Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2022

Course : Material and Energy Balance Computations **Semester : III**
Program : B. Tech. (CERP) **Time : 03 hrs.**
Course Code: CHCE 2013 **Max. Marks : 100**

Instructions:

✓ Attempt **all** questions from **Section-A** (each carrying 12 marks), **Section-B** (each carrying 20 marks). Assume suitable data wherever necessary. The notations used here have the usual meanings.

SECTION-A

S. No.		Marks	CO
1.	Make the following conversions: (i) Pressure of 5 atm to cm Hg (ii) 127lb/ft^3 to gr/cm^3 (iii) 499 g of $CuSO_4.5H_2O$ into moles (iv) 7.2 mg/ml $CaCl_2$ to normality	**12 M**	**CO1**
2.	(a) Explain Limiting reactant, excess reactant, and percent excess reactant (b) Ammonia reacts with sulfuric acid giving ammonium sulphate: $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ (i) 20m^3 of ammonia at 1.2 bar and 300 K reacts with 40 kg of sulphuric acid. Which one is the excess reactant and what is the percent excess? (ii) How much ammonium sulphate is obtained	**4+8 M**	**CO1**
3.	It is desired to compress 10 lb of carbon dioxide to a volume of 20 cu ft. Calculate the pressure in pounds per square inch which is required at temperature of 30 ^oC assuming the applicability of the ideal gas law.	**12 M**	**CO1**
4.	1000 kg/h of a thermic fluid, to be used as a heat transfer medium, is being indirectly heated in a heater from 380K to 550 K. Calculate the heat load on the heater in kW. The heat capacity equation for thermic fluid is $C_P = 1.436 + 2.18X10^{-3}\ T$ Where C_P is in kJ/kg.K and T is in K.	**12 M**	**CO2**
5.	In a process for producing caustic (NaOH), 4000 kg/h of a solution containing 10 wt% NaOH is evaporated in the first evaporator, giving a 20% NaOH solution. This is then fed into a second evaporator, which gives a product of 50% NaOH. Calculate the following: (a) The amount of water removed from each evaporator (b) The capacity of triple effect evaporator	**12 M**	**CO2**

SECTION-B			
6.	A wet solid containing 75% water is mixed with recycled dry solid to reduce the water content to 50% before being admitted into the granulator. The solid leaving the granulator is fed to a drier where it is brought into contact with dry air initially containing 0.20% water by weight. In the drier, the air picks up moisture and leaves with a moisture content of 5%. The solids leaving the drier contain 25% water. A portion of solid is recycled. For 500 kg/h of wet solid sent to the granulator as fresh feed, determine: (a) The amount of solid recycled (b) The circulation rate of air in the drier on a dry basis.	**20 M**	**CO4**
7.	A solution of 10% (weight) acetone in water is subjected to fractional distillation at a rate of 1000 kg/h to produce a distillate containing 90% acetone and a bottom product containing not more than 1% acetone. The feed enters at 340K, distillate and residue leave the tower at 300 K and 370K, respectively. A reflux ratio of 8 is employed. The rise in temperature of 30K is permitted for the cooling water circulated in the condenser employed for condensing the vapors into the distillate product and the reflux. Saturated steam 276 kPa is available for supplying the heat of vaporization in the reboiler. Heat losses from the column may be neglected. The heat capacity of acetone is 2.2 kJ/kg.K and that of water is 4.2 kJ/kg.K. The boiling point of 90% acetone-water solution is 332K. The latent heat of vaporization of acetone at 332K is 620 kJ/kg and that of water is 2500 kJ/kg. λ_{steam} at 276 kPa is 2730 kJ/kg. Calculate the cooling water circulation rate, and the rate of circulation of steam.	**20 M**	**CO3**