

THE KAVERY ENGINEERING COLLEGE*(An Autonomous Institution)***B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL-MAY 2025***Third Semester**Chemical Engineering***CH3351 – Chemical Process Calculations****Steam Tables/Psychometric Charts Can be Permitted***Regulations - 2021***Duration : 3 Hrs****Maximum : 100 Marks****PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)**

Q.No	Questions	BLT	CO	Marks
1.	It is necessary to store 1 kg mole of methane at a temperature of 50 °C and a pressure of 600 atm. Determine the volume of the vessel that must be provided?	L5	1	2
2.	Give the Vanderwaal's equation and explain the terms.	L2	1	2
3.	State three reasons for using a recycle stream in a chemical process.	L1	2	2
4.	List the uses of humidity chart.	L1	2	2
5.	Define molal and absolute humidity.	L1	3	2
6.	What is Orsat analysis?	L1	3	2
7.	Define theoretical flame temperature.	L1	4	2
8.	What do you understand by the term internal energy of a system? How is it related to the enthalpy of the system?	L1	4	2
9.	How the heat capacity of solids is calculated using Kopp's rule?	L1	5	2
10.	List the different methods used for calculating the heat of the reaction?	L1	5	2

PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)

Q.No	Questions	BLT	CO	Marks
11.	a i Pure water and alcohol are mixed to get a 60% (weight) alcohol solution. The densities in Kg/m³ of water, alcohol and the solution may be taken as 998, 798, 895 respectively at 293 K. Calculate the following: (1) Volume percentage of ethanol in the solution at 293 K (2) Molarity and Molality	L5	1	8
	ii A certain organic compound is found to contain 81.5 % C, 4.9% H and 13.6% N by weight. If the molecular weight of the compound is 103, determine the molecular formula of the compound. Or	L5	1	8
	b i A solution of kcl contains 35 kcl (by mass) at 323 K. The density of solution is 1.231 kg/lit. Find the molarity and molality.	L5	1	8
	ii A solution of sodium chloride in H₂O contains 25 NaCl (by mass) at 323 K. The density of the solution is 1.135 kg/litre. Find Molarity, Molality and normality of the solution.	L5	1	8

12.	a	An aqueous solution of Na_2CO_3 contains 15% carbonate by weight. 80% of the carbonate is recovered as $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ by evaporation of water and subsequent cooling to 278 K. The solubility of Na_2CO_3 at 278K is 9.0 % (weight). On the basis of 100 kg of the solution treated, determine the following: (1) The quantity of crystals formed (2) The amount of water evaporated	L5	2	16
		Or			
	b	Limestone is mixed with coke is being burnt in a kiln. An average analysis of the limestone is $\text{CaCO}_3 = 84.5\%$, $\text{MgCO}_3 = 11.5\%$ and the rest inerts. The coke contains 76.0% carbon, 21% ash and 3% moisture. The calcination of CaCO_3 is only 95% complete and that MgCO_3 is 90%. The carbon in the coke is completely burnt to CO_2 . The kiln is fed with one Kg of coke per 5 Kg of limestone. Calculate the weight of CaO in the product leaving the kiln. Assume that the moisture in the feed is completely vaporized.	L5	2	16
13.	a	A material is to be dried from 15% moisture by weight (wet basis) to 0.5% by circulation of hot air. The fresh air contains 0.02 kg of water/kg of dry air. Estimate the volume of fresh air required if 1000 kg/hr of dried material is to be produced. The exit humidity of air is 0.09 kg of water/kg of dry air. The air enters at 301 K and at atmospheric pressure.	L5	3	16
		Or			
	b i	What is wet bulb temperature? How it differs from adiabatic saturation temperature?	L2	3	8
	ii	How to find the humidity variables from humidity chart?	L2	3	8
14.	a	Write short notes on: (i) Mean heat capacity in heat calculation (ii) Calculation of standard heat of reaction	L2	4	16
		Or			
	b i	Discuss the effect of pressure and temperature on heat of the reaction.	L2	4	8
	ii	Discuss an energy balance for the closed and open system.	L2	4	8
15.	a	Estimate the difference of enthalpy of chloroform between 273 K and 500K at 1 atm. Chloroform vaporizes at 334 K. Given data: Specific heat of liquid is 1168 kJ/kmol K, Latent Heat is 29600 KJ/kmol and $C_{p \text{ Vapor}} = 31.86 + 14.5 \times 10^{-2} T - 11.2 \times 10^{-5} T^2$ KJ/kmol K.	L5	5	16
		Or			
	b	Estimate the theoretical flame temperature of a gas containing 22% CO and remaining N_2 when burnt with 100% excess air. Both gas and air are initially at 25 C. The standard heat of combustion of $\text{CO}_{(g)}$ at 25 C and 1 atm. Pressure is 67.64 Kcal/gm mole. The mean molal heat capacities in cal/gm mole K with in temperature range involved are as $\text{CO}_2 - 11.82$, $\text{O}_2 - 7.9$ and $\text{N}_2 - 7.5$.	L3	5	16

