

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. SEMESTER : VIII

BIOTECHNOLOGY

Subject Name: **BIO PROCESS ENGINEERING II**

Sr. No.	Course Contents	Total Hrs
1.	Sterilization Medium sterilization, The design of batch sterilization processes and continuous sterilization processes, Sterilization of fermenter, Sterilization of feeds, Sterilization of liquid wastes, Filter sterilization (Fermentation media, air), Theory and design of depth filters, Selection criteria for fermentation air filters. Media optimization: Plackett – Burman Design, Response surface optimization, simplex search method	6
2.	Biosensor Technology: Principles, Types, elements, characteristics, applications	4
3.	Monitoring of bioprocesses: Methods of on-line and off-line bio-mass estimation. Flow injection analysis.	3
4.	Simulation softwares : Modelling and simulation of bioprocesses: Study of structured models for analysis of various bioprocesses– compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism. Model simulation using MATLAB-SIMULINK software packages. Modelling of recombinant bacterial cultures. Bioreactor strategies for maximising product formation.	7
5.	Downstream Processing: Role of downstream processing in biotechnological processes.	1
6.	Removal of insoluble	
	Disruption of microbial cells: Composition and structure of cell walls (Bacteria, yeast and other fungi), Analysis of Disruption (direct and indirect measurement), Laboratory scale disruption techniques (mechanical and non mechanical), large scale disruption techniques (High speed Ball Mills, High pressure homogenizers and others)	2
	Flocculation: Electric Double layer, Forces between Particles and flocculation by electrolytes, The Schulze Hardy Rule, Flocculation rate.	1
	Sedimentation: Principle, methods and coefficients, sedimentation at low accelerations.	1
	Centrifugation: Introduction, Fluid and particle dynamics (Stoke's law, Settling in centrifugal field, Hindered settling), Centrifuge configurations (Tubular Bowl centrifuge, Chamber centrifuges, Decanter Centrifuges, Disc-stack centrifuge), Scale up (Tubular Bowl centrifuge, Decanter Centrifuges, Disc-stack centrifuge), Types of separator (Solid Bowl Machines and Solids discharging Disc separators), Methods for selection of centrifuge and applications.	3
	Filtration: Introduction, filter aids, theory, equipment, Tangential flow filtration, Hollow fiber membranes, Ultra filtration in biotechnology.	2
7.	Product isolation Liquid Liquid Extraction: Introduction, Principle, biochemical and technical aspects, Solvent selection, Extraction equipment selection, Process Considerations, Analytical applications Adsorption: Chemistry, Batch adsorption, Adsorption in continuous stirred tank, adsorption in fixed beds	4

8.	Product Purification	
	Precipitation: Principle, Precipitate formation phenomenon, Precipitation with a non solvent, precipitation with salts, precipitation with temperature, Design of precipitation systems	1.5
	Chromatographic techniques: 1) Molecular sieve chromatography (Introduction, materials, equipment, theory, operations) 2) Ion Exchange chromatography (Introduction, materials, equipment, theory, operations) 3) Affinity Chromatography (Introduction, matrix, spacer arms, coupling procedures, adsorption, elution, regeneration, theoretical modeling, applications) 4) Hydrophobic chromatography (Introduction, structure and synthesis of hydrophobic matrices, theoretical aspects, applications and resolving power) 5) High Performance Liquid Chromatography (Introduction, theory and practice, instrumentation, gradient and scale up)	10.5
	Electrodialysis: Principle and theory of operation, equipment, applications in biotechnology	1
9.	Product polishing-Crystallization: Basic concept, Size distribution, Batch crystallizers, crystallizer scale up and design.- Drying: Basic concept, equipments, scale up and design.	3
10.	Economics of downstream processing in Biotechnology, cost-cutting strategies, characteristics of biological mixtures, process design criteria for various classes of bio products (high volume, low value product and low volume, high value product), physico- chemical basis of bio separation processes	2-3

TEXT BOOK:

- 1) Comprehensive Biotechnology, Volume 2 by Murray Moo Young, Elsevier publication

REFERENCE BOOKS:

- 1) Bio separations Science and Engineering by Roger Harrison, Paul Todd published by Oxford university Press
- 2) Bio separations by Belter and Cussler published by Wiley interscience
- 3) Principles of fermentation Technology by P. F. Stanbury, A. Whitaker and S. J. Hall, Elsevier Publications.

List of Practicals:

SR.	Title
1	To get familiar with the application of biochemical kinetics simulation software
2	Analysis & interpretation through time course simulation & steady state analysis
3	To optimize ethanol from <i>S.Cerevisiae</i> using simulation software copasi through study of kinetics
4	(a)To Study MATLAB application for engineering tools (b)To study array and to check suitability to fit into kinetic data using MATLAB (c) To find out syntax error and correcting it to MATLAB experimentation
5	To determine the pattern of inhibition of copper sulphate on enzyme <i>invertase</i>
6	To draw the growth kinetics of feed batch culture by constant, linear and exponential feeding patterns

7	To plot the growth curve of <i>E.coli</i> strain and to estimate the specific growth rate and biomass yield coefficient from the substrate utilization data
8	To measure oxygen absorption rate by iodine titration method(oar) under the effect of static and shaking condition
9	To measure oxygen adsorption rate by iodine titration method(oar) under the effect of different sample volume in similar flask
10	To measure oxygen absorption rate by iodine titration method (oar) under the effect of different flask size during agitation
11	To determine the oxygen uptake rate by sodium sulphate titration method
12	To generate results of control process for a given input set of controllers by simulink package