

DEPARTMENT OF CHEMICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

SYLLABUS FOR Ph.D. ENTRANCE EXAMINATION, Autumn- 2016

A. CORE SUBJECTS

Mass Transfer

Molecular diffusion in fluids, mass transfer coefficient 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.

Process Thermodynamics

First law of Thermodynamics, Second law of Thermodynamics, gas and vapour mixtures, reactive mixtures, Thermo-physical properties of pure fluids. Equilibrium properties.

Process Engineering

Process synthesis: hierarchical conceptual design of process, batch v/s continuous, input-output structures of flow sheet. Choice of separation system. Heat exchanger network design, pinch technology.

Process Dynamics And Control

Lumped parameter system- classical and multivariable control theory, measurement of process variables such as temperature, pressure, composition, flow, level, density etc. Dynamics of instruments. Dynamic behaviour of first, second & higher order systems.

Transport Phenomena

Definition of transport properties, their measurement and estimation. Shell balance approach for developing equations for moment, heat & mass transport. Solution of problems involving transport in one dimension.

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

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 viscous flow problem. Laplace equation for irrotational flow. Boundary layer. Turbulent flow.

Heat transfer

Steady state conduction in one dimension. Heat transfer coefficient in fluids separated by plane wall, cylindrical wall, extended surfaces. Critical & optimum insulation thickness. Forced convection in system of simple geometrics. Heat transfer with a variable driving force – concurrent & counter current operations. Free convection from flat surface, cylinder & in an enclosure. Combined free & forced convection. Boiling & Condensation: Radiation heat transfer: Radiation from surface, radial intensity of black body, view factor of algebra. Radiation combined with conduction & convection. Heat Exchangers: Process design considerations, Double pipe, Shell & tube & Compact heat exchanger design. Effectiveness NTU method of HE analysis. Heat Transfer in agitated vessels. Unsteady state & multidimensional heat conduction. Boundary layer heat transfer.

B. ALLIED SUBJECTS

Plant Design

Plant layout auxiliaries, material handling, offsite facilities, selection & detailed design of equipment.

Environmental Engineering & Waste management

Ecology and Environment, Sources of air, water and solid Wastes, Air Pollution. Fate of pollutants, air pollution control technologies- centrifugal collectors, electrostatic precipitators, bag filter, & wet scrubber. Combustion generated pollutants, vehicle emission control. Water Pollution.

Energy: Conventional and Non Conventional sources

Biochemical Engineering

Kinetics of fermentation, bioreactor design, sterilization, bio-separation, cell structure, media formulation. Structure function & usage of proteins, DNA, RNA.

Safety in Process Industries

Chemical process industry (CPI) safety codes. Control technology to reduce accidents in CPI. Hazard evaluation techniques. Qualitative risk analysis, risk assessment (RA) accident probability, hazard operability studies (HAZOP), Hazard Analysis (HAZAN). Fault tree analysis (FTA), Event tree analysis (ETA). Safety analysis, safety review, preconditions & preparations. Analytical procedures. Safety Management

C. General Aptitude/ Mathematics.

1. Laplace Transforms
2. Numerical Methods
3. Statistical Methods- Bayes Theorem
4. Complex Variables & Special Functions