

DEPT OF PAPER TECHNOLOGY
IIT Roorkee Saharanpur Campus
Syllabus for M.Tech. Entrance Examination

Mathematics:

Matrix Algebra- Elementary operations and their use in getting the Rank, Inverse of a matrix and solution of linear simultaneous equations. Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Normal & Unitary matrices and their elementary properties; Eigen-values and Eigenvectors of a matrix. **Calculus**-Review of limits, continuity, differentiability. Mean value theorem, Taylors Theorem, Maxima and Minima; Riemann integrals, Fundamental theorem of Calculus, Improper integrals, applications to area, volume; Partial Derivatives, gradient and directional derivatives, chain rule, maxima and minima; Lagrange multipliers; Double and Triple integration, Jacobians and change of variables formula.

Thermodynamics:

Thermodynamic system, measurement of pressure, heat and work; Properties of pure simple compressible substance, equation of state for ideal and real gases, use of steam table, zeroth law of thermodynamics; First and second law of thermodynamics, thermodynamic analysis of closed system based on first and second law, heat engine, efficiency; Entropy; Vapour power cycle-rankine cycle.

Fluid Mechanics:

Fluid Statics, Fluid kinematics; Laminar flow; Shear rate and shear stress; Rheological properties of fluids; Newtonian and non-Newtonian fluids Basic; Equations of Fluid Flow, incompressible flow in pipes and channels, pressure drop through fitting and valves, concepts of equivalent length; Flow Measurement methods; Types of pumps, virtual head, specific speed, criteria of similarity, operating characteristics, NPSH, cavitation.

Material and Energy Balance:

Units and dimensions, conversion of units; Dimensional analysis; Concept of mole; Chemical equations and stoichiometry, Gas mixture, Dalton's law of partial pressures, Amagat's law; Vapor Pressure; Psychrometry; Material balance for systems with and without chemical reactions; Principles of thermophysics and thermochemistry; Types of fuels; Proximate and ultimate analyses, heating values; Material and energy balance in combustion processes; Thermal efficiency.

Chemistry:

Thermodynamics-Statistical concept of entropy, free energy, and chemical equilibria, chemical potential. **Chemical Kinetics and Catalysis**-Theories of chemical reaction rates, complex reactions. homogeneous and heterogeneous catalysis. **Phase Rule**-Phase rule, phase diagrams of 1 and 2 component systems, Lever rule. **Electrochemistry**-Introduction, anomaly of strong electrolytes, inter-ionic attraction theory, Debye – Hückel – Onsager equation, Wien effect, Debye – Falkenhagen effect, types of electrodes, galvanic cells, liquid junction potential, concentration cells with and without transference, polarization. **Stereoisomerism**-Overview of concepts, configuration, Fischer and Newman projections; Optical isomerism of simple cyclic systems and of compounds without asymmetric carbon atom (allenes, spirocompounds, etc.); chirality involving atoms other than carbon. **Organic reactions**-Aliphatic and aromatic substitution, Addition and elimination reactions: reaction steps, stereochemistry and reactivity.

Environmental Engineering:

Characteristics of water, physical, chemical and biological; Water pollution, definition, types of water pollution based on source (point and non-point), characteristics (physical, chemical, physiological and biological); Water quality standards and criteria for different uses; Control of water pollution at source level, by treatment methods – primary, secondary. **Air pollution**- Sources and types of air pollutants, major air pollutants.