

रासायनिक अभियांत्रिकी विभाग Department of Chemical Engineering	राष्ट्रीय प्रौद्योगिकी संस्थान श्रीनगर NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR (An Autonomous Institute of National Importance under the aegis of Ministry of Education, Govt. of India) हजरतबल, श्रीनगर, जम्मू-कश्मीर, 190006, भारत Hazratbal, Srinagar, Jammu and Kashmir, 190006, INDIA	
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SYLLABUS FOR Ph.D. ENTRANCE EXAMINATION, AUTUMN-2026

A. CORE SUBJECTS

[60% Marks]

Process Calculations and Thermodynamics

Mole concept, concentrations of liquid solutions, stoichiometric principles, Ideal and real gas laws, batch v/s continuous, Material balances with and without chemical reactions, Energy Balances, Recycle, Bypass, and Purge calculations, steady and unsteady state processes.

First and second laws of thermodynamics. Applications of the first law to closed and open systems. Second law and entropy. Thermodynamic properties of pure substances: equation of state and residual properties; properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.

Instrumentation and Process Control

Measurement of process variables; sensors and transducers; P&ID equipment symbols; process modeling and linearization, transfer functions and dynamic responses of various systems, systems with inverse response, process reaction curve, controller modes (P, PI, and PID); control valves; transducer dynamics; analysis of closed loop systems including stability, frequency response, controller tuning, cascade and feed forward control.

Chemical Reaction Engineering

Rate equation, stoichiometry & rate laws. Material balance for CSTR & PFR, their use for kinetic interpretation, and design comparison of batch reactor. Evaluation of performance properties of reactors. Analysis of rate data for batch/continuous flow reactors and development of rate equation catalysis: classification, preparation, and properties of catalysts. Physical and chemical adsorption. Gas-solid reactions. Film penetration theories. Enhancement factor in gas-liquid reactions.

Fluid Mechanics & Mechanical Operations

Properties & classification of fluids; Forces on fluids, Normal forces & shear stresses on fluids. Forces on submerged bodies. Kinematics of flow. Macroscopic balance of mass, energy & momentum. Fluid friction. Differential equations of fluid mechanics. Solution of the viscous flow problem. Laplace equation for irrotational flow. Boundary layer. Turbulent flow.

Particle size and shape, particle size distribution, size reduction and classification of solid particles; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, agitation and mixing; conveying of solids.

Mass Transfer

Molecular diffusion in fluids; mass-transfer coefficients in laminar and turbulent flows; mass, heat, and momentum-transfer analogies; Fick's law of diffusion. Gas liquid operations – humidification, gas absorption, distillation, extraction, crystallization, multi-component distillation.

Heat transfer

Equation of energy, steady and unsteady heat conduction, convection and radiation, thermal boundary layer and heat transfer coefficients, boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations; design of double pipe, shell and tube heat exchangers, and single and multiple effect evaporators.

Chemical Technology

Inorganic chemical industries (sulfuric acid, phosphoric acid, chlor-alkali industry), fertilizers (Ammonia, Urea, SSP, and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals; polymerization industries (polyethylene, polypropylene, PVC, and polyester synthetic fibers), cement and fertilizer industries.

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Plant Design and Economics

Principles of process economics and cost estimation, including depreciation and total annualized cost, cost indices, rate of return, payback period, discounted cash flow, optimization in process design, and sizing of chemical engineering equipment such as heat exchangers and multistage contactors.

B. ALLIED SUBJECTS

[20% Marks]

Wastewater Treatment: Characteristics of wastewater; physical, chemical, and biological treatment processes, preliminary and primary treatment, sedimentation, coagulation, and filtration.

Biological & Advanced Treatment: Activated sludge process, trickling filters, anaerobic treatment, nutrient removal, disinfection, adsorption and membrane processes; sludge treatment and disposal.

Energy Engineering: Conventional and renewable energy sources, energy conversion and efficiency, energy conservation, and basic principles of sustainable energy systems.

Environmental Engineering: Air and water pollution, solid and hazardous waste management, pollution control methods, environmental impact assessment, and sustainable environmental practices.

Biochemical Engineering: Cell Biology, Kinetics of fermentation, bioreactor design, sterilization, bio-separation, cell structure, media formulation. Structure, function & usage of proteins, DNA, and RNA.

C. GENERAL APTITUDE

[20% Marks]

1. Verbal Ability:

English grammar, sentence completion, verbal analogies, word groups, Instructions, critical reasoning and verbal deduction.

2. Quantitative Aptitude

Data interpretation: Data graphs (bar graphs, Pie charts, and other graphs representing data), 2- and 3-dimensional plots, maps, and Tables.