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

PAPER ID : 2457 Roll No. | | | | | | | | | | |

B.Tech.

(SEMESTER-VI) THEORY EXAMINATION, 2012-13

HEAT & MASS TRANSFER

Time : 3 Hours] *[Total Marks : 100*

SECTION – A

1. Attempt **all** question parts. 10 × 2 =20

(a) State Fourier's law of heat conduction.

(b) Distinguish between free and forced convection with examples.

(c) State the Stefan-Boltzmann and Wein's displacement laws of radiation.

(d) Sketch temperature distribution graph for condensers & evaporators.

(e) Classify various modes of mass transfer with an example each.

(f) What is meant by diffusion coefficient and give its dimensional unit ?

(g) What is the purpose of agitator in a crystallizer ?

(h) What is the difference between the constant rate period and falling rate period in time of drying ?

(i) Define Chemisorption.

(j) What is the difference between the NTU and HTU ?

SECTION – B

2. Attempt any **three** question parts. 10 × 3 = 30

(a) Explain

(i) the typical drying rate curve and bring out its salient features.

(ii) the factors governing the nucleation in crystallization.

SECTION – C

Attempt **all** questions. **10 × 5 = 50**

3. Attempt any **two** parts. **(5 × 2 = 10)**

(a) A solar collector surface has an absorptivity of 0.85 for wave lengths upto 3 μm and a value of 0.15 for wave lengths above this value. Determine assuming Kirchhoff's law holds good, the energy absorbed from a source at 5800 K if the flux is 800 W/m^2. Also determine the energy radiated by the body if its temperature was 350 K.

(b) Determine the area required in parallel flow heat exchanger to cool oil from 60 °C to 30 °C using water available at 20 °C. The outlet temperature of the water is 26 °C. The rate of flow of oil is 10 kg/s. The specific heat of the oil is 2200 J/kg K. The overall heat transfer coefficient U = 300 W/m^2 K.

(c) Classify evaporator and sketch any one type of it mentioning the parts.

4. Attempt any **one** part. **(10 × 1 = 10)**

(a) Explain briefly :

(i) The concept of critical thickness of insulation and state any two applications of the same.

(ii) Heat conduction in solids and gases.

(b) Write short notes on the following :

(i) Lumped heat capacity analysis

(ii) Use of Heisler and Grober chart

(iii) Nusselt number

(iv) Prandtl numbers

(v) Reynolds analogy

5. Attempt any **one** part. **(10 × 1 = 10)**

(a) Methane diffuses at steady state through a tube containing helium. At point 1, the partial pressure of methane is P_{A1} = 55 kPa and point 2, 0.03 m apart P_{A2} = 15 kPa and temperature is 298 K. At this pressure and temperature, the value of diffusivity is 6.75×10^{-5} m^2/s.

(i) Calculate the flux of CH_4 at steady state for equimolar counter diffusion.

(ii) Calculate the partial pressure at 0.02 m apart from point 1.

(b) Name the various mass transfer theories and write short note on film theory with the help of neat sketch.

6. Attempt any **one** part. **(10 × 1 = 10)**

(a) A granular solid with dry bulk density of 1600 kg/m^3 is being dried in a batch dryer in air at 65 °C with a humidity of 0.005 kg water per kg of dry air. The solids containing 0.5 kg water per kg. of dry solids are in 2.54 cm pans insulated so that heat and mass transfer occur from the top surfaces only. The solids are to be dried to final moisture content of 0.02 kg water per kg dry solids and have a critical moisture content of 0.01. Air passes over the pans at a mass velocity of 1.7 $kg/s.m^2$. Heat transfer by conduction and radiation may be neglected. For this granular material equilibrium content is zero. Calculate the drying time required. What would be the drying time if the flow rate is increased to 25 $kg/s.m^2$?

(b) Discuss the working of a continuous vacuum crystallizer with the help of a neat sketch and also mention the two important steps in formation of crystal.

7. Attempt any **one** part. **10 × 1 = 10**

(a) Discuss briefly the 'flooding' and 'loading' conditions in a packed tower stating the factors which influence them.

(b) Explain the principle of adsorption by concentration patterns in fixed bed.

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