source: https://en.wikipedia.org/wiki/Biochemical_engineering

22BT307 BIOREACTION ENGINEERING

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Chemical engineering principles in biotechnology, Bioprocess Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

The objective of the course is to familiarize reaction kinetics, diagnosis the ills of bioreactors and develop design equations for various bioreactors. Its major goal is successful design and operation of bioreactors to maximize yield and productivities of different metabolites.

MODULE-1

UNIT-1 **9L+0T+6P=15 Hours**

REACTIONENGINEERINGFUNDAMENTALS

Over view of reaction engineering, concepts of order and molecularity, elementary and non-elementary reactions, models for intermediates, significance of rate constant, temperature dependency of Arrhenius equation, differential method of analysis and integral method of analysis. Ideal reactor design using energy and material balances.

UNIT-2 **15L+0T+10P=25 Hours**

DESIGN OF IDEAL REACTORS

Determination / Search of reaction mechanism for biological reactions, Estimation of rate constant for first and second order irreversible reactions, development of performance equations for batch reactor, plug flow reactor, mixed flow reactor.

PRACTICES:

- Estimation of rate constant for any chosen reaction in continuous stirred tank reactor.
- Determination of rate constant for any selected reaction in plug flow reactor.
- Calculation of rate constant for any chosen reaction in combined reactor.
- Determination of rate constant for any selected reaction of equimolar feed in batch reactor.
- Determination of rate constant for any selected reaction of non-equimolar feed in batch reactor.

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

NON-IDEAL REACTORS

Differential mass balance equation, various modes of bioreactor operation, concepts of RTD, reasons for non-ideality, E, C and Fcurves, scale-up of bioreactors, bioreactor applications for processing plant and animal cells.

UNIT-2 **15L+0T+10P=25 Hours**

BIOREACTOR DESIGN

Development of performance equation for batch, fed-batch and continuous fermenters (chemostat & turbidostat), recycle flow in chemostat and multi stage chemostat. Design of various bioreactors, measurement of RTD and diagnosis of ills of non - ideal reactors. Industrial problems of bio reactors and RTD.

PRACTICES:

- Estimation of RTD for continuous stirred tank reactor.
- Estimation of RTD for continuous stirred tank reactors in series.
- Calculation of RTD for plug flow reactor.
- Determination of RTD for combined reactor.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply principles of reaction engineering to design ideal reactors.	Apply	1	1,3,4,5,9,10
2	Analyze concepts of RTD and non-ideal reactors.	Analyze	2	2,5,9,10
3	Develop design equations for various bio reactors.	Create	2	3,4,9,10
4	Determine the productivities of various bio reactors.	Evaluate	1,2	5,6,9,10
5	Evaluate ills of bioreactors.	Evaluate	2	4,5,7,9,10

TEXT BOOKS:

1. O. Levenspiel, “Chemical Reaction Engineering”, 3rd edition, Wiley, 2006.
2. Paulin M. Doran, “Bio-Process Engineering Principles”, 2nd edition, Elsevier, 2012.

REFERENCE BOOKS:

1. James E. Bailey and David F.Ollis, “Biochemical engineering fundamentals”, 2nd edition, McGraw Hill, 2017.
2. MichaelLShuler, Fikret Kargi and Matthew P DeLisa,“Bioprocess Engineering: Basic Concepts, 3rd edition, Pearson. 2017.
3. H.S. Fogler, “Elements of Chemical Reaction Engineering”, 4th edition, Prentice Hall of India, 2008.

SKILLS:

- ✓ *Calculation of rate of biochemical reactions.*
- ✓ *Designing the bioreactor.*
- ✓ *Estimation of RTD.*
- ✓ *Development of performance equations for various bioreactors.*