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

Paper ID : 154412 Roll No. | | | | | | | | | | |

B. TECH.

Theory Examination (Semester-IV) 2015-16

HEAT & MASS TRANSFER

Time : 3 Hours *Max. Marks : 100*

Section-A

1. **Attempt all parts, all parts carry equal marks. Write answer of each part in short.** (2×10 = 20)

   (a) What are various modes of heat transfer?

   (b) What is the fourier's law of heat conduction?

   (c) What is the difference between the 'natural' and 'forced' convection.

   (d) Differentiate between a black body and a gray body. What is kichoff's law?

   (e) Define the term absorptivity, reflectivity and transmissivity of radiation.

   (f) Give mathematical statement of fick's law of diffusion and give the meaning of each terms involved in equation.

2. **Attempt any five questions.** (5×10 = 50)

(a) What are the various materials used for insulation purposes? Distinguish between critical and optimum insulation thickness.

(b) Define the Reynolds numbers, prandtl number, Nusselt number and Stanton number and find the relation between them.

(c) Air at 27° C and 1 bar flow over plate at a speed of 2m/s. Calculate the boundary layer thickness at 400 mm from the leading edge of the plate. Find the mass flow rate per unit width of the plate. (For Air $\mu = 19.8\times10^{-6}$ kg/m.s at 27°C)

(d) Give governing differential equation for one – dimensional transient heat flow?

(e) A Wet solid of 28% moisture is to be dried to 0.5 % moisture in tray dryer. A laboratory test shows that it

(f) Give the sieder- tate equation for calculation of film coefficient in case of laminar flow.

(g) Explain in brief forced circulation evaporator with external horizontal heating surface with reference to its construction and working.

(h) How are Heat Exchangers are classified? Discuss briefly different types of heat exchangers. What is overall heat transfer coefficient? Give its significance.

Section-C

Attempt any two question from this section. (2×15=30)

3. (Non-equimolar counter diffusion in distillation of a binary – mixture)

An aqueous solution of methanol is being separated by distillation in a column. Methanol (A), which is the more volatile component moves from the liquid phase to the vapor phase while water(B), the less volatile component, gets trans-

ported in the opposite direction. At a section of the column the vapor phase contains 0.76 mol fraction methanol and the liquid has o.6 mol fraction of it. The temperature is 71.2°C and the total pressure is essentially atmosphere. The diffusional resistance offered is equivalent to that of a stagnant vapour film of 1.0mm thickness if the latant heat of vaporization of methanol is 274.6 Kcal/kg and that of water is 557.7 Kcal/kg at the given temperature. Calculate the flux of methanol and that of water vapour.

Given if the mole fraction of methanol in the solution is 0.6, it's mole fraction in the equilibrium vapour would be 0.825. The vapour phase mutual diffusivity DAB= 1.816×10^{-5} m^2/s.

4. What is the physical significance of HTU and NTU ? Calculate the height o equivalent of a theoretical plate.

5. (Calculation of the minimum solvent rate) In a petrochemical plant,a gas containing 4% cyclo-hexane and 96% inerts has to be treated with a non- volatile absorption oil in a packed tower. It is required to remove 98% of the cyclohexane of the feed gas. The feed solvent is free from cyclohexane. If the feed gas rate is 80 kmol per hour, calculate the minimum solvent rate. The equilibrium reaction is given as

$$Y = (0.2x)/(1+0.8x)$$