Institute of Infrastructure, Technology, Research And Management

Syllabus for Written Test

PhD Admission Autumn Semester (2026-24)

Department of Mechanical and Aerospace Engineering

Manufacturing, Materials, and Industrial Engineering

Machining (Metal Cutting): Mechanics of machining; basic machine tools; single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; non-traditional machining processes.
Casting and Joining Processes: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Principles of welding, brazing, soldering and adhesive bonding, Inspection and Quality Control, *additive manufacturing*.
Metal Forming and Sheet Metal Working: 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; *Sheet Metal working*: Blanking, Punching, piercing, bending, drawing etc.
Computer Aided Design and Manufacturing: Limits, fits and tolerances, Basic concepts of CAD/CAM and their integration tools.
Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning; lean manufacturing. Inventory Control: Deterministic models; safety stock inventory control systems. Operations Research: Linear programming, simplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.
Materials science: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials, powder metallurgy.

Mechanics and Design

Engineering Mechanics: Friction and its applications, belt-pulley, brakes, clutches, screw jack, wedge, vehicles. 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, deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses.
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.
Vibrations: Free and forced vibration of single degree of freedom systems, 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.

Thermal Sciences and Fluid Mechanics

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics, second law of thermodynamics; availability and irreversibility.
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, 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
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; 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.
Power Engineering and Refrigeration: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. *I.C. Engines:* Air-standard Otto, Diesel and dual cycles. *Turbomachinery*: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines; steam and gas turbines. *Refrigeration and air-conditioning*: Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychometric chart, basic psychometric processes.

Research Methodology

Meaning and Characteristics of research, Concepts and Methods of research, steps of research, Purpose and scope of inter-disciplinary research, Selection of research problems, Literature review, Application of ICT in Research, Research ethics, Types and Functions of Hypothesis, Sampling, Scaling and Data collection techniques and methods, Quantitative and Qualitative data analysis, Reference styles and Citation, Thesis and manuscript writing