Syllabus for Written Examination for Admission in PhD Programme in Chemical Engineering

Basic Chemical Engineering Calculations

Process variables estimation, basic Chemical Engineering Calculations, Material balance on reactive and non-reactive systems, Energy balance on reactive and non-reactive systems.

Fluid flow operations

Fluid statics, Pressure drop measurement by manometers, Newtonian and Non-Newtonian fluids, Mass and momentum balance equation,, Bernoulli equation, friction factor, pressure drop for flow through pipe, flow meters, pumps and compressors, agitation and mixing.

Mechanical Operations

Sieve analysis, Sphericity and Specific surface area of solids, Size reduction, Ball mill. Estimation of drag, Motion of particles in fluid. Free and Hindered settling, Estimation of terminal velocity, Sedimentation, Fluid flow through a packed bed, Determination of Pressure drop through packed bed, Determination of minimum fluidization velocity and pressure drop. Cake filtration, Gas-fluid separation.

Mass Transfer

Diffusion in fluids, steady state diffusion, diffusivity of liquids and gases, Mass transfer coefficient, theories for mass transfer coefficient, Absorption, Distillation, liquid-liquid extraction, Adsorption, Humidification and drying, Leaching, crystallization.

Heat Transfer

Steady-State Conduction in Plane Wall, The Cylinder and Sphere, Convection in Laminar Flow in Circular Tubes, Convection in Turbulent Flow in Circular Tubes, Heat Transfer by radiation, Boiling and Condensation, Heat Exchangers, Heat Exchanger Design.

Chemical Reaction Engineering

Elementary and non-elementary reactions, Rate of reaction, Rate constant and order of reaction, Arrhenius' law, Activation energy, Constant volume batch reactor, Variable volume batch reactor, Types of reactors, PFR, CSTR etc, Size comparison of single reactors, Performance equations for CSTR and PFR; RTD of fluid in reactors, Homogenous and heterogeneous reactions.

Chemical Engineering Thermodynamics

The law of conservation of Energy, First Law of Thermodynamics: Closed and Open Systems, enthalpy, heat capacity, specific heat, Equation of state, Estimation of thermodynamic properties. Heat effects, Second law and entropy, Maxwell's relations and fluid property estimation, Residual properties, Single Phase Mixtures and Solutions; Partial molar properties, Gibbs-Duhem equation, fugacity and fugacity coefficient for pure components and for mixture of gases and liquids. Excess properties of mixtures, activity co-efficient, Chemical reaction equilibrium.