

DEPARTMENT OF CHEMICAL ENGINEERING
SYLLABUS FOR Ph.D. ENTRANCE EXAMINATION, AUTUMN- 2021

A. CORE SUBJECTS [30 Marks]

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

Feed forward, feedback systems, block diagrams. Transfer function .Linear open loop system transfer function. Transient response of a *First Order* and 2nd order systems . Study of parameters of 2nd order under damped response. Components of control system. Stability criterion, Routh test.

Transport Phenomena

Newton's Law of Viscosity , Molecular Momentum Transport .Calculation of Momentum Flux. Shell Momentum Balances and Velocity Distributions in Laminar Flow .The Equations of Change for Isothermal Systems .The Equation of Continuity. The Equation of Motion . Shell Energy Balances and Temperature Distributions in Solids and Laminar Flow Diffusivity and the Mechanisms of Mass Transport.

Chemical Reaction Engineering

Rate equation, stiochiometry & 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: 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 [15 Marks]

Plant Design

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

Environmental Engineering & Waste management

Ecology and Environment. Fate of pollutants, centrifugal collectors, electrostatic precipitators, bag filter, & wet scrubber. Water Pollution.

Energy: Conventional and Non Conventional sources

Biochemical Engineering

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

C. GENERAL APTITUDE [15 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.