UCH604: BIOCHEMICAL ENGINEERING

L	T	P	Cr
3	1	2	4.5

Course Objectives:
To apply the chemical engineering principles in biological systems.

Introduction to Biochemical Engineering: Comparative study of chemical and biochemical processes, Basic concepts of microbiology.

Sterilization: Sterilization of air and medium; sterilization of fermentor, thermal death kinetics of microorganisms.

Biochemical Kinetics: Enzyme Kinetics with one or two substrates, modulation and regulation of enzyme activity, enzyme reactions in heterogeneous systems, Immobilized enzyme technology, Industrial application of enzymes.

Microbial Fermentation Kinetics: Fermentation and its classification, Growth-cycle phases (for batch cultivation), Continuous culture, Biomass production in cell culture, Mathematical modeling of batch growth, Product synthesis kinetics, Overall kinetics and thermal death kinetics of cells and spores, Analysis of multiple interacting microbial population.

Bioreactors: Classification and characterization of different bioreactors e.g. batch and continuous, mechanically and non-mechanically agitated, CST type, tower, continuous, rotating, anaerobic etc., Design and analysis of Bioreactors - CSTR and Air Lift Reactor, Scale up considerations of bioprocesses.

Transport Phenomenon in Bioprocess Systems: Agitation and aeration-gas-liquid mass transfer, oxygen transfer rates, determination of k_La, Heat balance and heat transfer correlations – sterilization etc.

Commercial production of bioproducts: Concept of primary and secondary metabolites, Production processes for yeast biomass, antibiotics, alcoholic beverages and other products.

Laboratory work:
Sterilization in steam autoclave, Estimation of reducing sugars (Glucose) by di-Nitro Salicylic Acid (DNS) method in a sample broth; Estimation of dimensionless mixing time in a batch reactor Understanding of dissolved oxygen (DO) measurement system of a bioreactor and its calibration, Estimation of volumetric oxygen transfer coefficient in a fermenter by dynamic gassing out technique; Understanding the functioning of bioreactor and to carry out blank sterilization of the reactor Operation of pH control system of a bioreactor and evaluation of response of the controller to different control settings; Enzyme assay; Enzyme kinetic studies; Demonstration & Examination of different organisms; Determination of

microbial cell biomass using spectrophotometer; Microbial growth kinetic study; Immobilization of enzymes, Immobilization of microbial cells

Course Learning Outcomes (CLO):

Upon completion of this course, the students will be able to:

1. calculate the kinetic parameters of enzymatic reactions.
2. calculate and analyze the kinetic parameters for microbial growth.
3. analyze bioprocess design and operation.
4. select suitable bioreactor.

Text Books

1. *Shuler M., Kargi F., Bioprocess Engineering: Basic Concepts, PHI (2012).*
2. *Bailey, J.E. and Ollis, D.F, Biochemical Engineering Fundamentals, McGraw Hill, New York (1986)*

Reference Books

1. *Doran, P.M Bioprocess Engineering Principles,., Academic Press (2012)*
2. *Aiba, S., Humphrey, A.E and Millis, N.F., Biochemical Engineering, Academic Press (1973)*
3. *Weith, John W.F., Biochemical Engineering – Kinetics, Mass Transport, Reactors and Gene Expression, Wiley and Sons Inc. (1994).*
4. *Stanbury P. F., Whittaker, A. and Hall, S. J., Principles of Fermentation Technology, Butterworth-Heinemann (2007).*

Evaluation Scheme:

S. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional (May includes lab/tutorials/ assignments/ quiz's etc)	40