

16BT306 BIOPROCESS ENGINEERING

Hours Per Week :

L	T	P	C
3	-	2	4

<http://www.educept.com/wp-content/uploads/2014/05/ferment.jpg>

Course Description and Objectives:

This course offers knowledge on various aspects of bioreactors, to understand the media requirements and working conditions for profitable run of bioprocess industries. The objective of the course is to provide insights into biological and kinetic concepts underlying bioprocess engineering.

Course Outcomes:

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

- CO1: Understand the fundamental concepts related to industrial scale fermentation process.
- CO2: Formulate the low cost fermentation medium for production of bio-products.
- CO3: Calculate the stoichiometry coefficients for microbial cell growth equations.
- CO4: Design the kinetic models for growth of microorganisms.
- CO5: Determine the rheology of fermentation fluids and evaluate the oxygen mass transfer coefficient.
- CO6: Remove contaminants by applying sterilization techniques.

SKILLS:

- ✓ *Design of depth filter.*
- ✓ *Design of sterilization equipment.*
- ✓ *Unit operation in bioprocess.*

UNIT - 1 L-9

INTRODUCTION TO BIOPROCESSES: Historical developments of bioprocess technology, overview of traditional and modern applications of biotechnology, outline of an integrated bioprocess and unit operations in bioprocess.

UNIT - 2 L-9

METABOLIC STOICHIOMETRY AND ENERGETICS: Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients; Energetics analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures.

UNIT - 3 L-9

KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION: Phases of cell growth in batch cultures, simple unstructured kinetic models for microbial growth; Monod model, growth of filamentous organisms; Growth associated (primary) and non - growth associated (secondary), substrate and product inhibition on cell growth.

UNIT - 4 L-9

TRANSPORT PROCESS IN BIOREACTORS: Mixing equipments, flow patterns in agitated tanks, radial and axial flow impellers, mechanism of mixing, assessing mixing effectiveness, power requirement for ungassed and gassed mixing, improvement of mixing in fermenters; Oxygen uptake in cell cultures, measuring dissolved oxygen concentration, parameters affecting dissolved oxygen concentrations, measurement of K_{La} .

UNIT - 5 L-9

STERILIZATION KINETICS: Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of depth filters; Design of sterilization equipment - batch and continuous.

ACTIVITIES:

- *Determine phases of cell growth.*
- *Calculate substrate and product inhibition on growth of cells.*
- *Evaluate thermal death kinetics.*
- *Measure dissolved O_2 concentration.*

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS

Total hours: 30

1. Medium formulation for the growth of microbes in fermenter.
2. Measurement of growth kinetics of microorganisms.
3. Kinetics of growth in batch cultivation- estimation of Monod kinetic parameters.
4. Effects of temperature on growth.
5. Estimation of energy of activation and Arrhenius constant for microorganisms.
6. Physical and chemical factors affecting the bacterial growth.
7. Fermenter operation for batch and fed-batch cultivation.

TEXTBOOKS:

1. M.L. Shuler and F. Kargi, "Bioprocess Engineering", 2nd edition, Prentice Hall of India, 2008.
2. P.M. Doran, "Biochemical Process Principles", 1st edition, Elsevier Publications, 2009.
3. K.R. Aneja, "Experiments in Microbiology, Plant Pathology and Biotechnology", 4th edition, New Age International Publishers. 2007.
4. P. Gunasekharan, "Laboratory Manual in Microbiology", 1st edition, New Age International Publishers. 2005.

REFERENCE BOOKS:

1. H.W. Blanch and D. S. Clark, "Biochemical Engineering", 1st edition, Marcel Dekker Publications, 2007.
2. B. Ollis and D. F. Ollis, "Biochemical Engineering Fundamentals", 2nd edition, McGraw Hill Publications, 1986.
3. J. Jayaraman, "Laboratory Manual in Biochemistry", 1st edition, New Age International Publications, 2007.
4. R. Eisenthal and N.J. Danson, "Enzyme Assays-A Practical Approach", 2nd edition, IRI Press, Oxford, UK, 1992.