17BT008- BIOPROCESS MODELING CONTROL & SIMULATION

Hours Per Week:

L	T	P	C
3	-		3

Total Hours:

L	T	P
45	-	-

BS	SA	CS	WA/RA	SSH	S
5	8	1-5	5	40	1-5

Course Description and Objectives:

This course deals with the basic models in bioprocess engineering. The main intention of this course is to provide knowledge of various parameters to be considered in bioprocess and control and simulation of bioprocesses.

Course Outcomes:

Upon successful completion of this course, the student will be able to

1. *Understand the basic concepts of modeling.*
2. *Develop models for bioprocesses.*
3. *Design, operate and analysis of bioreactors.*
4. *Simulate bioprocess models for optimum product yield.*

SKILLS TO BE ACQUIRED:

- *Modeling of fermentation processes*
- *Basic fundamental laws used in modeling*
- *Parameter estimation for enzyme kinetics and Monod equation*
- *Various simulation techniques*

ACTIVITIES:

- *Development of mathematical models for bioprocesses*
- *Design and operation of bioreactor*
- *Simulation of mathematical models using computer software*
- *Validation of mathematical models.*

UNIT - I **L-9**

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 inModeling, Cybernetics, Controlled System and Principles of Similarity.

UNIT - II **L-9**

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-FlowStirred–Tank Reactor (CSTR),Monod Growth Kinetics, Monod Chemostat Model, and Product yield coefficient and Growth-Cycle Phases for Batch Cultivation.

UNIT - III **L-9**

DESIGN AND ANALYSIS OF BIOLOGICAL RECTORS: Ideal Bioreactors – Fed Batch Reactors, Enzyme- Catalyzed Reactions in CSTRs, CSTR Cell eactorswith Recycle and Wall growth, The Ideal Plug-flowTubular Reactor, Dynamic Models.

UNIT - IV **L-9**

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 **L-9**

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., McGrawHill, International Book Company,1986

REFERENCEBOOK :

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