

**THE KAVERY ENGINEERING COLLEGE***(An Autonomous Institution)***B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV/DEC 2025***Sixth Semester**Chemical Engineering***CH3014 – Bioseparation and Downstream Processing***Regulations - 2021**Duration : 3 Hrs**Maximum : 100 Marks***PART – A (ANSWER ALL QUESTIONS) (Marks 10\*2=20)**

| <i>Q.No</i> | <i>Questions</i>                                      | <i>BLT</i> | <i>CO</i> | <i>Marks</i> |
|-------------|-------------------------------------------------------|------------|-----------|--------------|
| 1.          | Summarize the stages of downstream processing.        | L2         | 1         | 2            |
| 2.          | Recall the characteristics of fermentation broth.     | L1         | 1         | 2            |
| 3.          | Compare Flocculation and sedimentation.               | L2         | 2         | 2            |
| 4.          | Spell the role of filter media with any two examples. | L1         | 2         | 2            |
| 5.          | What do you understand by absorption factor?          | L1         | 3         | 2            |
| 6.          | Name any four packing materials in absorber.          | L1         | 3         | 2            |
| 7.          | Define plait point.                                   | L1         | 4         | 2            |
| 8.          | Infer mixture role.                                   | L2         | 4         | 2            |
| 9.          | Classify the membrane processes.                      | L2         | 5         | 2            |
| 10.         | Compare Binary and Hydrodynamic chromatography.       | L2         | 5         | 2            |

**PART – B (ANSWER ALL QUESTIONS) (Marks 5\*16 = 80)**

| <i>Q.No</i> | <i>Questions</i>                                                                                                                                                                                                                                                                                                                                 | <i>BLT</i> | <i>CO</i> | <i>Marks</i> |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|--------------|
| 11.         | a i Explain the characteristics and principles of Bioseparation in detail.                                                                                                                                                                                                                                                                       | L2         | 1         | 8            |
|             | ii Summarize on the cell disruption for product release by mechanical methods.                                                                                                                                                                                                                                                                   | L2         | 1         | 8            |
|             | Or                                                                                                                                                                                                                                                                                                                                               |            |           |              |
|             | b i Explain the cell disruption for product release by enzymatic methods.                                                                                                                                                                                                                                                                        | L2         | 1         | 8            |
|             | ii Describe in detail the pretreatment and stabilization of bioproducts.                                                                                                                                                                                                                                                                         | L2         | 1         | 8            |
| 12.         | a i Fermented broth is filtered under constant pressure of recovery of protease. A pilot scale filter is used to measure filtration properties. The filter area is 0.25 m <sup>2</sup> , the pressure drop is 360mmHg and the filtrate viscosity is 4cP. The cell suspension deposits 22g cake/Lit of filtrate. The following data are obtained. | L4         | 2         | 10           |

|                      |      |      |      |      |      |      |
|----------------------|------|------|------|------|------|------|
| Time (Mins)          | 2    | 3    | 6    | 10   | 15   | 20   |
| Filtrate volume(Lit) | 10.8 | 12.1 | 18.0 | 21.8 | 28.4 | 32.0 |

Analyze the specific cake resistance and filtrate medium resistance. What size filter is required to process 4000lit cell suspension in 30min at a pressure of 360 mmHg?

|    |                                               |    |   |   |
|----|-----------------------------------------------|----|---|---|
| ii | Compare cross flow and continuous filtration. | L4 | 2 | 6 |
|----|-----------------------------------------------|----|---|---|

Or

|     |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |    |   |    |
|-----|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|---|----|
|     | b   | Inspect the position of particular particles as a function of time and volumetric flow rate of feed in a disc type centrifuge with the diagram and explain the different types of centrifuge.                                                                                                                                                                                                                                                                                                                                                                                   | L4 | 2 | 16 |
| 13. | a   | Categorize the factors affecting the performance of an absorption column and describe in detail.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | L4 | 3 | 16 |
|     |     | Or                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |    |   |    |
|     | b   | An air-C <sub>6</sub> H <sub>6</sub> mixture containing 5% benzene enters counter current absorption tower where it is absorbed with hydrocarbon oil. $G_S = 600$ kmol/hr. Solubility follows Raoult's law. Temperature at 27.6°C and 1 atm operating condition. Average molecular weight of oil is 200. Vapour pressure of Benzene at 27.6°C is 103 mm Hg. Examine $L_{S,min}$ to recover 95% of entering benzene, number of theoretical stages if 1.5 times the minimum liquid rate used and the exit concentration of solute in liquid.                                      | L4 | 3 | 16 |
| 14. | a   | A 5% (by weight) solution of acetaldehyde in toluene is extracted with water in a 3-stage cross current unit. If 100 kg of water is used per stage for 500 kg of feed. Calculate (using graphical method) the percentage extraction of acetaldehyde and weights of final raffinate and mixed extract. The equilibrium relationship is given by the relation, $Y=2.3X$ where Y is in kg of acetaldehyde/ kg water, X is in kg of acetaldehyde/ kg of toluene. Assume water and toluene are immiscible with each other.                                                           | L5 | 4 | 16 |
|     |     | Or                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |    |   |    |
|     | b i | Derive Rayleigh's equation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | L5 | 4 | 10 |
|     | ii  | Derive $\alpha = P_A/P_B$ from fundamentals for an ideal binary mixture.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | L5 | 4 | 6  |
| 15. | a   | A pilot-scale gel-chromatography column packed with Sephacryl resin is used to separate two hormones A and B. The column is 5 cm in diameter and 0.3 m high; the void volume is $1.9 \times 10^{-4} \text{ m}^3$ . The water regain value of the gel is $3 \times 10^{-3} \text{ kg m}^{-3}$ dry Sephacryl; the density of wet gel is $1.25 \times 10^3 \text{ kg m}^{-3}$ . The partition coefficient for hormone A is 0.38; the partition coefficient for hormone B is 0.15. If the eluant flow rate is $0.71 \text{ h}^{-1}$ , estimate the retention time for each hormone. | L5 | 5 | 16 |
|     |     | Or                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |    |   |    |
|     | b i | Explain in detail on membrane chromatography.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | L5 | 5 | 8  |
|     | ii  | Explain in detail on affinity ultra filtration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | L5 | 5 | 8  |