

**Syllabus for Ph. D. Entrance Examination**  
**Department of Mechanical Engg.**

**Unit-1**

Imperfections in solids, diffusion mechanisms, dislocations and plastic deformation, strengthening mechanisms. Brittle fracture, ductile fracture, fatigue, S-N diagram, theories of fatigue, cumulative fatigue damage, crack initiation and propagation. Effect of different variables on fatigue. Creep, mechanisms of creep, creep fracture.

Conforming and non-conforming types of motion, rubbing, sliding, oscillating, rolling. Surface of interactions, elastic and plastic deformations, properties of materials, surface energy and flash temperature theory. Laws of sliding friction, concept of adhesion, sliding & rolling friction, measurement of friction. Laws of wear, types of wear such as adhesive, delamination, abrasive, fatigue, corrosive, fretting, erosive, electricals and oxidative measurement of wear in dry atmosphere and different environments. Prevention and control of wear and friction in machines, wear of cutting tool and dies, study of abrasion in grinding, lapping and honing. Mechanics of lubrication, lubricant types and application. Clearance in journal bearing, minimum film thickness, Sommerfeld Number, oil grooves and flow of oil in axial and circumferential grooves, cavitations and turbulence in oil bearing. Heat generation and cooling, bearing hydrostatic, hydrodynamic and their application in machine tools. Design of air bearing and other gas bearings.

**Unit-2**

Fundamentals of Metal cutting, system of tool nomenclature, tool standards, tool geometry, mechanism of Chip formation. Cutting tools, tool materials, optimum tool life, tool life equations, tool life test, machining optimization, Theory of tool wear. Test of machinability and influence of metallurgy on machinability. Fundamentals of metal casting. Characteristics, ingredients and additives of moulding sand, sand testing, core sands. Nature of cast metals, solidification of metals, nucleation and growth in metals and alloys, supercooling and freezing of alloys, centerline feeding resistance, rate of solidification, time of solidification, fluidity. Casting defects their causes and removal, repair of castings. Special Casting processes. Die casting of aluminium and its alloys, brass and bronze.

### **Unit-3**

Welding as a fabrication and repair process. Solidification structures in welded joints, various types of welding processes. Electron beam and laser beam welding. Welding equipments, weld joint design, operations and techniques. Metal fusion and weld penetration. Fundamentals of metal working, elements of the theory of plasticity, mechanics of metal working. Metallurgical structures, workability, metal working processes. Forging, rolling, drawing of rod, wires and tubes, extrusions and sheet metal forming. Introduction and need of non-conventional machining processes, principle and theory of material removal, process parameters. Advantages, limitation and applications of USM, EDM, LBM, ECM & EBM etc. Rapid Prototyping, honing, lapping and super finishing.

### **Unit-4**

Introduction to production systems, generalized model of production systems, life cycle concepts in production systems, facilities location and layout planning. Design of mass production systems, balanced assembly lines. Planning of production systems, model of aggregate production planning. Batch production system planning. Multistage production inventory system. In process inventory, sequencing and scheduling models, materials requirement planning. Plant location factors and theories, location of plant with multi-plant operations, locational dynamics, transportation model in plant location. Facilities planning, types of layouts. Charts required for facilities planning. Role of templates in plant layout. SPC & Quality control charts reliability and maintainability.

### **Unit-5**

Review of fluid Mechanics and Thermodynamics, Basic steam cycles used in steam turbine Plant. Two Dimensional flow, force due to fluid flow with circulation and vortices, creation of circulation around an aerofoil, determination of circulation through velocity triangle, vortex free flow in axial planes, stream function in vortex free flow.

Centrifugal Pumps and Compressor, flow in impeller channel, pre-rotation, theoretical analysis and experimental observation of channel flow, vane and channel shape, flow in discharge casing, Losses in pumps and compressors, specific speed as a type characteristic. Flow around bodies, cylinders and aerofoil, laminar and turbulent boundary layers, separation criterion, general differential equations of continuity, momentum and energy applied to compressible in viscid fluids. Sonic velocity, Mach number and propagation of disturbance in a fluid flow. Isentropic flow and stagnation properties, flow through nozzles and diffusers.