

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER– V • EXAMINATION – WINTER 2016**

**Subject Code: 150501****Date: 30/11/2016****Subject Name: Mass Transfer Operations-I****Time: 10:30AM – 01:00PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** State and Explain Fick's law of diffusion? Derive the expression for steady state equimolar diffusion of A in B. **07**
- (b)** Discuss classification of mass transfer operation in detail. **07**
- Q.2 (a)** Oxygen (A) is diffusing through carbon monoxide (B) under steady state condition with carbon monoxide non-diffusing. The total pressure is  $1 \times 10^5 \text{ N/m}^2$  and temperature is  $0^\circ\text{C}$ . The partial pressure of oxygen at two planes 2.0 mm apart is respectively 13000 and 6500  $\text{N/m}^2$ . The diffusivity for the mixture is  $1.87 \times 10^{-5} \text{ m}^2/\text{s}$ . Calculate the rate of diffusion of oxygen in  $\text{kmol/s}$  through each square meter of the two planes. **07**
- (b)** Explain the mass, heat and momentum transfer analogies. **07**
- OR**
- (b)** Derive the relation for film theory. **07**
- Q.3 (a)** A coal gas is to be freed of its light oil by scrubbing with wash oil as an absorbent and the light oil recovered by stripping the resulting solution with steam. The circumstances are as follows: **14**  
 Absorber: Gas in,  $0.250 \text{ m}^3/\text{s}$  at  $26^\circ\text{C}$ ,  $p = 1.07 \times 10^5 \text{ N/m}^2$ , containing 2.0% by volume of light oil vapors. The light oil will be assumed to be entirely benzene, and 95% removal is required. The wash oil is to enter at  $26^\circ\text{C}$ , containing 0.005 mole fraction benzene and has an average molecular weight 260. An oil circulation rate of 1.5 times the minimum is to be used. Wash oil-benzene solutions are ideal. The temperature will be constant at  $26^\circ\text{C}$ . At  $26^\circ\text{C}$ , the vapor pressure of benzene is  $p = 13330 \text{ N/m}^2$ . Compute the oil circulation rate.
- OR**
- Q.3 (a)** State and explain the criteria for solvent selection in absorption. **07**
- (b)** Write a short note on minimum liquid-gas ratio. **07**
- Q.4 (a)** Explain the working of venturi scrubber and packed tower with neat sketch. **07**
- (b)** State the characteristics of packing. Differentiate between random packing and regular packing. **07**
- OR**
- Q.4 (a)** Discuss the criteria for choice of solvent for liquid-liquid extraction. **07**
- (b)** Explain with a neat sketch the material balance for multi-stage cross current extraction. **07**
- Q.5 (a)** Discuss the different types of equilibrium diagrams for leaching. **07**
- (b)** Write a short note on counter current multiple contact Shanks system with neat sketch. **07**
- OR**
- Q.5 (a)** Write a Short note on Super saturation for Crystallization. **07**
- (b)** Explain construction and working of Swenson-Walker Crystallizer with the help of a neat sketch. **07**

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