5.

40

SEAT No.

No. of Printed Pages : 2

SARDAR PATEL UNIVERSITY EXTERNAL EXAMINATION M.SC. INDUSTRIAL CHEMISTRY (SECOND SEMESTER)

(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 che	oice question.	[80]			
	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 i					
		a. Increasing temperature c. Decreasing Reynolds number	d. None of these				
	4.	Prandtl Number is given by					
		a. C _p μ/k b. hD/k	c. h C _p /k d. h C _p /µ				
	5.	Maximum heat transfer rate is obtain	ned inregion.				
		a. Laminar b. Transition	c. Turbulent d. Creeping				
	6.	Heat flux is the amount of heat trans	sferred per				
		a. Unit area	b. Unit time				
		c. Unit area x unit density	d. Unit area x unit time				
	7.	7. The ratio of moles of reactant reacted to produce the desired product to					
		moles of reactant reacted is called_	<u></u> •				
		a. Yield b. Conversion	c. Mole ratio d. Selectivity				
	8.	The extent to which the reaction car					
		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 h	neat of mixing.				
	9.	Define % conversion and % yield.					
Q-3	a.		for spherical surface using Fourier's law	(06)			
		with neat diagram.					
	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 ^o C. The second layer is					
		30mm thick with $K = 0.06 \text{ W/m}^{\circ}\text{C}$ a	nd third layer is 2cm thick with K = 0.056 and outer surfaces is 670K & 320K. Find				
		the heat loss per meter length and the					
			·	~ በ ጥ ለ			

(PATO)

(1)

- b. The three types of material containing wall made up of. The distance (06) between wall is 0.114m, 0.229m, respectively. Temperatures are 760°C and 76.6°C. Thermal conductivity K₁= 0.138W/m°C, K₂ = 1.38 W/m°C. Find the interface temperature.
- Q-4 a. Discuss the construction and working of shell & tube heat exchanger with (06) neat diagram.
 - b. Oil (70kg/min) flowing through the tube side is cooled from 50° C to 34° C using water (36kg/min) entering at 15° 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. $^{\circ}$ C.

Mass	ρ (kg/m³)	Cp (KJ/kg.⁰C)	K (KJ/min.m.⁰C)	μ (kg/m.min)
Oil	910	2.0	0.012	2.52
Water	1000	4.18	0.036	0.06

Calculate the Uo 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. (06) The distillate contains 52% benzene & residue contains 5% benzene. Calculate the Kg of distillate and residue and % recovery of benzene.
 - b. 100Kg mixture of acetone (28%) and chloroform (72%) by weight is to be (06) separated by extraction using a solvent. Calculate the weight ratio of feed to solvent. The composition of extract and raffinate is as follows:

	Acetone	Chloroform
Extract	7.50	3.50
Raffinate	20.30	67.30

OR

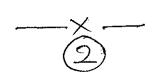
- b. Calculate the pressure required for small oxygen cylinder having 0.015m³ (06 volume and each containing 0.5kg of O₂. Cylinder is subjected to a maximum temperature of 323K. R = 8.314 m³.kPa/kmole.K
- Q-6 a. A combustion reactor is fed with 50kmole butane and 2100kmole air. (06) Calculate the % excess air for following reaction.

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

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

OR

b. A stream of CO₂ flowing at rate of 100Kmol/hr is heated from 298K to 383K. (06) Calculate heat that must be transferred per second. n=100, (a=21.3655, b=64.28x10⁻³T, c= -41.05 x10⁻⁶T², d= 9.79 x10⁻⁹T³) in KJ/KmolK.



1 3 C