

TRANSFER OPERATION - II
(BIOT 3104)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Which of the following is not a membrane separation process?
(a) Ultra-filtration (b) Chromatography
(c) Flash distillation (d) Reverse osmosis.
- (ii) Molecular diffusivity of a liquid
(a) increases with temperature
(b) decreases with temperature
(c) may increase or decrease with temperature
(d) is independent of temperature.
- (iii) Concentration polarization does not occur in which of the following processes
(a) Reverse osmosis (b) Ultra-filtration
(c) Micro-filtration (d) Electrophoresis.
- (iv) In absorption minimum operating line
(a) touches the equilibrium line
(b) has a slope of $(L/V)_{\min}$
(c) shows the maximum possible liquid concentration
(d) all the above.
- (v) Which of the following is not an application of ultrafiltration?
(a) Concentration (b) Purification (c) Diafiltration (d) Dialysis.
- (vi) What apparatus is used in distillation?
(a) Distillation flask, condenser, collection vessel
(b) Distillation flask, condenser
(c) Condenser, collection vessel
(d) Distillation flask, column.
- (vii) When the boiling temperature is plotted against the liquid composition, then it is called
(a) Cooling Curve (b) Heating Curve
(c) Bubble point curve (d) Volatility Phase Diagram

Group - D

6. (a) Derive the working formula for calculation of drying time under constant rate of drying. [(CO5)(Derive/IOCQ)]
 (b) Describe the different stages of crystal formation from a super saturated solution. [(CO4)(Understand/LOCQ)]
6 + 6 = 12
7. An inlet water solution of 100 kg/hr containing 0.01 wt fraction nicotine (A) in water is stripped with kerosene stream of 200 kg/hr containing 0.0005 wt fraction nicotine in a counter current stage tower. The water and the kerosene are essentially immiscible in each other. It is desired to reduce the concentration of exit water to 0.001 wt fraction nicotine. Determine the theoretical number of stages needed. The equilibrium data are as follows with x the weight fraction of nicotine in the water solution and y in the kerosene.

x	0.001010	0.00246	0.005	0.00746	0.00988	0.0202
y	0.000806	0.00196	0.00454	0.00682	0.00904	0.0185

[(CO5)(Solve/HOCQ)]

12**Group - E**

8. In a cross flow ultra filtration system for separation of protein from the fermentation broth, the flow rate of liquid through a tube of diameter $d = 2$ cm and length $L = 50$ cm is $Q = 2$ L/min. The flow regime is turbulent, $f = 0.0005$, and $C_4 = 2[\text{atm}(\text{s}/\text{cm})^2]$. The inlet pressure is $P_i = 2$ atm. Protein concentration in the solution and on gel film are $C_B = 30$ mg/L and $C_G = 100$ mg/L, respectively. Determine:
 (i) The transmembrane pressure drop.
 (ii) If the mass transfer coefficient (k) for protein flux is $k = 5$ cm/s, determine the flux of liquid through the UF membrane. [(CO6)(Analyse/IOCQ)]
(6 + 6) = 12
9. (a) What are the working principles of ultra-filtration, electro-dialysis and reverse osmosis? [(CO6)(Understand/LOCQ)]
 (b) Where can you apply the above unit operations in the field of biotechnology? [(CO6)(Analyse/IOCQ)]
6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	30.21	44.79	25

Course Outcome (CO):

After completion of the course, the students will be able to:

1. Understand the concept of diffusion and diffusivity and identify the type of diffusion in a given problem and solve it.
2. Determine gas-liquid mass transfer coefficient in a wetted wall column or packed bed absorption column and calculate the number of stages required for the unit operation.
3. Apply McCabe-Thiele Method and Rayleigh's equation as required in a distillation process.
4. Comprehend different other unit operations like adsorption, liquid-liquid extraction and crystallization explicitly.
5. Draw the drying characteristic curve under a given constant drying condition.
6. Study and apply the principle and operation of different advanced separation processes like dialysis, ultrafiltration, reverse osmosis, pervaporation and electrodialysis in the field of biotechnology.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question