

## **Ph. D Written Test Format and Syllabus**

Mechanical Engineering, Faculty of Engineering

### **Ph.D. Admission Test Format**

The written test consists of two parts.

1. **Part A:** Research Methodology 25 questions.
2. **Part B:** ME 25 questions

### **Part A: Research Methodology Syllabus**

#### **Research Fundamentals:**

Meaning of research; objectives of research; characteristics of good research, Research problem: Identification, selection, and techniques for defining research problem, Research process, Research outcomes, Review of Literature, Hypothesis: Definition and Types

#### **Types of Research:**

Types of research, fundamental and applied research, qualitative and quantitative. Research Design: Types of research design – Exploratory, Descriptive, Casual Analytical

#### **Sampling, Data Collection and analysis:**

Types and sources of data: Primary and secondary, Methods of collecting data: questionnaire, interview, observation, case study, experiments etc., Sampling and sampling methods, characteristics of good sample, sampling techniques, Statistical Methods for Data Analysis: measures of central tendency and dispersion

#### **Research Report:**

Main body of report, abstract and keywords, Referencing styles and bibliography. Journal and author indexing

#### **Ethics in Research:**

Biasing: Definition and Types, Plagiarism -Definition and forms, IPR, copyright infringement, AI Generated Content

## **Part B: Mechanical Engineering Syllabus**

### **Applied Mechanics and Strength of Materials:**

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; concept of shear centre; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

### **Theory of Machines and Mechanical Design:**

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.

### **Fluid Mechanics and Thermodynamics:**

Fluid Mechanics: Fluid properties; fluid statics, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; 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.



Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behavior of ideal and real gases; 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.

### **Heat Transfer and Applications:**

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, thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, 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

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

### **Materials, Manufacturing, and Industrial Engineering:**

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, moulds and cores; solidification and cooling; riser and gating design. 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 and CNC programming.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning; lean manufacturing.

Operations Research: Linear programming, simplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.