

(BT534) BIOPROCESS MODELING CONTROL & SIMULATION

Objectives of the Course:

1. To acquaint students with basic models in bioprocess engineering.
2. To give knowledge of various parameters to be considered in bioprocess modeling.
3. To acquaint students with controlling of bioprocess and simulation of bioprocess.

UNIT-I: Introduction to Modeling:

Process Design – Process Synthesis, Process Analysis, Optimization, Strategy for Process Engineering, Process Plant Simulation; Modeling Aspects – Physical Modeling, Mathematical Modeling, Model Formulation Principles, Fundamental Laws used in Modeling, Cybernetics, Controlled System and Principles of Similarity.

Unit-II: The Kinetics of Enzyme-catalyzed Reactions:

Michaelis–Menton Kinetics, Evaluation of Parameters in the Michaelis–Menton Equation: Kinetics of Substrate Utilization, Product Formation and Biomass Production in cell cultures – Ideal Batch Reactor, Ideal Continuous-Flow Stirred–Tank Reactor (CSTR), Monod Growth Kinetics, Monod Chemostat Model, and Product yield coefficient and Growth-Cycle Phases for Batch Cultivation.

Unit-III: Design and Analysis of Biological Reactors:

Ideal Bioreactors – Fed Batch Reactors, Enzyme- Catalyzed Reactions in CSTRs, CSTR Cell Reactors with Recycle and Wall growth, The Ideal Plug-flow Tubular Reactor, Dynamic Models.

Unit-IV: Modeling of Fermentation Processes:

System Analysis Approach to the Mathematical Modeling of fermentation processes – Kinetics of Simple Processes, Stoichiometry of Microbial Processes, Physiological Aspects of Mathematical Models for Fermentation Processes, Modeling of Oxygen Transfer, and The use of Simple Mixing Models for Simulation of Fermentation Processes; Mathematical Model Identification– Preliminary Analysis of Experimental data, Rate Relationship and Kinetic Parameters.

Unit-V: Fundamentals of Mass Balancing:

Mass Balances - Systems without Chemical Reactions, Study State Processes without Chemical Reactions, Intermittent Operation without Reactions; Systems with Chemical Reactions – Processes with (bio) Chemical Reactions, Steady state system with chemical reactions, Intermittent operation with Chemical Reactions. Transient Mass Balances – A Perfectly Stirred Tank Model, Transient Mass Balances with Reactions. The Plug Flow Model.

TEXT BOOKS :

1. B.V. Babu, “Process Plant Simulation”, OXFORD University Press, 2004.
2. JAMES E. BAILEY, David F. OLLIS, “Biochemical Engineering Fundamentals”, 2nd ed., McGraw Hill, International Book Company, 1986

REFERENCE BOOK :

1. B. VOLESKY and J. VOTRUBA, “Modeling and Optimization of Fermentation Processes”, ELSEVIER, 1992.