



## Department of Mechanical Engineering

### Syllabus for Ph.D. Admission Eligibility Test

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#### **Paper-I: Research Methodology**

Research and Types of research: Meaning of Research- Objectives of Research- Motivation in Research. Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical. Research Process. Criteria of good Research. Research Formulation – Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis. Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection – Modeling, Mathematical Models for research, Sampling Methods- Data processing and Analysis strategies. Data Analysis with Statistical Packages – Hypothesis-testing, Generalization-and Interpretation.

#### **Paper-II: Core Subjects**

##### **Section 1: Mechanics and Design**

**Engineering Mechanics:** Free body diagrams and equilibrium, Trusses and frames.

**Strength of materials (SOM):** Principal Stress and Strain, Stress and Strain, Bending Moment and Shear Force Diagram, Torsion, Riveted and Welded Joint, Spring, Theories of Column (Euler method, end conditions), Strain Energy Method (Castigliano's theory), Theories of failure.

**Theory of Mechanism (TOM):** Mechanism, Linear Vibration Analysis of Mechanical Systems, Gear train, Flywheel (Coefficient of Fluctuation of speed, Coefficient of Fluctuation of energy)

**Design:** Rolling Contact Bearings, Load-life Relationship, Sliding contact bearing, Modes of Lubrication, Sommerfeld Number, Fluctuating Load Consideration for Design, Clutch, Brake.

## **Section 2: Materials, Manufacturing, and Industrial Engineering**

**Engineering Materials:** Iron-carbon Equilibrium diagram, TTT diagram, Heat treatment, Crystal structure & crystal defects.

**Manufacturing Science:** Theory of metal cutting, forces, tool life, Rolling calculations, Wire drawing and Extrusion calculations, Sheet metal operations, clearance, force, power, shear calculations, Lathe, drilling, milling, shaping cutting time calculations, Grinding and finishing, ECM MRR, feed calculations, EDM theory, comparison of all NTMM, Limit, tolerance, fit, Jig & Fixture, 3-2-1 principle, Welding: V-I Characteristics calculations, Resistance welding calculations, Casting: allowances, Riser Design, Sprue Design, Pouring time calculations, Special, Castings.

**Industrial Engineering:** EOQ Models, PERT & CPM, Forecasting, Assembly line balancing.

**CAD/CAM:** Wire frame modelling, surface modelling, solid modelling, FMS, NC/CNC Machines, CIM.

## **Section 3: Fluid Mechanics and Thermal Sciences:**

**Fluid Mechanics:** Properties of fluid, Pressure measurement, manometers, Fluid kinematics, Bernoulli's equation, Flow measuring devices, Boundary layer, Thermal boundary layer, Compressible flow, Hydraulic turbine, Centrifugal pump.

**Thermodynamics:** Basic concepts, Application of first and second law of thermodynamics, Entropy, Availability, Pure substance, Gases and gas mixture, Thermodynamics relations.

**Heat Transfer:** Conduction, Critical thickness of insulation, Unsteady conduction (Lumped parameter analysis), Free and forced convection, Heat exchangers (LMTD, NTU), Radiation: The Stefan-Boltzmann Law, Shape factor algebra, Heat exchange between grey bodies).

**Refrigeration and Air Conditioning (RAC):** Heat engine, heat pump, refrigerator, Vapour compression systems, Psychrometry.

**Power plant:** Steam cycle, gas Cycle, Compressor.