Source : https://www.kgi.edu/news/what-is-bioprocess-engineering/

22BT301 BIOPROCESS ENGINEERING

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Chemical engineering principles in biotechnology, Microbiology and Fermentation Technology.

COURSE DESCRIPTION AND OBJECTIVES:

This course objective is to acquaint students on various aspects of cell growth kinetics and bioreactors, also provide an insight about the media and other requirements for successful run of bioprocess operations.

MODULE-1

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

INTEGRATED BIOPROCESS

Outline of an integrated bioprocess, Design of fermentation media, Kinetics of microbial growth, Monod model, Growth of filamentous organisms, Growth associated (primary) and non - growth associated (secondary), Substrate and product in hibition on cell growth, Environmental requirements for animal cell cultivations, Plant and animal cellcultures compared to microbial cultures.

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

BIOREACTORS FOR CULTIVATION OF ANIMAL CELLS

Bioreactor considerations for animal cell culture, Bioreactors for suspension cultures, Immobilized cellcultures, Methods used for cultivation of animal cells (suspension and anchored cell culture).

PRACTICES:

- Fermentation media and preparation of inoculum.
- Media design by Plackett - Burman.
- Batch growth kinetics - Monod kinetic parameters.
- Immobilization of cells.
- Effect of pH and temperature on growth.

MODULE-2

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

MIXING IN REACTORS

Mixing equipments, radial and axial flow impellers, Mechanism of mixing, Flow patterns in agitated tanks, time calculation for mixing, improvement of mixing infermenters; Assessing mixing effectiveness, Power requirement for gassed and ungassed systems, measuring dissolved oxygen concentration, Oxygen up take in cellcultures, Measurement of $K_L a$, Factors affecting $K_L a$ and scale-up.

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

DIFFERENT TYPES OF INDUSTRIAL STERILIZATION

Thermal death kinetics of micro organisms, 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.

PRACTICES:

- Fermenter operation for batch and fed-batch cultivation.
- Mixing time in reactors.
- Estimation of $K_L a$ by $Na_2 SO_3$ oxidation method.
- Determination of gas hold up in sparged reactor.
- Batch heat sterilization and thermal death kinetics.

SKILLS:

- ✓ *Cultivation of microorganisms in a fermenter.*
- ✓ *Apply the sterilization techniques.*
- ✓ *Design of fermentation media for production of bioproducts*

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	Design the low-cost media for lab scale fermentation process.	Design	1	1,3,5,7,9,10
2	Evaluate the kinetic parameters of microbial cell growth.	Evaluate	1	2,4,9,10
3	Identify the methods for cultivation and immobilization of cells.	Analyze	1	1,4,5,9,10
4	Determine mixing time and flow behaviour of fluids in the agitated tanks.	Evaluate	2	1,2,4,9,10
5	Analyze sterilization methods for complete elimination of all forms of microbial life and solve death rate kinetic parameters.	Analyze	2	2,3,4,9,10

TEXT BOOKS:

1. MichaelL Shuler, Fikret Kargi and Matthew P De Lisa,"Bioprocess Engineering Basic Concepts, 3rd edition, Pearson. 2017.
2. Paulin M. Doran, "Bio-Process Engineering Principles", 2nd edition, Elsevier, 2012.

REFERENCE BOOKS:

1. Douglas S.Clark and Harvey W. Blanch, "Biochemical Engineering", 2nd edition, CRC Press, 1997.
2. James E.Baileyand David F.Ollis,"Biochemical engineering fundamentals", 2nd edition, McGraw Hill, 2017.
3. D G Rao, "Introduction to Biochemical Engineering", 2nd edition, McGraw Hill, 2009.