[3 HOURS]

Total marks   80

NB:
1. Question No1 is compulsory.
2. Attempt any 3 question out of remaining five.
3. Assume suitable data if necessary.

1. a) Methane is cracked on catalyst and Hydrogen is diffused back. In the   **2**
following reaction find N_A/N_A+N_B
$$CH_4=C+2H_2$$

   b) What type of towers are suitable for foamy and corrosive liquids   **2**
   Explain loading and flooding in Packed towers in detail   **6**

   c) When a natural draft cooling tower is generally used?   **2**

   d) Calculate the rate of diffusion of water vapour from a thin layer of water at   **8**
   the bottom of the well 6m in depth to dry air flowing over the top of the well.
   Assume the entire system is at 298^0K and atmospheric pressure. If the well
   diameter is 3 m, find out the total weight of water diffused per second from
   the surface of the water in the well. The diffusion coefficient of water vapour
   in dry air at 298^0K and atmospheric pressure is $0.256 \times 10^{-4} m^2/s$.
   The partial pressure of water vapour of 298^0K is 0.0323 kg/cm^2

2. a) The air pressure in a tyre reduces from 2 bars to 1.99bars in five days. The   **10**
   volume of air in the tube $=0.025m^3$, the surface area $0.5m^2$ and wall thickness
   0.01m. The solubility of air in rubber is 0.07m3/m3 rubber. Estimate the
   diffusivity of air in rubber

   b) Explain film theory and penetration theory in detail.   **10**

3. a) Derive the relation between overall mass transfer coefficient and individual   **10**
   mass transfer coefficient when the mass transfer is both gas phase and liquid
   phase controlled.

   b) Write short notes on wetted wall column and sparged vessels.   **10**

4. a) A packed tower is designed to recover 98% CO_2 from a gas mixture containing **10**
   10 % CO_2 and 90% air using water. A relation ,
   y=14 x
   can be used for equilibrium conditions where y is(kg of CO_2)/(kg of dry air)
   and x is (kg of CO_2)/ (kg water)
   The water to gas rate is kept 30% more than the minimum value. Calculate
   the height of the tower if (HTU)og is 1 meter.

   b) Write short notes on **10**
   i)Lewis relation ii)Humid volume iii)Adiabatic saturation curves.

5. a) Give classification of cooling towers. Explain each one of them along with **8**
   diagrams.

   b) A batch of solid for which the following table of data applies is to be dried **12**
   from 25% to 6% moisture under conditions identical to those for which the
   data were tabulated. The initial weight of the wet solid is 250kg and the
   drying surface is $1m^2$/8kg dry weight. Determine the time for drying.

X	0.35	0.25	0.20	0.18	0.16	0.14	0.12	0.10	0.09	0.08	0.064
N	0.35	0.35	0.35	0.3	0.26	0.239	0.20	0.18	0.15	0.097	0.07

   Where , X=kg moisture/kg dry solid
   N=kg moisture evaporated/hr m^2

6. Write short notes on **any four** **20**
   i) Types of impellers
   ii)mass, momentum and heat transfer analogy for laminar flow
   iii)Diffusion through polymers
   iv)Packed tower vs. tray tower
   v)Factors affecting the choice of solvents

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