I Year & I Sem.; M.Tech. Biotechnology & Bioprocess Engg.	L	T	P	TO	C
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(BT531) ADVANCED BIOCHEMICAL REACTION ENGINEERING

Objectives of the Course:

1. Develop familiarity with chemical reaction kinatics.

2. Giving basic concepts of reactor design.

3. Making familiarity with reactor operation, studing various param eters like flow pattern and thermodynamics of reactions.

UNIT I: Overview of chemical reaction engineering:
Classification of reactions, variables affecting the rate of reaction, Concept of order, molecularity of a reaction, definition of reaction rate, concentration dependent term of rate equation, Temperature dependent term of rate equation, Evaluation of rate constants, temperature using Arrhenius equation. Searching for a mechanism

UNIT II: Ideal Reactors :
Irreversible unimolecular type first order reactions, irreversible bimolecular type second order reactions. Interpretation of batch reactor data. Introduction to reactor design- general discussion, symbols and relation ship between C_A and X_A. Ideal batch reactor, Steady-state mixed flow reactor, Steady-state plug reactors.

UNIT III: Multiple Reactions And Nonisothermal Reactions:
Introduction to multiple reactions, qualitative discussion about product distribution, quantitative treatment of product distribution and of reactor size. Heats of reaction, equilibrium constants from thermodynamics, equilibrium conversion, general graphical design procedure, optimum temperature progression, heat effects, adiabatic operations, non adiabatic operations.

UNIT IV: Characterization of Reactors:
Definition of bioreactor, Concepts of reactors based on flow characteristics, design of ideal reactors using material and energy balance. Batch bioreactor design. Definition of chemostat, turbidostat, single flow single stage chemostat, single flow multistage chemostat, recycle flow in chemostat, Plug flow behavior, design of plug flow reactor.

UNIT V: Non-Ideal Reactors & Heterogenous Reactions :
Concepts of residence time distribution, micro mixing and macro mixing, Reasons for non-ideality, concept of macro using –RTD analysis (E-C-F functions), diagnosing the ills of non-ideal bioreactors. **Heterogenous reactions:** Solid catalyzed reactions, the rate equation for surface kinetics, Pore diffusion, resistance combined with surface kinetics, perfomance equation for reactors containing porous catalyst particles, product distribution in multiple reactions.

TEXT BOOKS :

1. Octave Levenspiel, "Chemical Reaction Engineering" , 3rd ed. John Wiely & Sons, 1999.
2. D.G.Rao, "Introduction to Biochemical Engineering", McGraw-Hill, 2005.
3. P.M.Doran , "Bioprocess Engineering Principles", Academic Press, 1995.
4. M.L.Shuler and F. kargi , "Bioprocess Engineering", Prentice Hall of India ,1992.

REFERENCE BOOKS :

1. H.S. Fogler, "Elements of Chemical Reaction Engineering", 2nd ed. PHI, 1992.
2. J.M.Smith, "Chemical Engineering Kinetics", 3rd ed. Mc Graw Hill, 1981.

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