U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

April 2024 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 23CH3PCPPC / 22CH3PCPPC **Max Marks: 100**
Course: Process Principles and Calculations

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	CO	PO	Marks
1	a)		What are fundamental and derived quantities? Explain the system of units.	CO1	PO1	06
	b)		An aqueous solution of sodium chloride is prepared by dissolving 20 kg of NaCl in 80 kg of water. Calculate mole% composition of solution.	CO2	PO1	06
	c)		The gas analysis of the gas sample is given below (volume basis), CH_4=66%, CO_2=30%, NH_3=4%. Calculate (i) The average molecular weight of the gas (ii) The density of gas at 303k	CO2	PO2	08
			UNIT – II			
2	a)		100 kg mol/h of 40 mole% of solution of ethylene dichloride in toluene is fed to middle of the distillation column. the distillate contain 95 mole% ethylene dichloride and the bottoms consists of 90 mole% Toluene. What is the flow rate of each stream?	CO2	PO2	10
	b)		Soyabean seeds oil is extracted with hexane in batch reactors. The flaked seeds contain 18.2% oil, 69.5% solid and 12.3% moisture. At the end of the process, cake is separated from hexane oil mixture; the cake analysis yields 0.8% oil, 88.2% solids and 11.0% moisture. Find the percentage recovery of oil. All percentages are by weight.	CO2	PO2	10
			OR			
3	a)		A single effect evaporator is fed with 4000 kg/h of weak liquor containing 17% caustic by weight and is concentrated to get thick liquor containing 40% by weight caustic (NaOH). Calculate the amount of water evaporated and thick liquor obtained.	CO3	PO2	10
	b)		Explain (i) Bypass operation, (ii) Recycle operation, (iii) Purging operation.	CO2	PO1	10

			UNIT - III			
	4	a)	Calcium oxide is formed by decomposing limestone pure $CaCO_3$. In kiln, the reaction goes to 70% completion. (i) Determine the composition of the solid product withdrawn from the kiln. (ii) Determine the yield in kg of CO_2 produced per kg of lime stone.	***CO4***	***PO2***	**10**
		b)	Sulphur trioxide gas is obtained by the combustion of pyrites (FeS_2) according to the following reaction: $4FeS_2 + 15O_2 \rightarrow 2Fe_2O_3 + 8SO_3$ The reaction is accompanied by the following side reaction: $4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$ Assume that 80 % (weight) of the pyrites charged reacts to give sulphur trioxide and 20 % reacts giving sulphur dioxide. a) How many kilograms of pyrites charged will give 100 kg of SO_3? b) How many kilograms of oxygen will be consumed in the reaction?	***CO3***	***PO3***	**10**
			UNIT - IV			
	5	a)	A natural gas consists of 75% CH_4 and 25% N_2 is burnt in furnace. The CO_2 is scrubbed out of the resulting products for use in elsewhere. The exit gases from the scrubber analyze 6% O2 and 94% N_2. Calculate the percentage of excess air used.	***CO5***	***PO3***	**10**
		b)	A fuel oil contains 85% C and 15% H_2. It is burnt to form flue gas of following composition. CO_2 = 13%, O_2 =3.2% N_2=83.8% How many kgmol of flue gas are produced per kg of fuel oil?	***CO4***	***PO2***	**10**
			OR			
	6	a)	Explain ultimate and proximate analysis of coal.	***CO5***	***PO3***	**06**
		b)	Determine the flue gas analysis and air fuel ratio by weight when a medium fuel oil having the following composition: C=85.7%, H=10.3%, S=3.4%, O=0.5%, Ash = 0.1% (by weight) is burnt with 30% excess air. Assume that complete combustion takes place.	***CO5***	***PO3***	**14**
			UNIT - V			
	7	a)	Define the following (i) Heat capacity (ii) Heat of formation (iii) Heat of reaction (iv) Hess law	***CO1***	***PO1***	**08**
		b)	Calculate the heat required to rise the temperature of 1 kgmol of pure SO_2 from 300K to 1000K. heat capacity data for gaseous SO_2 is given by the following equation. $Cpso_2=43.46 + 10.64 \times 10^{-3}T - 5.95 \times 10^5 T^{-2}$	***CO6***	***PO2***	**12**

****