Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (OLD) - EXAMINATION – SUMMER 2017

Subject Code: 160503 **Date: 27/04/2017**

Subject Name: Process Equipment Design-I

Time: 10:30 AM to 01:30 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 **(a)** Discuss the design procedure of Continuous Gravity Decanter. **07**

(b) Design an Orifice meter based on the following data. **07**

Fluid = Water, I.D.(Pipe) =15.4 mm (Sch 40), Temp = Room Temp.

Density = 1000 Kg/M^3 ,Viscosity = 0.8CP, Manometric fluid = Mercury (S.G.=13.6).

Q.2 **(a)** Discuss allocation of fluid in Shell & Tube Heat Exchanger. **07**

(b) Discuss the function of following. **07**

(i) Baffles (ii) Tie rod (iii)Sealants (iv)Expansion Bellows

OR

(b) Give Comparison of Kettle type and Thermosyphon reboiler. **07**

Q.3 **(a)** Methanol from top of Distillation column is to be condensed outside tube in a Shell & Tube condenser at rate 1000 Kg/hr at atm pressure using Cooling water at 25°C. If Tube (O.D.=23.8mm and I.D. = 19.5 mm)with triangular orientation is to be used, find the No. Of Tubes. **14**

$$h_c = 0.95\, k_L \left\{ \rho_L(\rho_L - \rho_V)g \,/\, \mu_L \Gamma \right\}^{0.33}$$

Methanol Properties: ρ = 790 Kg/M^3,μ = .01 CP, λ=300 Kcal/Kg, B.P. =64°C

$$\Gamma = W_c/N_t\, \Pi\, d_0$$

Water Properties: ρ = 1000 Kg/M^3,μ = .8 CP, λ=525 Kcal/Kg.

No.of Passes	1	2	4	6	8
K_1	0.318	0.249	0.175	0.0743	0.0346
N_1	2.142	2.207	2.285	2.499	2.675

OR

Q.3 **(a)** Discuss either Spiral flow H.E. or Plate type H.E. **07**

(b) Give the criteria for selection of solvent in designing the solvent extractor. **07**

Q.4 **(a)** For separation of Dimethylformamide (DMF) from its dilute solution in water, counter current liquid-liquid extraction is used. Methylene chloride is solvent. DMF-water solution flow rate is 1000 kg/h and contains 20% DMF by mass. DMF is reduced to 1% in the final raffinate. Determine the minimum amount of solvent used. **07**

Phase equilibria equation is given by $y = 0.5555x$ at 25 °C where y and x are mass fractions of solute

(b) Discuss the industrial applications of Liquid Liquid Extraction. **07**

OR

Q.4 **(a)** Discuss function of Weir and Down comer in plate type column. **07**

(b) Determine the minimum reflux ratio for the binary distillation at standard atmospheric pressure for following **07**

Feed: Mixture of C_6H_6(Mole fraction 0.4). &$C_6H_5CH_3$(Mole fraction 0.6)
At saturated liq condition, X_D =0.99, X_B = 0.02, α = 2.25

Q.5 **(a)** A centrifugal pump is drawing water from an overhead tank, exposed to atmosphere. Vertical distance between free surface of liquid in the tank and centre line of the pump is 10 m. Capacity of centrifugal pump is $10M^3/h$. Maximum operating temperature is 50 °C. Vapor pressure of water at 50 °C is 92.51 torr. Total length of suction pipe 10.5 m, having two 90 ° elbows. Material of pipe is carbon steel. Density of water = 1000 kg/m³, Viscosity of water = 0.6 cP. , K_L for 90ºelbow = 0.75 **07**

For the velocity of water in suction line 1 m/s, Determine

(1) The size of suction pipe

(2) Total frictional pressure drop in suction line

(3) $(NPSH)_A$ of centrifugal pump.

Pressure drop $\Delta P/L = f v^2 \rho / g_c D_t$, $f = .04 R_e^{-0.16}$ for turbulent flow.

(b) Write a brief note on NPSH for centrifugal pumps **07**

OR

Q.5 **(a)** Discuss different type of Packings used in Absorption Tower. **07**

(b) Explain Flooding and Channeling in the Tower. How designer overcomes these problems. **07**

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