

II B.Tech I Semester Supplementary Examinations, November 2005
MATERIALS AND ENERGY BALANCE
(Chemical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

1. (a) Differentiate between density and specific gravity.
 (b) Write about the following :
 Specific gravity scales: Baume gravity scale, API scale, Twaddell scale. [8+8]
2. (a) Calculate the volume occupied by 13.6 kg of chlorine at a pressure 743 mm Hg and 21.1°C.
 (b) Calculate the weight of 3 cu.m of water vapor, measured at a pressure of 15.5 mm Hg and 23°C. [8+8]
3. (a) State Raoult's law. What are its limitations?
 (b) Estimate the vapor phase composition at 60°C in equilibrium with a liquid mixture containing 40 mole% benzene and 60 mole% toluene. Also calculate the composition of the liquid mixture, which boils at 90°C and 101.32 kPa. Vapor pressure data is given as: [8+8]

Temp. °C	Vapor pressure of Benzene, kPa	Vapor pressure of toluene, kPa
60	51.3	18.7
90	135.05	54.4

4. It is desired to supply 3000 cu.m per min of air at 60°C, dew point 23°C to a soap drier. The outdoor air is available at 15°C, wet bulb 10°C. Indicate two ways of carrying out the change, stating temperatures and humidities involved. [16]
5. (a) Define the following:
 Yield per pass.
 Ultimate Yield
 Recycle Ratio.
 Space time yield.
 (b) Write short notes on recycling operations practiced in chemical processing industries. [8+8]
6. Wood having an analysis (by weight) of 46% carbon 23% oxygen 5% ash, the rest being moisture and hydrogen is being burnt in a furnace. An orsat analysis of the flue gas after burning showed (by volume) CO₂ 14.9%, CO 1.65%, O₂ 3.45% and N₂ 80%. Calculate
 - (a) The complete analysis of the wood used.
 - (b) The Fuel to air ratio by weight.

- (c) The percentage of excess air used.
- (d) The complete composition of the stack gas. [4×4]
7. Write short notes on the following:
- (a) Humid heat capacity of air.
- (b) Latent heat of fusion and latent heat of transition.
- (c) Heat capacities of solids, liquids and solutions. [5+5+6]
8. (a) Define standard heat of reaction, heat of formation and heat of combustion
- (b) Calculate the heat of the following reaction,
 $\text{CaC}_2 + 2 \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{C}_2 \text{H}_2$
Heats of formation in cal/mol : $\text{CaC}_2 = -15000$, $\text{H}_2\text{O} = -68317$
 $\text{Ca(OH)}_2 = -235800$, $\text{C}_2\text{H}_2 = 54194$ [8+8]

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