

THE KAVERY ENGINEERING COLLEGE*(An Autonomous Institution)***B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV/DEC 2025***Third Semester**Chemical Engineering***CH3351 / UCHT24303 – Chemical Process Calculations****(Provide the Psychrometric Chart)***Regulations – 2021 & 2024**Duration : 3 Hrs**Maximum : 100 Marks***PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)**

<i>Q.No</i>	<i>Questions</i>	<i>BTL</i>	<i>CO</i>	<i>Marks</i>
1.	The thermal conductivity of an insulating brick is 0.15 Btu /ft hr °F. Examine the thermal conductivity in SI unit.	L2	1	2
2.	Estimate the equivalent weight of $\text{Al}_2(\text{SO}_4)_3$ and H_3PO_4 .	L2	1	2
3.	What is Stoichiometry?	L1	2	2
4.	Define limiting reactant with an example.	L1	2	2
5.	Demonstrate the relationship between humidity and molal humidity.	L2	3	2
6.	Distinguish between absolute and relative humidity.	L1	3	2
7.	Infer sensible heat and latent heat.	L2	4	2
8.	Recall Hess's law.	L1	4	2
9.	Define calorific value.	L1	5	2
10.	Compare proximate and ultimate analysis.	L2	5	2

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

<i>Q.No</i>	<i>Questions</i>	<i>BLT</i>	<i>CO</i>	<i>Marks</i>
11.	a i An aqueous solution of K_2CO_3 contains 50 % salt and the specific gravity of the solution is 1.53. Find the following (a) The mole percent of the salt in the solution (b) The volume percent of water assuming density of water is 1000 kg/m^3 and there is no volume change on mixing (c) The molality of the solution (d) The molarity of the solution (e) The normality of the solution ii An analysis of the vent gases from the chlorinator in a plant for making chlorinated rubber showed 70 % by volume HCl, 20% by volume Cl_2 and the rest CCl_4. Demonstrate the following (a) The percent composition by weight (b) The average molecular weight of the gas (c) The density at standard conditions (in kg/m^3).	L3	1	8

Or

	b	i	An aqueous solution contains 20 % ammonia, 60 % ammonium nitrate and 5 % urea by weight. Find the available nitrogen content of the solution.	L3	1	8
		ii	A compound having molecular weight 60 has the following percentages of the elements C=20 %, O ₂ =26.66 %, N ₂ =46.66 % and rest hydrogen. Interpret the empirical formula of the compound and its name.	L3	1	8
12.	a		The waste acid from a nitrating process contains 30% H ₂ SO ₄ , 35% HNO ₃ and 35% H ₂ O by weight. The acid is to be concentrated to contain 39% H ₂ SO ₄ and 42% HNO ₃ by addition of concentrated sulphuric acid containing 98% H ₂ SO ₄ and concentrated nitric acid containing 72% HNO ₃ (by weight). Find the quantities of the acids to be mixed to get 1000 kg of desired mixed acid.	L3	2	16
			Or			
	b	i	A single effect evaporator is fed with 10000 kg/h of weak liquor containing 15% caustic soda by weight and is concentrated to get thick liquor containing 40% by weight caustic soda (NaOH). Find (i) kg/h of water evaporated (ii) kg/h of thick liquor obtained.	L3	2	8
		ii	2000 kg of wet solids containing 70 % solids by weight are fed to a tray dryer where it is dried by hot air. The product finally obtained is found to contain 1 % moisture by weight, Interpret (i)Kg of water removed from wet solids (ii)Kg of product obtained.	L3	2	8
13.	a	i	The dry bulb temperature and dew point of ambient air were found to be 303K(30°C) and 298K(16°C) respectively. Determine (i)absolute molal humidity (ii)absolute humidity (iii)% RH (iv)% Saturation (v)Humid heat. Data: Vapour pressure of water at 298 K=1.818 kPa, Vapour pressure of water at 303 K=4.243 kPa and Barometric pressure=100 kPa.	L3	3	8
		ii	An air-water vapour sample at 101.3 kPa has a dry-bulb temperature of 328 K and is 10 % saturated with water vapour. Using the psychrometric chart, estimate the following (a) The absolute humidity, kg water vapour per kg dry air (b) The partial pressure of water vapour (c) The absolute saturation humidity at 328 K (d) The vapour pressure of water at 328 K (e) The percent relative saturation (f) The dew point of the system	L3	3	8
			Or			
	b		A mixture of acetone vapour and nitrogen gas at 101.3 kPa and 295 K contains acetone vapour to the extent that it exerts a partial pressure of 15 kPa. The vapour pressure of acetone at 295 K is 26.36 kPa. Evaluate the following: (a)The mole fraction of acetone in the mixture (b)The weight fraction of acetone in the mixture (c)The molal humidity (d)The absolute humidity (e)The molal saturation humidity (f)The absolute saturation humidity (g)The mass of acetone in 100 m ³ of the mixture	L3	3	16

14. a Temperature of oxygen is raised from 350 K (77° C) to 1500 K (1227°C). L4 4 16
Examine the amount of heat that must be supplied for rising the temperature of 1 kmol oxygen using C_p° data given below: $C_p^\circ = a + bT + cT^2 + dT^3$.

Gas	a	$bx10^3$	$cx10^6$	$dx10^9$
O ₂	26.0257	11.7551	-2.3426	-0.5623

Or

- b A stream flowing at a rate of 15000 mol/h containing 25 mole % N₂ and L4 4 16
75 mole % H₂ is to be heated from 298 K(25°C) to 473 K(200°C). Analyze the heat that must be transferred using C_p° data given below:

Gas	a	$bx10^3$	$cx10^6$	$dx10^9$
N ₂	29.5909	-5.41	13.1829	-4.968
H ₂	28.6105	1.0194	-0.1476	0.769

15. a The GHV(gross heating value) of gaseous n-butane is 2877.40 kJ/mol at L3 5 16
298 K(25°C). Find its NHV(Net Heating Value) in kJ/mol and kJ/kg. Latent heat of water vapour at 298 K(25°C)=2442.5 kJ/kg.

Or

- b A natural gas contains 85 % methane and 15 % ethane by volume. Infer the L3 5 16
GHV of this fuel in kJ/kg from the standard heats of combustion of methane and ethane.
 $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(g), \Delta H^\circ_c = - 802.62 \text{ kJ/mol}$
 $C_2H_6(g) + 3.5 O_2 \longrightarrow 2CO_2(g) + 3H_2O(g), \Delta H^\circ_c = - 1428.64 \text{ kJ/mol}$
 Latent heat of water vapour at 298 K(25°C)=2442.5 kJ/kg