PBT4I104 BIOCHEMICAL REACTION ENGINEERING

Module I: Material, energy balance and concepts of reaction engineering

Material Balance & Energy Balances: Mathematical requisites – use of log-log and semi-log graph paper, triangular diagram, graphical differentiation and graphical integration, material balance without chemical reaction, material balance with chemical reaction, energy balance; enthalpy changes, heat of reaction and its temperature dependence, heats of solution and mixing, adiabatic flame temperature, use of psychometric charts. Kinetics of homogeneous reactions: classification of reactions, reaction rate, speed of reaction, rate equation, concentration-dependent term of rate equation, rate constant, order and molecularity, representation of elementary and nonelementary reactions, kinetic models for nonelementary reactions, temperature-dependent term of a rate equation, activation energy and temperature dependency.

Module II: Reaction engineering of batch and continuous reactors

Kinetic analysis of batch reactor data: Integral and differential methods for analyzing kinetic data, interpretation of constant volume batch reactor, data for zero, first, second and third order reactions, half life period, irreversible reaction in parallel and series, auto catalytic reaction. Kinetic interpretation of batch reactor data for single reactions: interpretation of variable volume batch reaction data for zero, first and second order reactions, Ideal batch reactor, steady state CSTR and plug flow reactors and their use for kinetic interpretation. Design for single reaction: size comparison of single reactors, plug flow reaction in series and/or parallel, equal and different size of mixed reactor in series, finding the best system for given conversion, recycle reactor, Design of multiple reactions in batch, CSTR and PFR.

Module III: Heterogeneous reactions and Biochemical reactions

Reaction catalyzed by solids: introduction to heterogeneous reactions, rate equation for surface kinetics, pore diffusion resistance combined with surface kinetics, porous catalyst particles, performance equations for reactors containing porous catalyst particles, experimental methods for finding rates, advantages and disadvantages of packed bed and fluidized bed catalytic reactors. Biochemical reaction systems: microbial fermentation, batch fermentor and mixed flow fermentor, kinetic expressions of fermentation.

Books

1. Chemical process Principles (Part I & II), Houge, Watson & Ragatz, Asian Student Edition, Asia Publishing House.
2. Basic Principles and Calculations in Chemical Engineering, Himmelbalu, Prentice Hall (l) 6th Ed.
3. Coulson & Richardson's Chemical Engineering- Volume 3 (Chemical and Biochemical Reactors and process controls) ed. Ricchardson. J.F., Peacock. D.G.,First Indian ed. Asian Books Pvt.Ltd. 1998.
4. Levenspiel, O., Chemical Reaction Engineering,Wiley Eastern Ltd.
5. Smith & Vanness, Thermodynamics for Chemical Engineers, MGH.
6. Bailey & Oils, Biochemical Engg. Fundamentals, MGH
7. Foggler, Elements of Chemical Reaction Engineering