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18BT71

## Seventh Semester B.E. Degree Examination, June/July 2023

### Bioprocess Engineering

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

#### Module-1

- 1 a. Compare and contrast submerged and solid-state fermentation. (10 Marks)
- b. Elaborate the process design criteria for high value low volume products like insulin. (10 Marks)

OR

- 2 a. Discuss the process of fed-batch and continuous mode of fermentation. (10 Marks)
- b. Describe the production process of distilled beverage with examples. (10 Marks)

#### Module-2

- 3 a. Illustrate various methods of preservation of microbes. (10 Marks)
- b. Discuss the industrial applications of secondary metabolites. (10 Marks)

OR

- 4 a. Discuss the types of primary screening techniques of microbes. (10 Marks)
- b. Elaborate the environmental factors affecting secondary metabolite production. (10 Marks)

#### Module-3

- 5 a. Discuss the characteristics of biological mixture. (08 Marks)
- b. Yeast cells containing intracellular enzymes are in suspended form in aqueous media and are subjected to intense round waves. Analyze the process of recovery of enzymes in detail. (07 Marks)
- c. A suspension of spherical particles of 0.1mm diameter is settling in a centrifuge. The density difference between the solid particles and liquid was  $0.05\text{g/cm}^3$  and the viscosity of the liquid was 1.1cp. Calculate the settling time in a centrifuge rotating at 400rpm if the distance between axis of rotation and bottom of centrifuge was 12cm and distance between axis of rotation and liquid surface was 3cm. (05 Marks)

OR

- 6 a. After cell lysis, protein is purified by taking advantage of changes in solubility of protein of interest relative to other macromolecules in the cell extract. The purification process is initiated using ammonium sulphate. Examine this process of protein purification with neat sketch. (08 Marks)
- b. Elaborate the process of differential centrifugation. (07 Marks)
- c. An antibiotic exhibits a K value of 7 in organic solvent water system. If the aqueous feed has 25mg of solute, how much percentage could be extracted with an equal volume of organic solvent in multi-stage extraction with 2 stages? (05 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

**Module-4**

- 7 a. When suspended solids deposit on external membrane surface, membrane pores or within pores, it decreases performance. Elaborate the causes, consequences and its control techniques. (10 Marks)
- b. Describe the configuration of batch membrane separation equipment. (10 Marks)

**OR**

- 8 a. When dense membrane without pores is used in the separation process, discuss the associated membrane separation model. (10 Marks)
- b. Illustrate the principle of reverse osmosis. (10 Marks)

**Module-5**

- 9 a. Compare and contrast normal and reverse phase chromatography. (07 Marks)
- b. Discuss the process of gel filtration chromatography. (08 Marks)
- c. The relative molecular mass of a protein was investigated by exclusion chromatography using sephacryl S 300 column using standard compounds and elution data is tabulated below. Calculate the relative molecular mass of a protein whose retention volume was  $19.5\text{cm}^3$ . (05 Marks)

Standard compounds	Relative molecular mass	Relative volume ( $\text{cm}^3$ )
Aldolase	158000	22.5
Catalase	210000	21.4
Ferritin	444000	18.2
Thyroglobulin	669000	16.4
Blue dextran	2000000	13.6

**OR**

- 10 a. Illustrate the process of two-dimensional chromatography. (07 Marks)
- b. Elaborate the principle of GLC. (08 Marks)
- c. Two proteins of molecular weights  $2.5 \times 10^5$  and  $1 \times 10^4\text{kDa}$  were eluted out of a gel filtration column at 220 and 300mL respectively. Determine the molecular weight of a protein which elutes out at 270mL from the column under the same conditions. (05 Marks)

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