Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

UG/PG DEGREE END SEMESTER THEORY EXAMINATIONS, APR/MAY 2026

Third Semester

Chemical Engineering

CH3351/UCHT24303 – CHEMICAL PROCESS CALCULATIONS

(Steam tables/charts, Humidity tables/charts can be Permitted)

Regulations – 2021/2024

Duration : 3 Hrs ***Maximum : 100 Marks***

*PART – A(ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	*Questions*	*BTL*	*CO*	*Marks*
1.	List out the two examples each for basic and derived units.	L2	1	2
2.	Explain Intensive property and Extensive property with an example.	L2	1	2
3.	What are limiting and excess reactant? Give an example.	L1	2	2
4.	Define partial pressure. Give the relation between total pressure and partial pressure.	L1	2	2
5.	Define Relative humidity.	L1	3	2
6.	Explain the terms 'Recycle' and 'Purge'.	L2	3	2
7.	What are proximate and ultimate analysis of coal?	L1	4	2
8.	How does the heat capacity of a gas vary with temperature?	L2	4	2
9.	Define "Standard heat of reaction".	L1	5	2
10.	Give the importance of heat of combustion.	L2	5	2

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

Q.No		*Questions*	*BTL*	*CO*	*Marks*
11.	a	A mixed brine is electrolysed and a gaseous mixture is obtained at the cathode having the following composition by weight: Cl_2 = 67%, Br_2 = 28% and O_2 = 5% Calculate (a) the composition by volume, (b) the average molecular weight and (c) the density of the gas mixture at 298 K (25°C) and 101.325 kPa. (Atomic weights: Cl = 35.5, Br = 80, O = 16)	L2	1	16
		or			
	b	A gas mixture has the following composition by volume: SO_2 = 8.5%, O_2 = 10% and N_2 = 81.5% Find (a) the density of the gas mixture at a temperature of 473 K (200 °C) and 202.65 kPa g and (b) composition by weight.	L2	1	16
12.	a	The waste acid from a nitrating process containing 20% HNO3, 55% H_2SO_4 and 25% H_2O by weight is to be concentrated by addition of concentrated sulphuric add containing 95% H_2SO_4 and concentrated nitric acid containing 90% HNO_3 to get desired mixed acid containing 26% HNO_3 and 60% H_2SO_4. Calculate the quantities of waste and concentrated acids required for 1000 kg of desired mixed acid.	L3	2	16
		or			
	b	After a crystallization operation, the solution of calcium chloride in water contains 60 g of $CaCl_2$ per 100 g of water. Calculate the amount of this solution necessary to dissolve 200 kg of $CaCl_2.6H_2O$ crystals at a temperature of 298 K (25°C).	L3	2	16

The solubility of $CaCl_2$ at 298 K (25°C) is 819.2 g of $CaCl_2$ per 1000 g of Water.

13.	a	A mixture of acetone vapour and nitrogen contains 14.8% acetone by volume. Calculate the following at 293 K (20°C) and a pressure of 99.33 kPa. (a) Partial pressure of acetone. (b) Moles of acetone per mole of nitrogen (c) Relative saturation of mixture at 293 K (20°C). (d) Percentage saturation of mixture at 293 K (20°C) Data: Vapour pressure of acetone at 293 K = 24.638 kPa	L3	3	16
		or			
	b	A mixture of benzene vapour and nitrogen gas at 297 K and 100 kPa has a relative humidity of 60%. It is desired to recover 80% of benzene by cooling a mixture to 283 K (10°C) and compressing to a suitable pressure. Determine the pressure required for above duty. Data: Vapour pressure of benzene at 297 K=12.2kPa Vapour pressure of benzene at 283 K = 6kPa.	L3	3	16
14.	a	Obtain an empirical expression relating the heat of reaction and the temperature of the reaction for the following reaction: $SO_2 + ½\ O_2 \rightarrow SO_3$	L3	4	16

Component	ΔH_f^0, kJ/kmol
SO_3	-395720
SO_2	-296810

$$C_p^o = a + bT + cT^2 + dT^3$$

Component	a	b x 10^3	c x 10^6	d x 10^9
SO_3	22.036	121.624	-91.867	24.369
SO_2	24.771	62.948	-44.258	11.122
O_2	26.026	11.755	-2.343	-0.562

or

	b	Air containing 21 mole % O2 and 79 mole % N_2 is to be heated from 303 K (30°C) to 423 K (150°C) Calculate the heat required to be added if the air flow rate is 3 m^3 (NTP) per minute using the data given below:	L3	4	16

$$C_p^o = a + bT + cT^2 + dT^3$$

Gas	a	b x 10^3	c x 10^6	d x 10^9
O_2	26.0257	11.7551	-2.3426	-0.5623
N_2	29.5909	-5.141	-13.1829	-4.968

15.	a	i	The Orsat analysis of the flue gases from a boiler house chimney by volume is as given below : CO_2: 11.4%, O_2: 4.2%, and N_2: 84.4% Assuming that complete combustion takes place. (a) Calculate the % excess air (b) Find the C:H ratio in the fuel	L3	5	16
			or			
	b		The ultimate analysis of a coal sample is given below: Carbon = 61.5%, Hydrogen = 3.5%, Sulphur = 0.4%, Ash = 14.2%, Nitrogen = 1.8% and the rest oxygen. Calculate: (c) Theoretical oxygen requirement per unit weight of coal, (d) Theoretical dry air requirement per unit weight of fuel and (e) The Orsat analysis of flue gases when the coal is burned with 90% excess dry air	L3	5	16