School of Mechanical Sciences

Q-Exam subject & Syllabus

Subject Code: ME6LP11	Subject Name: **Solid Mechanics**

Concept of stress and strain: Normal stress, shear stress, state of stress at a point, ultimate strength, allowable stress, factor of safety; normal strain, shear strain, transformation of stress and strain, principal stresses, principal strains, Mohr's circle for stress and strain; Hooke's law, Poisson's ratio, generalized Hooke's law; theories of failure.

Energy methods: Castiglino's Theorem, applications of energy methods.

Torsion: Torsion of cylindrical bars, torsional stress, modulus of rigidity and deformation.

Flexural loading: Shear and moment in beams; load, shear and moment relationship; shear and moment diagrams; flexure formula; shear stress in beams; differential equation of the elastic curve, deflection of beams, asymmetric bending of straight Beams, shear center for thin–walled beam cross-sections, curved beams.

Axisymmetric problems: Thin and thick cylinders, press-fit.

Column: Buckling of slender columns, Euler bucking load for different end conditions.

Text/Reference Books:

[1] Mechanics of Materials - Ferdinand Beer , E. Russell Johnston, Jr., J. DeWolf (TMH)
[2] Elements of Strength of Materials - S. Timoshenko, D. H. Young (East West Press)
[3] Advanced Mechanics of Solids - Boresi A.P., and Schmidt R.J (Willey)
[4] Advanced Mechanics of Solids - Srinath L.S (Tata McGraw – Hill)

Subject Code: ME6LP12	Subject Name: **Theory of Machines**

Introduction: - Terminology, Definition, Types of Mechanism (Planner, Spatial), Mobility, Classification of Mechanisms, Kinematic Inversion, Movability Criteria.

Analysis of Mechanism: Position Analysis - Graphical Method, Analytical Method; Velocity Analysis- Graphical Method, Analytical Method, Instantaneous Centres of Velocity; Acceleration Analysis- Graphical Method, Analytical Method.

Gears: Terminology and definition, fundamental law of gearing, Involute properties, interference and Undercutting, Involumetry, Types of Gears; Gear Train - Simple and Compound Gear Train, Epicyclic Gear Train, Analysis of Planetary Gear by formula and tabular Method, Differentials.

Dynamics of Machines: - Static and Dynamic Force Analysis for simple mechanisms, Dynamics of reciprocating Engines - Dynamic Analysis, Equivalent Masses, Inertia Forces, Crankshaft torques, Engine Shaking Forces and Shaking Moments; Flywheel; Balancing- Static unbalance, Dynamic unbalance, Dynamic balancing, Balancing of single cylinder and multicylinder Engines; Governors- Classification, Centrifugal and inertia governors, Terminology used in Governors- Height, equilibrium speed, Hunting, isochronism, stability, sensitiveness; Gyroscopes- Gyroscopic Action in Machines, gyroscopic torque and couple.

Text/Reference Books:

[1] Ghosh A., and Malik A.K., *Theory of Machines and Mechanism*, East-West Press.
[2] Norton R.L., *Design of Machinery*, McGraw-Hill.
[3] Shigley J.E., and Uicker J.J., *Theory of Machines and Mechanisms*, McGraw Hill, Inc.

Subject Code: ME6LP13	Subject Name: **Vibrations**

Fundamental Aspects of Vibrations: Vibration, main causes, advantages and disadvantages; engineering applications of vibration and noise; vector method of representing harmonic motion; characteristics of vibration, harmonic analysis and beats phenomenon, work done by harmonic forces on harmonic motion; periodic, non- harmonic functions; elements of vibratory system; lumped and distributed parameter systems.
Undamped Free Vibrations: Derivation of differential equation of motion: the energy method, the method based on Newton's second law of motion, and Rayleigh's method.
Damped Free Vibrations: Viscous damping: coefficient of damping; damping ratio; under damped, over damped and critically damped systems; logarithmic decrement; frequency of damped free vibration; Coulomb or dry friction damping; frequency, decay rate and comparison of viscous and Coulomb damping; solid and structural damping; slip or interfacial   damping.
Single Degree Freedom Forced vibration: Harmonic excitation with viscous damping, Steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments. Whirling Motion and Critical Speed: Whirling motion and Critical speed: Definitions and significance.
Systems With Two Degrees of Freedom: Un-damped free vibration of 2 DOF and Principal modes of vibration; torsion vibrations; Forced, Un-damped vibrations with harmonic

excitation; Coordinate coupling; Dynamic vibration absorber; torsion Vibration Absorber; Pendulum type of dynamic vibration.

Text/Reference Books:

[1] Mechanical Vibration – S. S. Rao (Prentice Hall)
[2] Theory of Vibrations with Applications – W. T. Thomson and M. D. Dahleh (Pearson)

Subject Code: ME6LP21	Subject Name: **Fluid Mechanics**

Concept of continuum and definition of a fluid. Body and surface forces, stress tensor, scalar and vector fields. Hydrostatics, Eulerian and Lagrangian description of flow Velocity and stress field, Fluid Kinematics, Reynolds transport theorem, Integral and differential forms of governing equations: mass, momentum, and energy conservation equations, Navier- Stokes equations, Exact solution of Navier-Stokes equations, Euler's equation, Bernoulli's Equation. Stream and Velocity potential function, Circulation, Irrotational vortex, Similarity, Boundary layer, flow separation, viscous flow through pipes.

Text/Reference Books:

[1] Frank White, Fluid Mechanics
[2] Y A Cengel and J M Cimbala, Fluid Mechanics, Fundamentals and applications

Subject Code: ME6LP22	Subject Name: **Thermodynamics**

Introduction; system and surroundings; types of thermodynamic equilibrium; zeroth law; first law for a closed system; heat; work; internal energy; enthalpy; work done during various thermodynamic processes; steady flow energy equation; second law of thermodynamics; entropy; Kelvin – Planck statement; Clausius statement; Carnot's theorem; irreversibility; TdS relations; entropy principle.

Text/Reference Books:
[1] Yunus A Cengel; Michael A Boles, Thermodynamics: An Engineering Approach
[2] P.K. Nag, Engineering Thermodynamics

Subject Code: ME6LP23	Subject Name: **Heat Transfer**

Introduction: Modes of heat transfer, thermal conductivity, combined modes of heat transfer, concept of thermal contact resistance.

Conduction: Derivation of heat conduction equation, steady state one-dimensional heat conduction with and without generation of heat in simple geometries: plane wall, cylindrical and spherical walls, critical thickness of insulation, heat transfer from extended surfaces, Unsteady conduction: lumped heat-capacity system.

Convection: Forced convection: energy equation, concept of thermal boundary layer and derivation of thermal boundary layer equation, flat plate in parallel flow, internal flows:

concept of thermally fully developed flow and its corollaries, fully developed pipe flow, The Energy Balance for Constant Surface Heat Flux & Constant Surface Temperature, Steady Laminar Incompressible and Fully Developed Flow Through a Pipe with Constant Surface Heat Flux & Constant Surface Temperature, Reynolds Analogy.

Free convection: Vertical plate at constant temperature: governing equation, recognition of dimensionless terms, various empirical correlations under different situation.

Heat Exchangers: Classification of heat exchangers, overall heat transfer coefficient, concept of fouling factor, LMTD and NTU methods of analysis for a double pipe heat exchanger.

Radiation: Radiation properties, blackbody radiation, Planck's law, Stefan-Boltzman law, Kirchoff's law, radiation exchange between black surfaces, concept of view factor, radiation exchange between non-black surfaces, two-surface enclosure, three surface.

Text/Reference Books:
[1] Frank P. Incropera , David P. DeWitt, "**Fundamentals of Heat and Mass Transfer**"

[2] Yunus A. Cengel, Afshin J. Ghajar, "**Heat and Mass Transfer : Fundamentals and Applications**"

[3] M. Necati Ozisik, "**Heat Transfer: A Basic Approach**"

[4] J.P. Holman, "**Heat Transfer**"

Subject Code: ME6LP31	Subject Name: **Casting**

Types of casting processes, sand mould components, composition of moulding sand, cast microstructure, pattern allowances, mould filling time, solidification, design of sprue, runner, riser, casting defects.

Text/Reference Books:
[1] P N Rao, "**Manufacturing Technology (Foundry, Forming, and Welding)-Volume I**", McGraw Hill (India).

[5] [2] A Ghosh, A K Mallik "**Manufacturing Science**", East-West press.

Subject Code: ME6LP32	Subject Name: **Welding**

Types of welding processes. fusion arc welding, study of heat flow and temperature distribution in fusion arc welding, weld macrostructure, weldability, carbon equivalent, concept of residual stress, welding distortion.

Text/Reference Books:
[1] P N Rao, "**Manufacturing Technology (Foundry, Forming, and Welding)-Volume I**", McGraw Hill (India).
[2] A Ghosh, A K Mallik, "**Manufacturing Science**", East-West press.

[3] M P Groover, "**Fundamentals of Modern Manufacturing**", Wiley publications.

Subject Code: ME6LP33	Subject Name: **Machining Sciences**

Cutting tool geometry, ASA, ORS and NRS system; Mechanism of chip formation. Mechanics of machining, Cutting forces estimation; Shear angle relationship: Merchant's solution, Lee and Shaffer theory; Cutting temperature: causes, effects, estimation, shear zone and tool chip interface temperature measurement and control. Role of friction in metal cutting, Cutting fluid applications. Failure modes, wear and life of cutting tools. Practical machining operations like drilling, shaping, milling; Cutting tool materials; Role of geometrical and process parameters and cutting fluid on machinability; Mechanics of grinding; Economy of machining and grinding; Special techniques and advanced technology of machining and grinding.

Text/Reference Books:

[1] P N Rao, "**Manufacturing Technology (Metal Cutting and Machine Tools)-Volume 2**", McGraw Hill (India).

[2] A B Chattopadhyay, "**Machining and Machine Tools**", Wiley publications.

[3] G K Lal, "**Introduction to Machining Science**", New Age Publications.