Ref. No.: Ex/PG/FTBE/T/127B/2024

M.TECH. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING
FIRST YEAR SECOND SEMESTER EXAM 2024
Subject-MODERN SEPARATION AND PURIFICATION PROCESS

Time : 3 Hours **FM-100**

(Use separate answer-script for each part.)

Part - I (50 Marks)

Answer questions no 4 and any two from the following

1. Dye is extracted using Tx-100 at 75^0C. Dye concentration needs to be reduced from 3.9 x10^{-4} (m) to 3.7 x 10^{-6} (m). Calculate the surfactant concentration require for reducing the dye using the following data.
   $m= 2.4 \times 10^{-1} - 5.9 \times ^{-3} T + 3.7 \times 10^{-5} T^2$
   $n= -5 \times 10^4 + 1.3 \times 10^3 T - 5.9x T^2$
   $P=5.9 - 200 C_o - 1.9x 10^{-8} C_o^{-2}$
   $R= 0.39 + 6.9 C_o + 4x 10^{-9} C_o^{-2}$
   $Q= -0.051$, $S= 0.09$
   All notations carries its usual meaning.
   Discuss the mechanism of micelle formation by surfactant? (15+5=20)
2. Derive an equation for particle settling during sedimentation through tubular-bowl centrifuge.
   A viscous solution containing particles with density 1361 kg / m^3 is to be clarified by centrifugation. The solution density is 791 kg/$m^3$and tis viscosity is 100 cp. The centrifuge has a bowl with r_2 = 0.02125 m, r_1 = 0.00616 m and height b= 0.1970 m. calculate the critical particle diameter of the largest particles in the exit stream if N= 24000rev/ minand flow rate q=0.002832 m^3/h. (10+10=20)
3. How electrolytic concentration, pH and temperature effects the extraction process using surfactant. Discuss the working principle of separation by using HPLC. (4+3+3+10=20)
4. Derive the functional relationship between flow rate and the dimension of the filter for centrifugal filtration process. 10

[Turn over

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Subject : MODERN SEPARATION AND PURIFICATION PROCESS **Time : 3 hours** **Full Marks : 100**

PART II (50 Marks)

Use Separate Answer scripts for each Part.

Answer any five questions.

1. With the help of suitable figures explain the process of reverse osmosis (RO). How is osmotic pressure of a solution determined? 7+3
2. An RO system is being used for a feed solution of 1.5% NaCl for desalination of water. Determine the flux in kg/m^2.hr if a transmembrane pressure of 1300kPa is applied. The solvent permeability constant, A_w of the membrane is 0.012 litre/m^2.hr.kPa. Solute concentration in the permeate side may be neglected. 10

   Data given:

gmol NaCl/ kg water	Density (kg/m3).	Osmotic pressure (atm)
1.	0	0
2.	0.01.	0.47
3.	0.10.	4.56
4.	0.50.	22.55
5.	1.00.	45.80
6.	2.00.	96.2

3. What is concentration polarization and what are its negative effects on membrane operation? How can concentration polarization be minimized? 7+3
4. Deduce the correlation between the flux and the polarization modulus in ultrafiltration (UF). What is gel polarization? 8+2
5. How is the process of ultrafiltration applied in the food and beverage industry? Write about any three applications. 10
6. An UF system is being used to concentrate gelatin. The flux rate was 1560 litre /m^2.day at 6% solids and the flux rate was 750 litre/ m^2.day at 10% solids. Determine the concentration of the gel layer and find the flux rate at 8% solids. 10
7. With the help of a neat diagram explain the operation of a Spiral Wound Membrane Module.
8. (a) Deduce an expression for series resistances in membrane processes used for dialysis.
   (b) Calculate the flux and the rate of removal of urea at a steady state in g/hr from blood in a cellophane membrane dialyzer at 37^{0}C. The membrane is 0.030 mm thick and has an area of 2.0 m^2. The mass transfer coefficient on the blood side is estimated as k= 1.5×10^{-5} m/s and that on the aqueous side is 4.0×10^{-5} m/s. The permeance of the membrane is 8.5×10^{-6} m/s. The concentration of urea in the blood side is 0.025 g urea /100 ml and that in the dialyzing fluid can be taken to be zero. 5+5