

Reference Books:

(i) Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, (1997).

(ii) Hibbeller, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2000).

(iii) Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd., (2003).

(iv) Merian J.L. and Kraige L.G., "Engineering Mechanics", Vol. 1 Statics and Vol. 2 Dynamics, Wiley-India, 5 Edition, (2006).

DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

UG/PG : UG	Department: Mechanical Engineering
Course Code: MET-204	Course Name: Casting, Forming and Welding.
Credit: 3	L-T-P: 3-0-0
Pre-requisite course: Mechanical Workshop	

Syllabus

Casting

Molding methods and processes-materials, equipment, molding sand ingredients, essential requirements, sand preparation and control, testing, cores and core making. Design considerations in casting, gating and risering, directional solidification in castings. Heat Transfer & Fluid Mechanics aspects in casting, Sand castings-pressure die casting-permanent mould casting-centrifugal casting precision investment casting, shell moulding, CO_2 moudling, continuous casting-squeeze casting-electro slag casting, Thixo Molding, Moulding for Magnesium alloys. Gas injection moulding. Fettling , finishing, defects in Castings. Foundry melting furnaces: selection of furnace-crucibles oil fired furnaces, electric furnaces-cupola, Hot blast etc.

Forming

Principle, Solid Mechanics aspects of Forming, classification and equipment for forging , rolling and extrusion processes, Defects and analysis: Rod/wire drawing-tool, equipment and principle of processes defects, Tube drawing and sinking processes. Mannessmann processes of seamless pipe manufacturing. Classification conventional and HERF processes, Presses-types and selection of presses, formability of sheet metals, Principle, process parameters, equipment and application of the following processes. Deep drawing, spinning, stretch forming, plate bending, press brake forming, Explosive forming, electro hydraulic forming, magnetic pulse forming. Super plastic forming, electro forming-fine blanking, P/M forging-Isothermal forging-high speed, hot forging high velocity extrusion.

Welding

Types of welding-gas welding-arc welding-shielded metal arc welding, TAW, GMAW, SAW, ESW-Resistance welding (spot, seam, projection, percussion, flash types)-atomic hydrogen arc welding-thermitwelding soldering, brazing and braze welding. Electron beam and Laser beam welding-plasma arc welding-stud welding-friction welding-explosive welding ultrasonic welding-underwater welding-roll bonding-diffusionbonding-cold welding-welding of plastics, dissimilar metal. Gas welding equipments-welding power sourcesand characteristics-safety aspects in welding-automation of welding, seam tracking, vision and arc sensing-welding robots. Defects in welding-causes and remedies-destructive testing methods - NDT of weldments - testing of pipe, plate, boiler, drum, tank-case studies-weld thermal cycle-residual stresses-

distortion-relieving of stresses, weld ability of cast iron, steel, stainless steel, aluminium alloys-effect of gases in welding, fatigue failure in weldments.

References Books:

1. Taylor H F, Flemings M C and Wulff J, Foundry Engineering , Wiley Eastern Limited, 1993.
2. Lindberg R.A, Processes and Materials of Manufacture , Prentice Hall of India (P) Ltd.,1996
3. Lancaster J.F., Metallurgy of welding , George allen and Unwin, 1991.
4. 4.Kalpakjian Serope,Manufacturing engineering and Technology, Wesley Publishing Co., 1995.
5. William F. Hosford&Caddel Robert M., Metal forming (Mechanics & Metallurgy), Prentice Hall Publishing Co., 1990

DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

UG/PG : UG	Department: Mechanical Engineering
Course Code: MET-206	Course Name: Material Science
Credit: 2	L-T-P: 2-0-0

Syllabus

Unit-1:

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 Non-Cubic Structures, structure of ceramics, polymers, and composites materials.

UNIT – 2

Diffusion: Diffusion Mechanisms, Steady & Non-steady State Diffusion, Fick's Laws.

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 Mechanisms : Point Defects, Line Defects and Dislocations, Interfacial Defects and Bulk or Volume Defects, Recovery, Recrystallization and Grain Growth, Mechanisms of Strengthening, Solid Solution Strengthening, Work Hardening, Grain Boundary Strengthening, Strengthening by Second Phase Particles - Precipitation and Dispersion, ceramics, polymers, composites materials specific properties

UNIT – 3

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, Modes of Fracture Toughness, Impact Fracture, Ductile-Brittle Transition, Types of Impact Testing, Fatigue, Crack Initiation and Propagation, S-N Curve, Factors in Fatigue Life, Fatigue Testing, Creep, Stages of Creep Curve, Stress and Temperature Effects. Non-destructive testing of materials

Unit-4

Properties Alteration of Materials: Alteration of properties by heat treatment, Heat treatment method, Quantification of altered material properties by heat treatments.

Books:

1. Materials Science, V. Raghavan, PHI Learning Private Ltd., 2010.
2. Callister's Materials Science and Engineering,W.D.Callister,Jr,R.BalasubramaniamWiley India, 2010
3. Materials Science, G.K. Narula, K.S. Narula, V.K. Gupta, Tata McGraw Hill, 2010.
4. Engineering Materials: Polymers, Ceramics and Composites, A.K. Bhargava, PHI Learning (P) Ltd..

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Date:

UG/PG: UG	Department: ME
Course Code: MEP-207	Course Name: Mechanical Engg. Drawing
Credit: 3	L-T-P: 0-0-3

Syllabus

Course Content

1. Limits, Fits and Tolerances: Definitions; Classification of Fits; Basic Terminology; Standard Tolerances; Positioning of Tolerances; Fundamental Deviation; Tolerance Zone Selection.
2. Production Drawings: Introduction; Detail Drawing; Production Design Assembly Drawing: Types of Assembly& Procedures; BOM; Checking Machine Drawings & Method of amendment and Corrections.
3. Drawing Standards: Code of Practice for Engineering Drawing, BIS and ISO specifications - Welding symbols, riveted joints, Cotters, keys, fasteners - Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.
4. Rivets & Riveted Joints & Welded Joints: Rivets and Methods of Riveting; Types of Rivet Heads; Rivet Symbols; Types of Joints; Connecting parallel plates and plates at right angles.
5. Screw Threads and Screw fastenings: Screw Threads Nomenclature and Forms; Conventional Representation; Types of Bolts, Nuts and Screws; Locking devices.
6. Keys, Cotter Joints and Pin Joints: Types of Key Joints; Types of Cotter Joints; Types of Pin Joints and Knuckle joints.
7. Shaft Couplings: Applications and Types of Couplings; Rigid and Flexible Couplings.
8. Bearings: Journal Bearings; Pivot Bearings; Ball and Roller Bearings; Assembly of Bearings.
9. Pulleys: Application and Type of Pulleys
10. Pipe and Pipe Joints: Different Pipes and their uses; Pipe Joints.
11. Valves: Introduction and Classification of Valves; Valve Seats; Feed Check Valve

Reference Books:

(i) Engineering Drawing and Machine Drawing by N.D.Bhatt, V.M.Panchal, Charotar Publishing House.
(ii) Machine Drawing with AutoCAD by GoutamPohit and GoutamGhosh, Pearson Education
(iii) Machine Drawing includes AutoCAD by Ajeet Singh, Tata MacGraw Hill
(iv) Machine Drawing by K.L.Narayana, P.Kannaiah, K.Venkata Reddy, New Age International
(v) Engineering Drawing and Graphics using AUTOCAD by T.Jayapoovan, Vikas Publishing
(vi) Engineering Drawing and Graphics + AutoCAD by K.Venugopal, New Age International

UG/PG : UG	Department: Mechanical Engineering
Course Code: MEP-208	Course Name: Casting, Forming and Welding lab
Credit: 1	L-T-P: 0-0-2
Pre-requisite course: Mechanical Workshop	

List of Experiments

1) Testing of greensand properties.
2) Greensand mould design & making process with complete gating system including its testing through a CAE software for thermal aspects.
3) Making of a shell using shell moulding machine.
4) Study of defects in castings.
5) Making of lap joint by resistance welding process and its strength evaluation
6) Study of bead geometry in arc welding process for its strength & micro-structure.
7) Determination of weld characteristics using DC and AC power sources.
8) Study of butt joint strength evaluation by GMAW process.
9) Welding of Aluminium with GTAW process.
10) Preparation of moulds of simple objects like flange, gear V- grooved pulley etc.
11) Process parameters of gas welding, TIG, MIG & Spot welding Jobs.
12) Use of Die and Mould for Sheet Metal Fabrication.
13) Simulation of manufacturing processes on various tools.
14) NDT experiments.
15) Industry visits.

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Date:

Program: B.Tech. Mechanical Engineering	Department: Mechanical Engineering
Course Code: MET-209	Course Name: Fluid Mechanics Lab
Credit: 1	L-T-P: 0-0-2

List of Experiments

1. To find coefficient of discharge of Venturimeter.
2. To find coefficient of discharge of Nozzle meter.
3. To find coefficient of discharge of Orifice meter.
4. To find coefficient of friction for flow through pipes using Darcy equation
5. To prove Bernoulli's equation
6. To measure flow through Triangular Notch
7. To measure Coefficient of discharge for flow through Orifice and mouthpiece

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Date:

UG/PG	Department: ME
Course Code: MAT205	Course Name: MATHEMATICS III
Credit: 3	L-T-P: 2-1-0

Syllabus

Solution of system of linear equations: Direct methods- Gauss Elimination, Gauss-Jordan Elimination Method, LU- decomposition method, QR-Factorization, Iterative methods: Jacobi iteration, Gauss-Seidel iteration method.

Interpolation: For unequal intervals, Interpolation for equal intervals, Finite difference operators, Interpolating polynomials using finite differences, Numerical Differentiation.

Numerical Integration: Trapezoidal rule, Simpson's 1/3, 3/8 rule

Numerical solution of ODE: Euler's method, Modified Euler's method, Runga-Kutta method, Numerical solution of PDE, Statistics and engineering, Population and sample, Pareto diagram, frequency distributions, stem and leaf displays, quartiles and percentiles.

probability, axioms of probability, Baye's theorem: Random variables and probability distribution, mean and variance of a probability distribution, binomial distribution, Chebyeshev's inequality, Poisson distribution, Normal distribution, simulation.

Estimation and tests of hypothesis: Curve fitting, least square approxiation, regression analysis.

Textbook(s)/Reference book(s)

1. Jain ,Iyenger, Jain, *Numerical methods for the scientific and engineering computation,* New age publisher, New Delhi
2. S.S.Sastry, *Introductory methods for numerical analysis*, Prentice -Hall of India.
3. Ravindra J., *Probability and statistics for Engineers*, Wiley India,2010.
4. Hayter A. J., *Probability and statistics for Engineers* ,Cengage learning,2009.

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