# SYLLABUS OF ESE-2016

## MECHANICAL ENGINEERING (For Both Objective and Conventional Type Papers)

## PAPER - I

| S.NO. | SUBJECT NAME | SYLLABUS |
|---|---|---|
| 1 | **Thermodynamics, Cycles and IC Engines** | Basic concepts, Open and Closed systems<br>Heat and work<br>Zeroth, First and Second Law, Application to non - Flow and Flow processors<br>Entropy, Availability, Irreversibility and Tds relations<br>Claperyron and real gas equations, Properties of ideal gases and vapours<br>Standard vapour, Gas power and Refrigeration cycles. Two stage compressor<br>C-I and S.I. Engines<br>Pre-ignition, Detonation and Diesel-knock, Fuel injection and Carburetion, Supercharging<br>Turboprop and Rocket engines, Engine Cooling, Emission & Control, Flue gas analysis, Measurement of Calorific values<br>Conventional and Nuclear fuels, Elements of Nuclear power production |
| 2 | **Heat Transfer and Refrigeration and Air Conditioning** | Modes of heat transfer One dimensional steady and unsteady conduction<br>Composite slab and Equivalent Resistance<br>Heat dissipation from extended surfaces, Heat exchangers, Overall heat transfer coefficient, Empirical correlations for heat transfer in laminar and turbulent flows and for free and forced Convection, Thermal boundary layer over a flat plate<br>Fundamentals of diffusive and connective mass transfer, Black body and basic concepts in Radiation, Enclosure theory, Shape factor, Net work analysis<br>Heat pump and Refrigeration cycles and systems, Refrigerants<br>Condensers, Evaporates and Expansion devices, Psychrometry, Charts and application to air conditioning, Sensible heating and cooling, Effective temperature, comfort indices, Load calculations, Solar refrigeration, controls, Duct design |
| 3 | **Fluid Mechanics** | Properties and classification of fluids, Manometry, forces on immersed surfaces, Centre of pressure, Buoyancy, Elements of stability of floating bodies<br>Kinematics and Dynamics<br>Irrotational and incompressible<br>In-viscid flow. Velocity potential, Pressure field and Forces on immersed bodies<br>Bernoulli's equation, Fully developed flow through pipes, Pressure drop calculations, Measurement of flow rate and Pressure drop<br>Elements of boundary layer theory, Integral approach, Laminar and turbulent flows, Separations<br>Flow over weirs and notches<br>Open channel flow, Hydraulic jump<br>Dimensionless numbers, Dimensional analysis, Similitude and modelling<br>One-dimensional isentropic flow, Normal shock wave, Flow through convergent - divergent ducts, Oblique shockwave, Rayleigh and Fanno lines |
| 4 | **Fluid Machinery and Steam Generators** | Performance, Operation and control of hydraulic Pump and impulse an reaction Turbines, Specific speed, Classification<br>Energy transfer, Coupling, Power transmission, Steam generators Fire-tube and water-tube boilers<br>Flow of steam through Nozzles and Diffusers, Wetness and condensation<br>Various types of steam and gas Turbines, Velocity diagrams<br>Partial admission<br>Reciprocating, Centrifugal and axial flow Compressors, Multistage compression, role of Mach Number, Reheat, Regeneration, Efficiency, Governance |

# PAPER – II

| S.NO. | SUBJECT NAME | SYLLABUS |
|---|---|---|
| 1 | **Theory of Machines** | Kinematic and dynamic analysis of planer mechanisms. Cams<br>Gears and gear trains, Flywheels, Governors. Balancing of rigid rotors and field balancing<br>Balancing of single and multicylinder engines, Linear vibration analysis of mechanical systems<br>Critical speeds and whirling of shafts Automatic controls |
| 2 | **Machine Design** | Design of Joints : cotters, keys, splines, welded joints, threaded fasteners, joints formed by interference fits, Design of friction drives : couplings and clutches, belt and chain drives, power screws<br>Design of Power transmission systems : gears and gear drives shaft and axle, wire ropes<br>Design of bearings : hydrodynamics bearings and rolling element bearings |
| 3 | **Strength of Materials** | Stress and strain in two dimensions, Principal stresses and strains, Mohr's construction, linear elastic materials, isotropy and anisotropy, stress-strain relations,<br>uniaxial loading, thermal stresses<br>Beams : Bending moment and shear force diagram, bending stresses and deflection of beams<br>Shear stress distribution. Torsion of shafts, helical springs, Combined stresses, thick-and think-walled pressure vessels, Struts and columns, Strain energy concepts and theories of failure |
| 4 | **Engineering Materials** | Basic concepts on structure of solids, Crystalline materials, Detects in crystalline materials<br>Alloys and binary phase diagrams, Structure and properties of common engineering materials, Heat treatment of steels, Plastics, Ceramics and composite, materials, Common applications of various materials |
| 5 | **Production Engineering** | **Metal Forming:** Basic Principles of forging, drawing and extrusion; High energy rate forming; Powder metallurgy<br><br>**Metal Casting:** Die casting, investment casting, Shall Moulding, Centrifugal Casting, Gating & Riser design; melting furnaces<br><br>**Fabrication Processes:** Principles of Gas, Arc, Shielded arc Welding; Advanced Welding Processes<br><br>**Weld-ability:** Metallurgy of Welding<br><br>**Metal Cutting:** Turning, Methods of Screw Production, Drilling, Boring, Milling, Gear Manufacturing, Production of flat surfaces, Grinding & Finishing Processes. Computer Controlled Manufacturing Systems-CNC, DNC, FMS, Automation and<br>Robotics., Cutting Tools Materials, Tool Geometry, Mechanism of Tool Wear, Tool Life & Machinability; Measurement of cutting forces, Economics of Machining, Unconventional Machining Processes, Jigs and Fixtures, Fits and tolerances, Measurement of surface texture, Comparators Alignment tests and reconditioning of Machine Tools |
| 6 | **Industrial Engineering** | **Production Planning and Control :** Forecasting - Moving average, exponential smoothing, Operations, scheduling; assembly line balancing, Product development,<br>Break-even analysis, Capacity planning, PERT and CPM<br><br>**Control Operations :** Inventory control ABC analysis, EOQ model, Materials requirement planning, Job design, Job standards, Work measurement, Quality Management – Quality analysis and control<br><br>**Operations Research :** Linear Programming - Graphical and Simplex methods, Transportation and assignment models, Single server queuing model<br><br>**Value Engineering:** Value analysis for cost/ value |