Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER II (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2723001 **Date: 27/05/2016**

Subject Name: Advanced Mass Transfer

Time:10:30 am to 01:00 pm **Total Marks: 70**

Instructions:

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

Q.1		Discuss in detail the steps for calculating number of stages in multi component distillation by Lewis-Matheson method.	14
Q.2	a)	Discuss the use of heat pump with refrigerant in distillation column for energy saving.	07
	b)	Hydrogen gas at 2 std atm flows through a pipe made of unvulcanized neoprene rubber, with ID and OD 30 and 60 mm, respectively. The solubility of hydrogen is reported to be 0.093 cm^3 (STP)/cm^3. atm and the diffusivity of hydrogen through the rubber to be 1.8×10^{-6} cm^2/s. Calculate the rate of loss of hydrogen by diffusion per meter of pipe length.	07
		OR	
	b)	Write a short note on diffusion through polymers.	07
Q.3	a)	State and discuss the various types of membrane modules in detail.	07
	b)	Discuss in detail the advantages of membrane separation processes.	07
		OR	
Q.3	a)	State the advantages and disadvantages of super heated steam drying (SSD).	07
	b)	Explain the working principal of super heated steam drying (SSD) and classify SSD based on its operating pressure.	07
Q.4	a)	Discuss with example the selection of operating pressure in multi component distillation.	07
	b)	Explain briefly the selection criteria for packed tower and tray tower with suitable examples.	07
		OR	
Q.4	a)	Predict the fractional solute removal and pressure drop in a ventury scrubber based on the following data: Solvent to gas ratio = 1.4 L/m^3 Throat velocity of gas phase = 100 m/s Avg. molar mass of flue gas = 29.48 kg/kmol SO_2 concentration in flue gas = 4000 ppm Discharge pressure from ventury = Atmospheric Volumetric flow rate of flue gas = 24000 Nm^3/h Temperature = $90^{O}C$ Density of lime solution = 1012.5 kg/m^3	09

Assume number of transfer unit = 1
Take equilibrium mass of SO_2 per 100 mass of H_2O = 0.035
Take Average temperature of scrubber = $50^{O}C$
Pressure drop equation for venturi scrubber is,

$$\Delta P = 2.584 \times 10^{-3}\, V_G^2 \rho_G A_{th}^{0.133} (L'/G')^{0.78}$$

b) State the advantages of falling film absorber. 05

Q.5 a) Derive the rate equation for straight mass transfer (Physical Absorption of A) based on two film theory with neat sketch. 07

b) For a fast second order reaction with low C_B show that $-r_A = \dfrac{1}{\dfrac{1}{K_{Ag}} + \dfrac{H_A}{K_{Al} aE}} P_A$ 07

Q.5 Explain with neat sketch and suitable example the variable specifications for typical design cases based on key components and the required equilibrium stages. 14