16BT301 BIOCHEMICAL REACTION ENGINEERING

Hours Per Week :

L	T	P	C
3	-	2	4

Source:
http://newscenter.lbl.gov

Course Description and Objectives:

This course introduces various types of bio-reactors and their economical design. In addition, it also provides insights into chemical reaction kinetics . The objective of the course is to impart knowledge on bio-reactor designing for specific conditions and also to compare performances of various bio-reactors.

Course Outcomes:

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

CO1: Understand different types of reactions and their kinetics.

CO2: Apply growth kinetics to reactor design.

CO3: Analyze product distribution in multiple reactions.

CO4: Develop performance equations for different reactors.

CO5: Diagnosis of ills of bioreactors.

CO6: Design and scale up of bioreactors

SKILLS:

- ✓ *Calculate rate of biochemical reactions.*
- ✓ *Design a bioreactor and operate on various modes.*
- ✓ *Estimate RTD for bio-reactors.*

ACTIVITIES:

- *Hypothesize and validate reaction mechanism.*
- *Design bio-reactor.*
- *Develop growth kinetics based on unstructured models.*
- *Measure RTD by tracer injection methods.*

UNIT - 1 L-9

FUNDAMENTALS OF REACTION ENGINEERING: Concept of order, molecularity of a reaction, searching a mechanism for a reaction, evaluation of rate constants, temperature using Arrhenius equation; Irreversible unimolecular type first order reactions, irreversible bimolecular type second order reactions and interpretation of batch reactor data.

UNIT - 2 L-9

IDEAL REACTORS: Batch reactors, mixed flow reactors, plug flow reactors, plug flow reactors in series and parallel, mixed flow reactors in series, reactors of different types in series.

UNIT - 3 L-9

BIOREACTOR DESIGN AND ANALYSIS: Definition of bioreactor, concepts of reactors based on flow characteristics, design of ideal reactors using material and energy balance; Performance equation for batch, continuous (chemostat and turbidostat) and fed batch bioreactor; Multiple stage chemostat, recycle flow in chemostat, design of plug flow reactors, comparison of productivity in plug flow and single stage single flow chemostat.

UNIT - 4 L- 09

MULTIPLE REACTIONS: Parallel series, series-parallel reactions, calculation of yield and selectivity, role of thermodynamic parameters, design principles of non isothermal reactions and pressure effects.

UNIT - 5 L- 09

NON- IDEAL REACTORS AND REACTOR APPLICATIONS: 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; Design and analysis of airlift bioreactors; Application in animal cell culture; Basic concept of scale-up.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS Total hours: 30

1. Estimation of rate constant for continuous stirred tank reactor.
2. Determination of rate constant for plug flow reactor.
3. Calculation of rate constant for combined reactor.
4. Determination of rate constant for batch reactor.
5. Determination of rate constant for adiabatic batch reactor.
6. Estimation of RTD for continuous stirred tank reactor.
7. Estimation of RTD for continuous stirred tank reactors in series and determine number of reactors in series theoretically.
8. Calculation of RTD for plug flow reactor.
9. Determination of RTD for combined reactor.

TEXT BOOKS :

1. O. Levenspiel, "Chemical Reaction Engineering", 3rd edition, John Wiley and Sons, 2008.
2. P.M. Doran, " Bioprocess Engineering Principles", 2nd edition, Academic Press, 2013.
3. H.S. Fogler, "Elements of Chemical Reaction Engineering", 2nd edition, Prentice Hall of India, 1999.

REFERENCE BOOKS :

1. D.G. Rao, "Introduction to Biochemical Engineering", 1st edition, McGraw Hill, 2005.
2. M. L. Shuler and F. Kargi, "Bioprocess Engineering", 2nd edition, Prentice Hall of India, 2001.