

# 20BT012 ADVANCED BIOPROCESS ENGINEERING

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P	WA/RA	SSH/HSB	CS	SA	S	BS
45	-	-	-	-	-	-	-	-

## Course Description and Objectives:

This course helps to familiarize various aspects of bioreactors, to understand the media requirements and working conditions for profitable run of bioprocess industries with the help of data analysis.

## Course Outcomes:

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

- Operate the fermenter
- Design the medium for production of metabolites
- Understand the modes of fermentation

## SKILLS:

- ✓ Operation of autoclave and fermenter
- ✓ Able to design and optimize the medium
- ✓ Solid-state fermentation
- ✓ Shake-flask fermentation

**ACTIVITIES:**

- Calibration of Bernoulli's theorem
- Estimation of frictional losses with different types of fitting to pipes
- Calculation of capacity of pump required for pumping of fluid using centrifugal pump
- Flow measurement using venturimeter.

**UNIT - I**

**Kinetics of Microbial Growth, Sterilisation and Product Formation:** Different modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth Monod model, Growth of filamentous organisms, Substrate and product inhibition on cell growth and product formation. Different types of industrial sterilization, 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.

**UNIT - II**

**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 energetic analysis of microbial growth and product formation, Oxygen consumption and heat evolution in aerobic cultures.

**UNIT - III**

**Bioreactor Operation:** Choosing the cultivation method, design and operation of a typical aseptic, aerobic fermentation process, Environmental requirements for animal cell cultivations, Reactors for large scale production using animal cell, plant cell cultivation, Active and Passive Immobilization of cells, Diffusional limitations in Immobilized cells, Bioreactor considerations in Immobilized cell.

**UNIT - IV**

**Transport Phenomena in Bioprocess System:** Gas – Liquid mass transfer in cellular systems, Determination of oxygen rates, Mass transfer for freely rising or falling bodies, Correlations for mass transfer coefficient and interfacial area, Mass transfer across free surface, Other factors affecting KLa, Heat transfer correlations.

**UNIT - V**

**Mixed culture and Solid State Fermentation:** Introduction, Major classes of interactions in mixed cultures, simple models describing mixed cultures interactions, Mixed cultures in nature and industrial utilization of mixed cultures, Solid-state fermentation.

**TEXT BOOKS:**

1. Shuler, M.L. and Kargi, F. "*Bioprocess Engineering – Basic concepts* – 2nd Ed., Prentice Hall of India Pvt. Ltd., 2005
2. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, *Principles of Fermentation Technology*, 2<sup>nd</sup> ed., Butterworth – Heinemann an Imprint of Elsevier India Pvt. Ltd., 2005.

**REFERENCE BOOKS:**

1. Bailey and Ollis, "Biochemical Engineering Fundamentals", 2nd Ed., McGrawHill, 1986.
2. Pauline M. Doran, "Bioprocess Engineering Calculation", Blackwell Scientific Publications.
3. Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering," Marcel Dekker, Inc.