भारतीय प्रौद्योगिकी संस्थान तिरुपति
INDIAN INSTITUTE OF TECHNOLOGY TIRUPATI
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Syllabus for M.S.(R) & Ph.D. Written test/ Interview – January 2026 semester

Department of Mechanical Engineering – Fluids and Thermal Engineering

Engineering Mathematics; Fundamentals from UG/PG coursework, project work relevant to Fluids & Thermal Engineering

Engineering Mathematics

Linear Algebra: Algebra of matrices; Inverse and rank of a matrix; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalisation of matrices; Cayley-Hamilton Theorem.

Calculus: Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima. Evaluation of definite and indefinite integrals; Applications of integrals to evaluate areas and volumes, Double and triple integrals, and their applications.

Vector Calculus: Gradient, divergence, and curl; applications of these concepts in engineering analyses.

Ordinary Differential Equations: First order equations (linear and nonlinear); Second order linear differential equations with variable coefficients.

Fluids and Thermal Engineering

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics, Third law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.

Fluid Mechanics: Introduction, definition of a fluid, continuum hypothesis, fluid properties, stress at a point, classification of flows, rheological classification; Fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; Fluid kinematics, Lagrangian and Eulerian description, vorticity and rotationality; Reynolds transport theorem, Bernoulli equation, conservation of mass, continuity equation, stream function, potential function, conservation of momentum, momentum analysis of flow systems; Dimensional analysis; Internal flow, flow

through pipes, head losses in pipes, laminar and turbulent flow in pipes, Moody's chart; External flow, lift and drag, flow over flat plates, cylinders and spheres; Viscous flow of incompressible fluids, boundary layers; Elementary turbulent flow, Basics of Compressible 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, 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, Boiling and condensation.