



GUJARAT TECHNOLOGICAL UNIVERSITY

Integrated Master of Science (Biotechnology)

Semester: 8

Subject Name: Downstream Processing

Subject Code: 1380402

Prerequisite: Candidates enrolling in the Integrated MSc in Industrial Biotechnology program, which includes a compulsory course in Downstream Processing, should have a solid foundation in core scientific disciplines such as biochemistry, microbiology, and chemical engineering principles.

Rationale: Integrating a compulsory course in Downstream Processing into the MSc Industrial Biotechnology curriculum is essential due to its critical role in the biomanufacturing pipeline. Downstream processing encompasses the recovery, purification, and formulation of biotechnological products, directly impacting product yield, purity, and overall production economics.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
4	0	8	8	70	30	30	20	150

Course Content:

Module No:	Module Content	No. of Sessions	70 Marks (External Evaluation)
1	<p><u>Screening and Design purification strategies</u></p> <p>Overview of down-stream processing, Establishment of design space for biopharmaceutical process, High-throughput process development, Media selection in ion-exchange chromatography in single microplate, high-throughput screening of dye- ligand for chromatography.</p>	10	10
2	<p><u>Low-resolution protein purification methods</u></p> <p>Aqueous two phase partitioning systems, A platform for isolation of process related impurities from therapeutic proteins, Simultaneous purification refolding of protein by affinity precipitation and macro (Affinity ligand)-facilitated three-phase partitioning (MLFTPP), Co-expression and co-purification of antigen-antibody complexes in bacterial cytoplasm and periplasm, immunoglobulin purification by caprylic acid; Filtration, chromatography (comparison), rationale of choosing between quality and cost of different products.</p>	12	14
3	<p><u>Protein purification and characterization</u></p> <p>Introduction, initial recovery of proteins, removal of whole cells and cell debris, concentration and primary purification,</p>	10	12



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	protein inactivation and stabilization, protein characterization.		
4	<u>Large scale protein purification</u> Some general principles, range and medical significance of impurities potentially present in protein based therapeutic products, labelling and packing of finished products.	7	8
5	<u>Animal based products</u> General DSP, Case studies of: monoclonal antibodies, Tissue plasminogen activator, insulin, erythropoietin.	7	10
6	<u>Plant based products</u> General DSP, Case studies of: shikonin, Protein extracts from Seed material and green tissues.	7	8
7	<u>Microbial based products</u> General DSP, Case studies of: lipase, cellulose, amylase, horseradish peroxidase, subtilisin, ethanol, citric acid, xanthan gum.	7	8

Reference Books:

1. Nikolaos E. Labrou ; Protein Downstream Processing: Design, Development and Application of High and Low Resolution Methods in Molecular Biology Humana Press Latest Edition
2. Gary Walsh : Proteins: Biochemistry and Biotechnology Wiley Blackwell 2nd Edition
3. Desai, M. Downstream Processing of Proteins: Methods and Protocols Humana Press Latest Edition

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
1	Discuss cell separation, filtration and treatment of product by chemical, physical and biological means. Various techniques involved in the purification process.	UN
2	Describe about recovery, extraction and purification of biosynthetic products in biotech industries.	AN
3	Communicate concepts and ideas effectively.	EL
4	Transparency, honesty and ethical reasoning in handling biomolecules and product processing.	RM

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create



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List of Experiments:

1. Conventional filtration
2. Centrifugation in batch and continuous centrifuge
3. Cell disruption
4. Protein precipitation and its recovery
5. Ion-exchange chromatography
6. Membrane based filtration-ultra, filtration in cross flow modules and micro filtration
7. Adsorption process in batch and continuous mode.

