PhD Syllabus for Entrance in the area of of Mechanical Engineering

Unit 1: Engineering Mathematics: Linear Algebra: Matrix algebra, systems of linear equations, eigenvalues and eigenvectors. Differential equations: First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler-Cauchy equation; initial and boundary value problems. Numerical Methods: Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi-step methods for differential equations.

Unit 2. Engineering Mechanics & Strength of Materials Free-body diagrams, equilibrium, friction, Trusses, frames, and virtual work, Stress-strain, elastic constants, Mohr's circle, Shear force & bending moment diagrams, torsion, columns Strain energy methods and thermal stresses

Unit 3: Theory of Machines & Vibrations Planar kinematics and kinetics of rigid bodies, Cams, gears, flywheels, and governors, Balancing of rotating and reciprocating masses, Free & forced vibrations, damping, resonance, Critical speeds of shafts, vibration isolation

Unit 4: Machine Design Failure theories: static and fatigue, Design of fasteners: bolts, rivets, welded joints, Shafts, springs, clutches, brakes, Bearings: rolling and sliding, S-N curve, design for fluctuating loads

Unit 5: Fluid Mechanics Properties of fluids, fluid statics, Forces on submerged bodies, buoyancy, stability, Control-volume approach: mass, momentum, energy Bernoulli's equation, Navier-Stokes, flow through pipes, Compressible flow basics, boundary layer

Unit 6: Heat Transfer Conduction: 1D steady/unsteady, fins, Lumped system, Heisler charts, Convection: forced and free, dimensionless numbers, Heat exchanger: LMTD and NTU methods, Radiation: Stefan–Boltzmann law, view factors, network analysis

Unit 7: Thermodynamics: Thermodynamic systems, properties, processes, First and second laws, entropy, Availability and irreversibility, Thermodynamic relations, , Behavior of ideal and real gases

Unit 8: Power Engineering and IC Engines Gas and vapor power cycles: Rankine, Brayton, Otto, Diesel, Dual, Regeneration, reheat, intercooling, Air and gas compressors, Performance of IC engines and components

Unit 9: Refrigeration and Air Conditioning Vapour compression and gas refrigeration cycles, Heat pump cycles and COP, Psychrometry, Properties of moist air, cooling load concepts

Unit 10: Manufacturing Processes, Machining, Metrology & Automation Casting: patterns, gating, riser, solidification, Forming: rolling, forging, extrusion, drawing, Sheet metal: blanking, deep drawing, bending, Welding, soldering, brazing, adhesive bonding, Powder metallurgy, Mechanics of metal cutting, tool life, cutting fluids, Non-traditional machining: EDM, ECM, USM, etc. Jigs and fixtures, tool geometry, CNC and part programming, Metrology: limits, fits, tolerances, comparators, CMM, Basics of CAD/CAM, additive manufacturing