



**B.E/B.TECH / M.E / M.TECH/MCA DEGREE EXAMINATIONS: NOV/ DEC 2024**

(Regulation 2024)

First Semester

**BIOTECHNOLOGY**

24MBT504 - Bioproduct Separation and Purification Engineering

**COURSE OUTCOMES**

- CO1:** Apply various cell lysis methods to optimize selective permeabilization and release intracellular products in bioprocesses
- CO2:** Analyse membrane filtration and centrifugation techniques to enhance primary separation.
- CO3:** Evaluate the effectiveness of precipitation and chromatography techniques for bioproduct recovery.
- CO4:** Evaluate the principles and applications of lyophilization/freeze drying and crystallization in the final polishing of bioproduct.
- CO5:** Design process flowsheets and perform economic evaluations in bioproduct recovery.
- CO6:** Develop integrated strategies for continuous bioprocessing and scale-up.

**Time: Three Hours**

**Maximum Marks: 100**

**PART A (4\*20 = 80 Marks)**

- |    |    |  |    |     |                   |
|----|----|--|----|-----|-------------------|
| 1. | a) | Explain the impact of multiple passes in high-pressure homogenization on cell disruption efficiency.   | 4  | CO1 | [K <sub>2</sub> ] |
|    | b) | Summarize the challenges associated with scaling up ultrasonication for industrial applications.   | 4  | CO1 | [K <sub>2</sub> ] |
|    | c) | Classify different types of green solvents used in solvent extraction to ensure minimal environmental impact.  | 4  | CO1 | [K <sub>2</sub> ] |
|    | d) | Solve a scenario where selectively permeabilizing the outer membrane of a gram-negative bacterial cell to release periplasmic proteins is required using detergent-based lysis, and justify your choice of surfactant. | 8  | CO1 | [K <sub>4</sub> ] |
| 2. | a) | Explain the differences between tangential flow filtration and high-performance tangential flow filtration.  | 4  | CO2 | [K <sub>2</sub> ] |
|    | b) | Summarize the advantages of vibrating membrane filtration over traditional membrane filtration methods.  | 4  | CO2 | [K <sub>2</sub> ] |
|    | c) | Infer the principle and applications of Centrifugal membrane filtration in bioprocess industry.  | 6  | CO2 | [K <sub>2</sub> ] |
|    | d) | Discuss the working principle of continuous tubular centrifugation and its applications in bioseparation process.  | 6  | CO2 | [K <sub>2</sub> ] |
| 3. | a) | Examine the principle and mechanism involved in Aqueous Two-Phase Systems in bioseparation with suitable example.  | 10 | CO3 | [K <sub>2</sub> ] |
|    | b) | Analyze the steps involved in setting up and optimizing an ion exchange chromatography process for separating charged biomolecules.  | 10 | CO3 | [K <sub>4</sub> ] |

- |    |    |   |   |     |                   |
|----|----|---|---|-----|-------------------|
| 4. | a) | Explain the differences between lyophilization, spray drying, and crystallization in terms of their principles                          | 4 | CO4 | [K <sub>2</sub> ] |
|    | b) | Outline the critical factors influencing the selection of suitable drying method for a specific bioproduct.                             | 8 | CO4 | [K <sub>2</sub> ] |
|    | c) | Summarize the key components of capital cost estimation, operating cost estimation, and profitability analysis in bioprocess economics. | 8 | CO5 | [K <sub>2</sub> ] |

**Answer any ONE Question**

**PART B (1\*20 = 20 Marks)**

- |    |    |   |    |     |                   |
|----|----|---|----|-----|-------------------|
| 5. | a) | Evaluate the steps involved in bioproduct production process using SUPER PRO and highlighting key steps in process design with a detailed flowsheet.        | 10 | CO5 | [K <sub>5</sub> ] |
|    | b) | Propose a process integration approach for a biopharmaceutical production system, detailing how unit operations can be integrated for maximum productivity. | 10 | CO6 | [K <sub>6</sub> ] |

OR

- |    |    |   |    |     |                   |
|----|----|---|----|-----|-------------------|
| 6. | a) | Interpret the implementation of PAT in a continuous downstream purification process, emphasizing real-time monitoring and automation. | 10 | CO5 | [K <sub>6</sub> ] |
|    | b) | Elaborate the key benefits of continuous processing in bioprocessing and its challenges associated with scaling up of bioprocessing.  | 10 | CO6 | [K <sub>5</sub> ] |

\*\*\*\*\*