

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-VII EXAMINATION – WINTER 2025****Subject Code:3170411****Date:26-11-2025****Subject Name:Downstream Processes****Time:10:30 AM TO 01:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

MARKS

- | | | | |
|------------|-----|--|-----------|
| Q.1 | (a) | Define bioproducts and provide examples of small biomolecules and macromolecules. | 03 |
| | (b) | Explain the importance of classifying bioproducts and provide examples of particulate and macromolecular bioproducts. | 04 |
| | (c) | Describe how you would design a bioseparation process for isolating proteins from a microbial culture. Outline the stages involved and the techniques you would use at each stage to ensure maximum purity and yield. | 07 |
| Q.2 | (a) | List two techniques for measuring cell disruption. | 03 |
| | (b) | Describe the structural differences between the cell walls of bacteria, yeast, and other fungi. | 04 |
| | (c) | Discuss how you would address membrane fouling in an industrial-scale filtration system. Include preventive measures, troubleshooting strategies, and any design considerations to ensure system longevity and efficiency. | 07 |
| | | OR | |
| | (c) | You are tasked with separating a highly charged biomolecule from a mixture using ion-exchange chromatography. Outline the steps involved in selecting the appropriate matrix, preparing the sample, and optimizing the elution process. | 07 |
| Q.3 | (a) | Differentiate between mechanical and non-mechanical cell disruption techniques. | 03 |
| | (b) | Explain the role of high-pressure homogenizers and high-speed ball mills in large-scale cell disruption | 04 |
| | (c) | Design a liquid-liquid extraction process to isolate a specific bioactive compound from a plant extract. Include your considerations for solvent selection, extraction equipment, and process optimization to maximize yield and purity. | 07 |
| | | OR | |
| Q.3 | (a) | Describe the role of filter media in filtration processes. | 03 |
| | (b) | Describe the factors that influence membrane fouling and how it affects filtration system efficiency. | 04 |
| | (c) | Design a molecular sieve chromatography setup to separate nucleic acids of different sizes. Describe the choice of materials, equipment, and operational settings necessary to achieve effective separation. | 07 |
| Q.4 | (a) | List the main components involved in affinity chromatography. | 03 |
| | (b) | Differentiate between production centrifuges and ultracentrifugation in bioproduct separation processes. | 04 |
| | (c) | Suppose you need to crystallize a protein for pharmaceutical applications. Describe the process design considerations, including crystallizer type, crystallization conditions, and strategies for optimizing crystal size and purity. | 07 |

OR

- Q.4** (a) What factors are considered in the solvent selection for liquid-liquid extraction? **03**
(b) Explain the concept of ion-exchange chromatography and its significance in the separation of charged biomolecules. **04**
(c) Imagine you are tasked with precipitating a protein from a solution using salt precipitation. Describe the procedure, choice of salt, factors affecting precipitation efficiency, and any post-precipitation steps to enhance protein purity. **07**

- Q.5** (a) Briefly explain the principle of hydrophobic chromatography. **03**
(b) Describe the theory and instrumentation involved in High Performance Liquid Chromatography (HPLC). **04**
(c) Develop a plan to use ultracentrifugation to separate subcellular components in a bacterial cell lysate. Explain rotor selection, centrifugation settings, and how to handle the fractionation process for accurate component isolation. **07**

OR

- Q.5** (a) What is the purpose of a batch crystallizer? **03**
(b) Describe the design considerations involved in creating efficient filtration and drying systems for bioproduct processing. **04**
(c) For the recovery of microbial cells in a fermentation broth, design a flocculation and sedimentation process. Describe the selection of flocculants, operating parameters, and design considerations for efficient cell recovery. **07**
