

Printed Pages : 4



CH-301

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 151301

Roll No.

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B. Tech.(SEM. III) (ODD SEM.) THEORY
EXAMINATION, 2014-15**PROCESS CALCULATIONS**

Time : 3 Hours]

[Total Marks : 100

Note : Attempt ALL questions.**1. Do any two parts : $10 \times 2 = 20$**

- (a) What is the importance of Ideal Gas Law. Calculate Average molecular weight of given mixture whose composition in mol% is given Methane = 80% Ethane = 10% Nitrogen = 10% and also express this composition in weight percentage assuming ideal gas law is applicable and calculate the density at standard conditions in gram/liter.
- (b) Calculate the total pressure and the composition of vapors in contact with a solution at 100°C containing 35% Benzene 25% Toluene and remaining Xylene by weight at 100°. The vapor pressures at this temperature are Benzene (M.W.=78, V.P.= 1340mm Hg) Toluene(M.W.= 92, V.P.= 560mm Hg) and Xylene (M.W. =106, V.P.= 210mm Hg).

- (c) Combustion gases having the following molal composition are passed into an evaporator at a temperature of 200 °C and a pressure of 743 mm Hg

Nitrogen = 79.2 %

Oxygen = 7.2%

Carbon dioxide = 13.6%

Water is evaporated, the gases leaving at a temperature of 85 °C and a pressure of 740 mm Hg with the following molal composition

Nitrogen = 48.3 %

Oxygen = 4.4%

Carbon dioxide = 8.3%

Water = 39.0%

Calculate :

- (a) Volume of gases leaving the evaporator per 100 cu ft entering.
- (b) Weight of water evaporated per 100 cu ft gas entering.

2. Do any **two** parts :

10×2=20

- (a) Explain Molal humidity, Humid Volume, Dew point, Dry and Wet bulb temperature and Humid heat.
- (b) A mixture of dry flue gases and Acetone at a pressure of 750 mm Hg and a temperature of 30 °C has a dew point of 25 °C. It is proposed to condense 90 % of the acetone in this mixture by cooling to 5 °C and compressing. Calculate the necessary pressure in mm. Vapor pressure of acetone
At 25°C = 229.2 mm Hg
At 5°C = 89.1 mmHg.
- (c) Explain about humidity chart and how it is used for engineering calculations ?

3. Do any **two** parts : **10×2=20**
- (a) With the help of flow diagrams explain Recycle, Bypass and Purging and their importance in a chemical industry.
 - (b) In the operation of synthetic ammonia plant a 33% nitrogen, 66% hydrogen and 1% argon mixture is fed to the converter resulting in a 30% conversion to ammonia. The ammonia formed is separated by condensation and the unconverted gases are recycled to the reactor. The tolerance limit of argon entering the reactor is assumed to be 5%. Calculate recycle and purge ratio. (all percentages are in mole %).
 - (c) In a Textile mill a double effect evaporator system concentrates weak liquor containing 4% (by weight) caustic soda to produce a lye containing 25% solids (by weight). Calculate the evaporation of water per 100 kg feed in the evaporator.
4. Do any **two** parts : **10×2=20**
- (a) What do you understand by Energy balance in chemical process industries? What is its importance.
 - (b) The analysis of 15000 lit of a gas mixture at standard condition is as follows $\text{SO}_2 = 10\%$, $\text{O}_2 = 12\%$ and $\text{N}_2 = 78\%$. How much heat must be added to this gas to change its temperature from 30 to 425°C? The Cpm Values are in cal/g mole °C
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|--------------|---------------|--------------|--------------|
| Gas | SO_2 | O_2 | N_2 |
| Cpm at 30 °C | 10 | 6.96 | 6.80 |
| Cpm at | 11 | 7.32 | 7.12 |
- (c) Develop an expression for the relation between temperature and heat of reaction assuming a hypothetical reaction.

5. Do any **two** parts :

10×2=20

- (a) What is the difference between unsteady and steady state operations ? A tank contains a 10 litre of a salt solution at a concentration of 2 g/lit another salt solution enters the tank at a rate of 1.5 litre/min at a salt concentration of 1 g/lit. The contents are stirred well and the mixture leaves the tank at a rate of 1 lit/min .Estimate the time at which the concentration in the tank will be 1.6 g /litre.
 - (b) Explain a steady state process where simultaneous material and energy balance is applied and how ?
 - (c) What do you understand by degree of freedom ? how it is helpful in solving the problems ? Explain with the help of example, explain design and state variables.
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