U.S.N.										

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

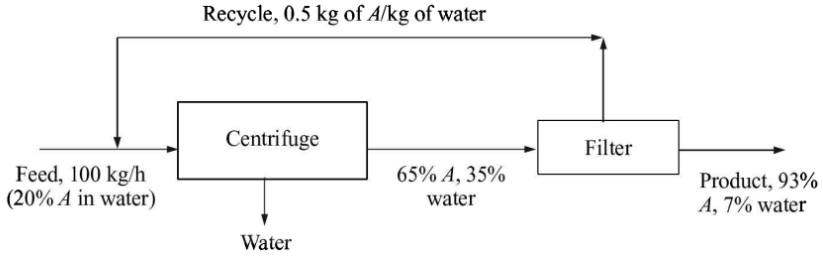
Autonomous Institute Affiliated to VTU

April 2024 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 19CH3DCPPC **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.

		UNIT - I	CO	PO	Marks
1	a)	The equation for the heat transfer to or from a stream of gas flowing in turbulent motion is as follows: $$h = \frac{aC_pG^{0.8}}{D^{0.2}} = \frac{16.6C_pG^{0.8}}{D^{0.2}}$$ Where, h = heat transfer coefficient $\left(\frac{kcal}{h.m^2.℃}\right)$, C_p = Heat capacity $\left(\frac{kcal}{kg.℃}\right)$, D =internal diameter of pipe (m), G = Mass velocity $\left(\frac{kg}{m^2.s}\right)$, and a = constant. It is desired to transform the equation into a new form $$h = \frac{aC_pG^{0.8}}{D^{0.2}}$$ where h = $\left(\frac{Btu}{h.ft^2.℉}\right)$, C_p = $\left(\frac{Btu}{lb.℉}\right)$, D = ft, and G = $\left(\frac{lb}{ft.s}\right)$	CO 1	PO 1	12
	b)	Define the followings: (i) Normality (ii) Molarity (iii) Dalton's law.	CO 1	PO 1	8
		UNIT - II			
2	a)	It is desired to make up 1000 kg of solution containing 35 % by weight of a substance 'A'. Two solutions are available, one containing 10 wt % percent 'A' and other containing 50 wt % of 'A'. How many kilograms of each solution will be required?	CO 2	PO 2	10
	b)	10000 kg/h of solution containing 20 % methanol is continuously fed to a distillation column. Distillate is found to contain 98 % methanol and waste solution from the column carries 1 % methanol. All percentages are by weight. Calculate (i) the mass flow rates of distillation and bottom product and (ii) the percent loss of methyl alcohol.	CO 3	PO 2	10
		OR			

	3	a)	Explain bypass, recycle and purging operations in chemical processes along with diagram.	*CO 2*	*PO 2*	**10**
		b)	Final purification stage in the preparation of a pharmaceutical product A from natural sources requires centrifuging and continuous filtration as depicted in the figure given below:  Determine the flow rate of the recycle stream in kg/h.	*CO 3*	*PO 2*	**10**
			UNIT - III			
	4	a)	Define the followings: (i) Limiting reactants (ii) Fractional yield (iii) Selectivity	*CO 4*	*PO 1*	**8**
		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?	*CO 4*	*PO 3*	**12**
			UNIT - IV			
	5	a)	Define the following: (i) Fuel (ii) Calorific value (iii) Theoretical oxygen (iv) Complete combustion (v) Incomplete combustion.	*CO 5*	*PO 3*	**10**
		b)	Calculate the net calorific value (NCV) at 298 K at a sample of fuel oil having C/H ratio 9.33 (by weight) and containing sulphur to the extent of 1.3 % by weight. Data given: The GCV of the fuel oil at 298 K = 41785 kJ/kg Latent heat of water vapor at 298 K = 2442.5 kJ/kg	*CO 5*	*PO 3*	**10**
			OR			
	6	a)	Define the followings: (i) Ultimate analysis (ii) Proximate analysis	*CO 5*	*PO 3*	**10**
		b)	A certain fuel is burnt in a furnace and its flue gas sample is carefully analyzed in a mercury filled Orsat apparatus. The flue gas was found to contain: CO_2 = 13.5 %, CO = 2.1 %, O_2 = 6.5 % and N_2 = 78.1 %. Calculate the percentage of excess air used.	*CO 5*	*PO 3*	**10**

			UNIT - V			
	7	a)	Calculate the enthalpy change for one mole of a gas when it is heated from 400 K to 1500 K at 1 atm pressure given that the mean specific heat of the gas at the reference temperature of 273 K are 35 kJ/kmol·K at 400 K and 50 kJ/kmol·K at 1500 K.	***CO 6***	***PO 3***	**10**
		b)	Define the followings: (a) Heat capacity (b) Heat of formation (c) Theoretical flame temperature (d) Heat of combustion	***CO 6***	***PO 3***	**10**

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