Bioreactor Design and Analysis

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Biotechnology	3-0-0, (3)	OE4	BT108304BT

[Pre Requisite- The student is expected to have a basic knowledge of modelling aspects. Prerequisite courses can be Material Balances and energy balances, Biological Rate processes.]

Course Objectives

The course introduces the student to design principles of batch, fed-batch and continuous bioreactors. The student will also be able to identify suitable criterion for the scale-up of bioprocesses and characterize bioreactors. Specify design criteria for medium sterilization.

Course Content

UNIT 1:

Modelling of Microbial growth and product formation kinetics, Thermal death kinetics of microorganisms, Techniques used in sterilization, Design criterion for sterilization, Batch, continuous and air sterilization of medium. Structured and Unstructured models for microbial growth: Growth associated, Non growth associated and combined Growth associated Non growth associated product kinetics: Design of batch and continuous medium sterilization process: Methods of Air Sterilization

UNIT 2:

Fermentation Process-General requirements; Basic design and construction of fermenters and its ancillaries; Material of construction, Vessel geometry and bioreactor design considerations for plant and animal cell cultures. Ideal and non-ideal multiphase reactors. Aseptic inoculation and sampling in Bioreactors.Resi dence Time Distribution (RTD) in Bioreactors

UNIT 3:

Batch growth of microorganism: Quantifying growth kinetics: Growth patterns and Kinetics in Batch culture, Environmental factors affect to growth kinetics, Substrate limited growth, the logistic equation for microbial growth, Using Unstructured Non- segregated Models to predict specific growth rate. Specific devices to operate continuous culture: Chemostat and turbidostat. The ideal Chemostat,: Steady state substrate, steady state biomass, steady state product formation calculation, derive Productivity (DP/DX) of a chemostat. Relationship between Specific Growth Rate and Doubling Time of microorganisms;Dilution Rate in Chemostat culture: Application of Fed Batch Culture

UNIT 4:

CSTR with recycle, CSTR in series, Oxygen rate transfer, Scale up, Scale down. Large scale production and purification of recombinant proteins. Design and operation of Novel Bioreactors: Batch Bioreactor, CSTR, Plug flow Reactor, Airlift, Packed bed, Bubble column, Fluidized bed, Tower Bioreactor, Photo bioreactor, Bioreactors for waste treatment processes, SSF bioreactors. Volumetric Oxygen Transfer Coefficient (KLa) determination by Sulphite Oxidation, Gassing out method. Scale up criteria and scale up studies based on Power consumption per unit volume of the fermentation broth of gassed and ungassed system. Membrane Bioreactors, Immobilized cell Bioreactors

Text book

1. Kargi F, Shuler ML. Bioprocess engineering: basic concepts. Prentice-Hall PTR; 1992.
2. T Panda, Bioreactors analysis and design, Tata McGraw Hill, New Delhi, New York, 2011
3. Bailey, James E., and David F. Ollis. Biochemical engineering fundamentals. McGraw-Hill, 2018.

Interactomics

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Biotechnology	3-0-0, (3)	Open Elective	BT108407BT

[Pre-requisites: NIL]
[Seat Capacity: 75]
[Students from other than the Biotechnology Branch should have ≥ 8.5 CPI]

Course Objectives

1. To impart knowledge of the interaction between biomolecules, particularly proteins and the consequences of those interactions in a biosystem.
2. This course would feature intensive information to explore the endless possibilities in Interactomics studies using genomics and proteomics approaches, that can be useful for a student at any stage.

Course Content

Unit-1:

Introduction to Proteomics, Interactomics, System Biology; High throughput platforms of Interactomics: Protein arrays; Cell-free expression-based protein microarrays.

Unit-2:

Nucleic Acid Programmable Protein Arrays (NAPPA) Technology and its applications in the study of antibody immune response in disease & drug screening.

Unit-3:

Applications of protein microarrays in deciphering post-translational modifications (PTMs) and biological networks; Basics and Applications of Reverse Phase Protein Arrays.

Unit-4:

Biomolecular interactions using Bio-Layer Interferometry (BLI) and its applications in protein research; Application of multi-omics approach for better understanding of cancers.

Course Materials

Required Text: Textbooks

1. Protein Interactions: The Molecular Basis of Interactomics; Volkhard Helms (Editor), Olga V. Kalinina (Editor); ISBN: 978-3-527-83052-7, November 2022
2. NPTEL course materials on Interactomics: Basics & Applications, by Prof. Sanjeeva Srivastava, IIT Bombay