

**A 319**

B.E/B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2005.

Seventh Semester

Industrial Biotechnology

IB 431 – DOWNSTREAM PROCESSING

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the four major steps involved in downstream processes?
2. What is the need for pre-treatment of fermentation broth before filtration?
3. In scaling up centrifuges, what are the two major approaches followed?
4. Name four types of partitions in liquid extraction problems.
5. Name the factor that is common, and, one that is different between crystallization and precipitation processes.
6. What is the separating principle involved in Iso-electric focusing process?
7. Name four adsorption isotherms and write their empirical equations.
8. What are the types of moisture contents associated with solids?
9. Name two distinct characteristics of ultrafiltration.
10. What is the principle of working of affinity resins?

PART B — (5 × 16 = 80 marks)

11. (i) Describe the role and importance of downstream processing. (4)
- (ii) What are the problems faced and objectives of bioproduct purification? (8)
- (iii) Discuss the salient cost-cutting strategies adopted in bio-processes. (4)

12. (a) (i) Obtain an equation for a liquid extraction operation having  $n$  stages, connecting the feed rate and the raffinate concentrations of solute and the extraction factor. (12)
- (ii) Also, obtain an expression to indicate per cent fraction of extraction. (4)

Or

- (b) Discuss in detail the following operating parameters of a bead mill during cell disruption : (i) bead loading (ii) feed rate (iii) agitator speed and (iv) size and density of beads. (16)
13. (a) (i) Explain the concept of pre-coating in filtration operation. (4)
- (ii) Discuss in detail the various pre-treatment methods adopted in fermentation broth prior to filtration. (12)

Or

- (b) 250 cm<sup>3</sup> of a fermented slurry of 0.016 g/cm<sup>3</sup> concentration can be filtered in 32 min. The filter has a surface area of 8.3 cm<sup>2</sup>, a pressure drop of 1 atm. And a filter medium of negligible resistance. The cake has a solid density of 1.09 g solids/ cm<sup>3</sup> of cake. Take the slurry density to be that of water. The results of this experiment are to be used to estimate the time to filter 1600 L of this slurry through a centrifugal filter. The filter has a basket of 51cm rad. and 45 cm. height. It turns at 530 RPM. When it is spinning, the liquid and the cake together are 5.5 cm thick. What is the time taken to filter this slurry? (16)
14. (a) (i) Describe the concept of recrystallization; show by this process how both yield purity can be improved. (4)
- (ii) Derive an expression for the population density  $\eta$  in a continuous crystallization process. (8)
- (iii) Write an equation for the crystal growth rate in terms of crystal mass and its area; compare the properties of the two constants  $k$  and  $\kappa$ . (4)

Or

- (b) A partially hydrolyzed sugar is extracted from water into a solvent. It has  $K$  values of 6.4 and 0.22 mol/L at pH 4.0 and pH 5.8 respectively. What is the value of  $K$  at pH 7? (16)

15. (a) In an elution chromatographic method, derive an expression for obtaining the length 'l' of the column using the quantitative method of analysis. (16)

Or

- (b) An enzyme isolated from yeast can be adsorbed on cellulose. The adsorption follows a Langmuir Isotherm. The maximum uptake is  $70 \text{ mg/cm}^3 (q_0)$  adsorbent; half of this maximum occurs when the solution contains  $50 \text{ mg/L}$  of the enzyme. We have a feed of  $1.5 \text{ L}$  of this enzyme containing  $220 \text{ mg/L}$  How much cellulose should be added to get a 90% recovery? (16)
-