

22BT401 DOWNSTREAM PROCESSING

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:

The course presents the state of the art in downstream processing of biotechnological products. It provides knowledge on different techniques for solid-liquid separation, product release, concentration and purification of valuable bio-products with a focus on the integrated process.

MODULE-1

UNIT-1

9L+0T+6P=15 Hours

DOWNSTREAM PROCESSING METHODS

Need & Importance of downstream processing in biotechnology, range and characteristics of bioproducts, characteristics of fermentation broths, cell disruption - physical, chemical & mechanical methods, filtration, centrifugation, extraction, A few case studies highlighting the down stream processing steps involved in the production of ethanol, citric acid.

UNIT-2

15L+0T+10P=25 Hours

CELL DISRUPTION TECHNIQUES

Equipment's for cell disruption— bead mill, homogenizer, ultrasonicator, Industrial filters - plate and frame filter, pressure leaf filter, continuous rotary filters, Industrial-scale centrifuges - disc bowl, tubular and decanter centrifuges, Equipment for extraction and industrial scale contactors.

PRACTICES:

- Cell disruption techniques - Ultra sonication.
- Cell disruption techniques - Enzymatic vs Chemical methods.
- Solid - liquid separation - Centrifugation.
- Aqueous two - phase extraction of biologicals.
- Production of ethanol.

MODULE-2

UNIT-1

9L+0T+6P=15 Hours

MEMBRANE SEPARATION TECHNOLOGY

Membrane separations - advantages, classification, factors affecting the separation process, Principles of dialysis & electro-dialysis, Sophisticated chromatographic techniques, Crystallization - theoretical considerations, drying, freeze drying, lyophilized products, polishing and product formulation.

UNIT-2

15L+0T+10P=25 Hours

PURIFICATION AND FINISHING OPERATIONS

Design of membrane module configurations, design of equipment for microfiltration, ultrafiltration, reverse osmosis, HPLC, ion- exchange, Gel filtration, affinity, GC, Crystallization - Equipment for Batch crystallization, Industrial drying equipment design - rotary drum drier, Equipment for Freeze drying - Lyophilizer.



source: <https://bioprocessintl.com/downstream-processing/downstream-single-use-technologies/downstream-processing-single-use-solutions/>

SKILLS:

- ✓ *Performing experiments for product recovery.*
- ✓ *Solving problems related to various unit operations.*
- ✓ *Evaluating the product yield post purification.*

PRACTICES:

- Performance evaluation of a reverse osmosis unit.
- Concentration of proteins by dialysis.
- Compound / product analysis by HPLC.
- Product polishing by Freeze drying / Lyophilization.

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 | Apply the principles of downstream processing in biotechnology industry. | Apply | 1,2 | 1,2,6,9,10 |
| 2 | Develop downstream processing flowsheets for product recovery and isolation. | Develop | 1 | 2,3,6,9,10 |
| 3 | Analyze economics of "low volume and high value" and "high volume and low value" products. | Analyze | 1 | 2,4,9,10 |
| 4 | Design of sequence of unit operations for bio-separations. | Create | 1,2 | 3,4,6,9,10 |

TEXT BOOKS:

1. Belter, P.A., E.L.Cussler and Wei-Houhu, "Bio separations–Down stream Processing for Biotechnology", 1st edition, John Wiley, 1988.
2. B. Sivasankar, "Bio separations Principles and Techniques", 1st edition, PHI Publications, 2009.

REFERENCE BOOKS:

1. S.N. Mukhopadhyay, "Process Biotechnology Fundamentals", 2nd edition, Viva, 2005.
2. P. F. Stanbury and A. Whitaker, "Principles of Fermentation Technology", 2nd edition, Elsevier, 2008.
3. R.O. Jenkins, "Product recovery in bioprocess technology", Butterworth Heinemann Limited, Oxford, 1992.