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

Autonomous Institute Affiliated to VTU

August 2024 Supplementary Examinations

Programme: B.E. **Semester: III**
Branch: Biotechnology **Duration: 3 hrs.**
Course Code: 19BT3DCPPC **Max Marks: 100**
Course: Process of Principles and Calaculations

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

UNIT - I

1 a) Define normality, molarity, and molality with equations. **06**

b) A gas mixture has a composition of 25% carbon dioxide, 25% carbon monoxide, 10% oxygen, and 40% nitrogen, on mole basis. Express the composition of mixture on weight basis. **06**

c) A stock solution concentration is 25 N. Calculate the volume of this solution to be added to prepare the following list of solutions. **04**
i. 500 mL of 0.2 N
ii. 125 mL 1 N
iii. 250 mL 5 N
iv. 100 mL 20 N

d) Calculate the molality and molarity of a solution when 5 mL of 100% H_2SO_4 was added to a 100 mL-standard volumetric flask and then the volume is made up to 100 mL using distilled water. Given data: density of 100% H_2SO_4 is 1.20 g/cc. **04**

UNIT - II

2 a) State and explain the Amagat's law and Dalton's law. **05**

b) Differentiate between absolute humidity, molal absolute humidity, and relative humidity. **05**

c) A mixture of gases is analyzed and found to have the following composition by weight. CO_2: 12.0%, CO: 6.0%, CH_4: 27.3%, H_2: 9.9%, and N_2: 44.8%. Calculate the average molecular weight of the gas mixture. **10**

OR

3 a) State and explain the Henry's law and Raoult's law. Write their applications. **05**

b) Prove that mole % = pressure % for ideal gas. **05**

c) In a vessel at 101.325 kPa and 300 K, the % relative humidity of water vapor in the air is 25. If the partial pressure of water vapor when the air is saturated with vapor at 300 K is 3.6 kN/m^2. Calculate **10**
a) The partial pressure of water
b) The absolute humidity of air
c) The percentage humidity
d) The humid volume

UNIT - III

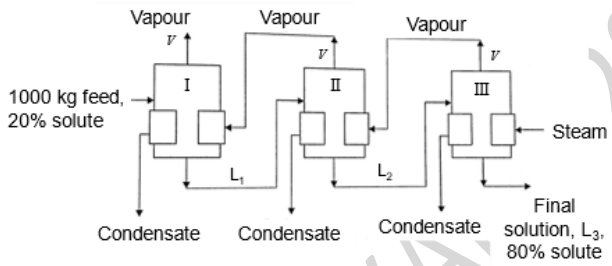
4 a) Write the general material balance equation with flow diagram for **10**
i. Distillation
ii. Absorption
iii. Crystallization

iv. Extraction
v. Drying

b) A binary mixture consists of 35% benzene and 65% toluene, which is continuously fed to the distillation column at a rate of 1000 kg/h. The distillate flow rate was 10% of the feed flow rate. The distillate (top product) contains 85 % benzene. Draw neat block diagram of distillation and calculate quantity and compositions of the residue stream. **10**

OR

5 a) A triple effect evaporator (as shown in the below Figure) is used to concentrate 1000 kg of aqueous solution from a concentration of 20% solute to 80% solute. Assuming an equal amount of vaporization in each effect, calculate the composition and weight of the solution entering the second and third effects. **12**



b) 2000 kg of wet solids containing 70% solids by weight are fed to a tray dryer, where it is dried by hot air. The product finally obtained is found to contain 1% moisture be weight. Calculate the following. **08**

(i) Amount of water removed from the wet solids in kg.
(ii) Amount of product obtained after drying in kg.

UNIT - IV

6 a) Explain the following terms with the examples: **10**
i. Limiting reactant
ii. Excess reactant
iii. Conversion
iv. Yield
v. Selectivity

b) A combustion reactor is fed with 50 kmol/h of butane and 2500 kmol/h of air. Calculate the percentage excess oxygen and the composition of gases leaving the combustion reactor. Assume complete combustion. **10**

UNIT – V

7 a) Derive a relationship between temperature and heat of reaction for the following reaction. **10**

$$aA + aB \rightarrow lL + mM$$

Given, specific heat as, $C_P = \alpha + \beta T + \gamma T^2$.

b) Production of single cell proteins from hexadecane is given by the following equation. If the respiratory quotient (RQ) is 0.4, determine the stoichiometric coefficients. **06**

$$C_{16}H_{34} + aO_2 + bNH_3 \rightarrow cCH_{1.66}O_{0.27}N_{0.2}\ (\text{biomass}) + dCO_2 + eH_2O$$

c) Differentiate between the standard heat of formation and standard heat of combustion. **04**

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