[40] SEAT No._____ No. of Printed Pages : 2

SARDAR PATEL UNIVERSITY
EXTERNAL EXAMINATION
M.SC. INDUSTRIAL CHEMISTRY
(SECOND SEMESTER)
PS02CICH24: HEAT TRANSFER OPERATIONS AND STOICHIOMETRY
WEDNESDAY, 20TH MARCH, 2019

Time: 10:00 am to 1:00 pm **Total Marks: 70**

Q-1. Answer the following multiple choice question. **[08]**

1. Identify the correct relation.
   a. 1 W = 1 cal/sec b. 1 W = 1cal/hr
   c. 1 W = 1kcal/sec d. 1 W = 1 J/sec
2. An insulator should have_____.
   a. High thermal conductivity b. Low thermal conductivity
   c. Less resistance to heat flow d. None of the above
3. Heat transfer co-efficient for liquids increases with_____.
   a. Increasing temperature b. Decreasing temperature
   c. Decreasing Reynolds number d. None of these
4. Prandtl Number is given by_____.
   a. $C_p\mu/k$ b. hD/k c. h C_p/k d. h C_p/μ
5. Maximum heat transfer rate is obtained in_____region.
   a. Laminar b. Transition c. Turbulent d. Creeping
6. Heat flux is the amount of heat transferred per_____
   a. Unit area b. Unit time
   c. Unit area x unit density d. Unit area x unit time
7. The ratio of moles of reactant reacted to produce the desired product to total moles of reactant reacted is called_____.
   a. Yield b. Conversion c. Mole ratio d. Selectivity
8. The extent to which the reaction can proceed is decided by_____.
   a. Yield b. Excess reactant c. Limiting reactant d. Stoichiometry

Q-2 Answer any seven of following. **[14]**

1. Define conduction and convection.
2. Distinguish between steady state and unsteady state heat conduction.
3. State Fourier's law with equation.
4. Define LMTD for counter current flow.
5. Draw neat diagram of U tube heat exchanger.
6. What are the roles of baffles in shell and tube heat exchangers?
7. Brief triangular tube pitch with its importance.
8. Define enthalpy with importance in heat of mixing.
9. Define % conversion and % yield.

Q-3 **a.** Derive the equation for heat transfer for spherical surface using Fourier's law with neat diagram. **(06)**

b. A 0.15 m diameter pipe is covered with 3 layer of insulation. The first layer is 0.04m thick with a thermal conductivity of 0.09 W/m^{0}C. The second layer is 30mm thick with K = 0.06 W/m^{0}C and third layer is 2cm thick with K = 0.056 W/m^{0}C. The temperature at inner and outer surfaces is 670K & 320K. Find the heat loss per meter length and the interface temperature. **(06)**

(P.T.O.)

OR

b. The three types of material containing wall made up of. The distance between wall is 0.114m, 0.229m, respectively. Temperatures are 760^{0}C and 76.6^{0}C. Thermal conductivity K_1= 0.138W/m^{0}C, K_2 = 1.38 W/m^{0}C. Find the interface temperature. **(06)**

Q-4 **a.** Discuss the construction and working of shell & tube heat exchanger with neat diagram. **(06)**

b. Oil (70kg/min) flowing through the tube side is cooled from 50^{0}C to 34^{0}C using water (36kg/min) entering at 15^{0}C shell side. 20 tubes are kept in shell (ID 0.8m), each tube has ID 0.027m and OD 0.03, k_m = 0.02 kJ/min.m.^{0}C.

Mass	ρ (kg/m^3)	Cp (KJ/kg.^{0}C)	K (KJ/min.m.^{0}C)	μ (kg/m.min)
Oil	910	2.0	0.012	2.52
Water	1000	4.18	0.036	0.06

Calculate the U_0 and require length of heat exchanger for:

Parallel flow heat exchanger **(06)**

OR

b. ***Counter flow heat exchanger*** **(06)**

Q-5 **a.** 100Kg of feed to a distillation column contains 28% benzene & 72% toluene. The distillate contains 52% benzene & residue contains 5% benzene. Calculate the Kg of distillate and residue and % recovery of benzene. **(06)**

b. 100Kg mixture of acetone (28%) and chloroform (72%) by weight is to be separated by extraction using a solvent. Calculate the weight ratio of feed to solvent. The composition of extract and raffinate is as follows: **(06)**

	Acetone	Chloroform
Extract	7.50	3.50
Raffinate	20.30	67.30

OR

b. Calculate the pressure required for small oxygen cylinder having 0.015m^3 volume and each containing 0.5kg of O_2. Cylinder is subjected to a maximum temperature of 323K. R = 8.314 m^3.kPa/kmole.K **(06)**

Q-6 **a.** A combustion reactor is fed with 50kmole butane and 2100kmole air. Calculate the % excess air for following reaction. **(06)**

$$C_4H_{10} + 6.5O_2 \rightarrow 4CO_2 + 5H_2O$$

b. Groundnut seed contains oil and solids 45% each are fed to an expeller. The cake contains 80% solids and 5% oil. Calculate the %recovery of oil. **(06)**

OR

b. A stream of CO_2 flowing at rate of 100Kmol/hr is heated from 298K to 383K. Calculate heat that must be transferred per second. n=100, (a=21.3655, b= 64.28x10^{-3}T, c= - 41.05 x10^{-6}T^2, d= 9.79 x10^{-9}T^3) in KJ/KmolK. **(06)**

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