Model Question Paper

SIXTH SEMESTER B.TECH DEGREE

(2013 SCHEME)

BRANCH: BIOTECHNOLOGY & BIOCHEMICAL ENGINEERING

13.602: DOWNSTREAM PROCESSING (B)

Time: 3 Hours Max. Marks:100

PART A

*(Answer **ALL** questions, each carries **2** marks)*

1) Write a short note on the different types of classifiers.
2) What is a gyro- tester? State its use.
3) The specific resistance of the cake biomass was found to vary with pressure drop as follows. Find the compressibility of the cake.

Pressure drop (kN/m^2)	Cake resistance (m/ kg)
330	3.56×10^{11}
134. 3	2.16×10^{11}
46.1	1.45×10^{11}
21.1	1.07×10^{11}

4) Explain the terms ‘salting-in’ and ‘salting-out’.
5) What is a supercritical fluid? Give examples of ‘aqueous biphasic systems’.
6) Explain the principle of immunoelectrophoresis.
7) What are adsorption isotherms?
8) Give the advantages of crystallization as a finishing step in bioseparations.
9) State the steps for preliminary economic evaluation of a project for manufacturing a biological product.
10) How is molecular weight of a protein determined by gel filtration?

PART B

*(Answer **ANY ONE** question from each module, each carries **20** marks)*

MODULE I

11) (i) Estimate the Debye radius for particles in a solution of 50mM NaCl at 4ºC. If the surface electrostatic potential of particles in this solution is 10 mV, estimate the electrostatic potential 1nm from the surface.

(ii) Derive the Σ value for a disk type centrifuge. **(10+10)**

OR

12) Give an account of the action of enzymes in cell disruption. How is this method useful in sequential release of products. **(10+10)**

MODULE II

13) The breakthrough data given in the table were obtained for the adsorption of a pharmaceutical product in a lab column (5cm diameter x 15cm high) at a feed flow rate of 400 mL/ h and feed concentration of 0.75 U/ L, where U is units of biological activity of the pharmaceutical product. It is desired to scale up the process to operate in a column 30 cm high. What break-point time can be expected in a 30 cm high column? **(20)**

Time (h)	c_i (U/ litre)
20.5	0.01
26.7	0.20
32.0	0.39
36.0	0.53

OR

14) The operation of a pilot scale reciprocating plate extraction column has been optimized for the extraction of an antibiotic from whole fermentation broth using amyl acetate as solvent. The antibiotic has a partition coefficient K of 7.5. The optimal operating conditions are as follows: solvent flow rate of 105 mL/ min, flow rate of fermentation

broth of 70 mL/ min, and ratio of antibiotic in the raffinate to antibiotic in feed of 0.07. The column was 2.54 cm in diameter, and the height of the extractor (height of the reciprocating plates) was 1.83 m. The agitator speed was 280 strokes/ min. What column size and agitator speed are required to give a ratio of antibiotic in the raffinate to antibiotic in the feed of 0.03 and to handle fermentation broth at a rate of 1 50 000 litres every 12 h? **(20)**

MODULE III

15) (i) A column 20 cm long, with an internal diameter of 5 cm, gives sufficient purification to merit scale-up. The column produces 3.2 g of purified protein per cycle, and a cycle takes 6 h, from equilibrium through regeneration. The throughput requires is of 10 g/h. What are the new column's dimensions if linear velocity is held constant?

(ii) If the available standard column diameters are 20 cm and 25 cm, what flow rates and bed depths would apply to each of these columns? **(10 + 10)**

OR

16) (i) What is isotachophoresis? How is it carried out?

(ii) Describe the various electrophoretic techniques. **(10 + 10)**

MODULE IV

17) Give a detailed account on the principles of crystallization. **(20)**

OR

18) Estimate the dimensions of a drying chamber for a spray dryer that has an output of 1000 kg/h of a heat-sensitive biological material at 60 ºC containing 5% moisture and having a mean particle size of 100 μm. The feed contains 40% solids by weight in an aqueous solution at 4 ºC. The inlet air has a humidity of 0.01 kg/kg dry air and is at 150 ºC, while the outlet air is at 80 ºC. The specific heat of the dry solids is 0.3 kcal $kg^{-1}{}^{o}C^{-1}$. **(20)**