Q. Code: 966112

Reg. No. | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, DEC 2019

Third Semester

CH18301 – CHEMICAL PROCESS CALCULATIONS

(Chemical Engineering)

(Regulation 2018)

Time: Three Hours **Maximum : 100 Marks**

Answer **ALL** questions

PART A - (10 X 2 = 20 Marks)

		CO	RBT
1.	Convert the heat transfer coefficient of value 100 Btu/h.ft^2.°F into W/m^2 °C	1	U
2.	Calculate the volume of 15 kg of Chlorine at a pressure of 0.9 bar and 293 K.	1	U
3.	Define limiting reactant and degree of completion.	2	R
4.	Write any four significances of recycling.	2	R
5.	Compare Relative humidity and percentage humidity.	3	U
6.	If 'H' is the absolute humidity and 'T' is the dry bulb temperature of humid air, explain how to calculate the wet bulb temperature 'T_w' and the dew point temperature 'T_D' using humidity chart?	3	AP
7.	Distinguish exothermic and endothermic reactions with example.	4	AP
8.	Define theoretical flame temperature.	4	R
9.	Give the use of Orsat apparatus.	5	R
10.	List few process simulators used in chemical industries.	5	R

PART B - (5 X16 = 80 Marks)

11.	(a)	1000 litres of mixture of H_2, N_2 and CO_2 at 150°C was found to have the following ratio for the partial pressure of the gases: PH_2:PN_2:PCO_2 is 1:4:3. If the total pressure is 2 atm absolute, calculate. I. Mole fraction of each of these gases II. Weight per cent of each of these gases III. Average molecular weight IV. Weight of CO_2 in kg.	**(16)**	1	AP

(OR)

	(b)	(i)	Compare pressures given by the ideal gas and van der Waals equation for 1 mole of CO_2 occupying a volume of (381×10^{-6}) m^3 at 40 °C. Given: $a = 0.3646$; $b = 4.28 \times 10^{-5}$	**(10)**	**1**	**AP**
		(ii)	A compound's molecular weight is 103. Given Carbon = 81.5%, Hydrogen = 4.9% and N_2=13.6%, by weight. Find its formula?	**(6)**	**1**	**AN**
12.	(a)	(i)	An evaporator system concentrating weak liquor from 10% to 50% solids, handles 200kg of solids per hour. If the same system is to concentrate a weak liquor from 5% to 40%. Find the capacity of the system in terms of solids that can be handled to be same assuming water evaporating capacity to be same in both cases.	**(10)**	**2**	**AP**
		(ii)	A cotton mill dries a water soaked fabric in a drier from 54% to 9% moisture. How many kg of water is removed by drying operation per 1200 kg of feed.	**(6)**	**2**	**AP**
			(OR)			
	(b)		300 kg of N_2 and 75kg of H_2 are brought together and allowed to react at 823K and 300 atm. It is found that there are 38 kmol of gases present at equilibrium. How many kilo moles of N_2, H_2 and NH_3 are present at equilibrium? Which is the limiting reactant? What is the % Excess? What is the degree of completion? What is the % conversion of hydrogen to NH_3? Given reaction: $N_2 + 3H_2$ gives $2NH_3$	**(16)**	**2**	**AN**
13.	(a)		Air-water vapour sample has a DBT of 55^0C with an absolute humidity of 0.03 Kg H_2O vapour/Kg dry air at 1 atm pressure. Calculate (i) Percentage humidity (ii) Absolute molal humidity (iii) Relative humidity (iv) Humid volume (v) Enthalpy	**(16)**	**3**	**AN**
			(OR)			
	(b)		A mixture of nitrogen – acetone vapour at 800 mmHg and 25ºC has percentage saturation of 80%. Calculate (i) absolute humidity (ii) partial pressure of acetone (iii) absolute molal humidity and	**(16)**	**3**	**AN**

(iv) volume percentage of acetone. Assume vapour pressure of acetone at 25°C as 190mmHg

14.	(a)	(i)	Calculate the theoretical flame temperature of a gas having 20% CO and 80% N_2 when burnt with 150% excess air. Both the reactants are at 25°C. Data: ΔH^o_f of CO_2 = -94052 cal/gmol ΔH^o_f of CO = -26412 cal/gmol Mean heat capacities in cal/gmol.°C are CO_2 = 12, O_2 = 7.9, N_2 = 7.55	**(10)**	**4**	**AN**
		(ii)	Calculate the enthalpy of sublimation of Iodine from the following data: $H_2(g) + I_2(s) \longrightarrow 2\ HI(g)\ \Delta H_R = 51.9$ kJ $H_2(g) + I_2(g) \longrightarrow 2\ HI(g)\ \Delta H_R = -9.2$ kJ	**(6)**	**4**	**AP**
			(OR)			
	(b)		Write short notes on the following: I. Hess's law of heat summation II. Kopp's rule III. Heat of combustion and heat of formation IV. Heat capacity	**(16)**	**4**	**U**
15.	(a)		A producer gas contains CO_2: 9.2%, C_2H_4: 0.4%, CO: 20.9%, H_2: 15.6%, CH_4: 1.9% and N_2: 52%, when it is burnt, the products of combustion are found to contain CO_2:10.8%, CO: 0.4, O_2 :9.2%, N_2: 79.6%. Calculate the following: (a) m^3 of air used per m^3 of producer gas (b) % excess air (c) % N_2 that has come from producer gas.	**(16)**	**5**	**AP**
			(OR)			
	(b)		Discuss the uses and application of any two process simulators in chemical process industry.	**(16)**	**5**	**U**