Faculty of Engineering & Technology
Research Entrance Test (RET)
Syllabus: Mechanical Engineering

SECTION A: RESEARCH METHODOLOGY

Unit 1: Introduction to Research: Research methodology: meaning and significance of research; objectives of research; motivation in research; types of research; concept of basic and applied research; quantitative and qualitative research techniques; need for theoretical framework; hypothesis development; hypothesis testing using quantitative data; research design and purpose of the study including exploratory, descriptive, and hypothesis-testing research; impact factor; citation and citation index.

Unit 2: Experimental Design: Laboratory and field experiments; internal and external validity; factors affecting internal validity; measurement of variables; scales and measurement of variables; development of scales; rating scales and attitudinal scales; validity testing of scales; concept of reliability in scale development; stability measures.

Unit 3: Data Collection, Analysis and Inference: Probability distributions: binomial, Poisson, normal, exponential, Weibull, and geometric distributions; sampling techniques including random sampling, stratified sampling, systematic sampling, and cluster sampling; statistical tests such as Student's t-test, F-test, and chi-square test and their applications in research studies; forecasting methods; basic concepts of factor analysis, cluster analysis, and discriminant analysis; experimental designs including completely randomized design, randomized block design, and Latin square design; accuracy, precision, and error analysis.

Unit 4: Multivariate Statistical Techniques: Data analysis techniques including factor analysis, cluster analysis, discriminant analysis, multiple regression and correlation, canonical correlation; application of statistical software packages (SPSS) in research.

Unit 5: Research Report and Ethics : Significance of research report writing; steps involved in report writing; layout of a research report; types of research reports; integral parts of a report; precautions in writing a research report; oral presentation techniques; policy on academic honesty and integrity; academic cheating and plagiarism; opportunities for carrying out research projects with funding and assistance from government agencies.

Ph.D. Entrance Examination:2025-26

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Unit 1: Engineering Mechanics: Free-body diagrams and equilibrium; friction and its applications including rolling friction, virtual work; kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations; Lagrange's equation. 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.

Unit 2: 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, effect of damping; vibration isolation; resonance; critical speeds of shafts.

Unit 3: 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.

Unit 4 : 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

Unit 5: 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.

Unit 6: Manufacturing Science: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials., Different types
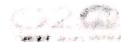
of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding. 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, Limits, fits and tolerances; linear and angular measurements; comparators; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly; concepts of coordinate-measuring machine (CMM), Basic concepts of CAD/CAM and their integration tools; additive manufacturing.

Unit 7: Industrial Engineering: Deterministic models; safety stock inventory control systems.

Linear programming, simplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM, Forecasting models, aggregate production planning, scheduling, materials requirement planning; lean manufacturing.