GALGOTIAS UNIVERSITY

NAAC GRADE A+ Accredited University

DEPARTMENT OF MECHANICAL ENGINEERING

PhD entrance syllabus (Mechanical Engineering)

ENGINEERING MECHANICS

Free-body diagrams and equilibrium; friction and its applications including rolling friction, belt-pulley, brakes, clutches, screw jack, wedge, vehicles, etc.; trusses and frames; virtual work; kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations; Lagrange's equation.

MECHANICS OF MATERIALS

Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; the concept of shear center; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with the universal testing machine; testing of hardness and impact strength.

THEORY OF MACHINES

Displacement, velocity, and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope. Free and forced vibration of single degree of freedom systems, the effect of damping; vibration isolation; resonance; critical speeds of shafts.

MACHINE DESIGN

Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted, and welded joints; shafts, gears, rolling and sliding contact bearings, brakes, and clutches, springs. Limits, fits, and tolerances;

FLUID MECHANICS

Fluid properties; fluid statics, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum, and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; the viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings; basics of compressible fluid flow.

HEAT-TRANSFER

Modes of heat transfer; one-dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, the effect of turbulence; heat exchanger performance, LMTD, and NTU methods; radiative heat transfer,

Stefan- Boltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis.

THERMODYNAMICS

Thermodynamic systems and processes; properties of pure substances, the behavior of ideal and real gasses; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability, and irreversibility; thermodynamic relations.

POWER PLANT, REFRIGRATION AND TURBOMACHINERY

Power Engineering: Air and gas compressors; vapor and gas power cycles, concepts of regeneration and reheat. I.C. Engines: Air-standard Otto, Diesel, and dual cycles. Refrigeration and air-conditioning: Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes. Turbomachinery: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines; steam and gas turbines.

ENGINEERING MATERIALS

Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials.

CASTING, FORMING, AND JOINING PROCESSES

Different types of castings, design of patterns, molds, and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering, and adhesive bonding.

MACHINING AND MACHINE TOOL OPERATIONS

Mechanics of machining; basic machine tools; single and multi-point cutting tools, tool geometry and materials, tool life, and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, jigs and fixtures; abrasive machining processes; NC/CNC machines and CNC programming. Basic concepts of CAD/CAM and their integration tools; additive manufacturing.

INDUSTRIAL ENGINEERING

Forecasting models, aggregate production planning, scheduling, materials requirement planning; lean manufacturing. Inventory Control: Deterministic models; safety stock inventory control systems. Operation research: Linear programming, simplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM