## VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING SESSION 2015 - 16 (ODD SEMESTER)

**Total Pages-5** 

 $(Set-Q_1)$ 

## B.Tech-5th (M & M) Transport Phenomena

Full Marks: 70

Time: 3 hours.

Q. No. 1 is compulsory and answer any five from the rest of the questions

The figures in the right-hand margin indicate marks

1. Answer the following (any ten):

 $2 \times 10$ 

- (a) Explain Reynolds number (Re) in brief and write its significance.
- (b) CO gas at 200 °C flows over a steel plate maintained at 50 °C. The convection heat transfer coefficient is 75 W/m<sup>2</sup>.K. Calculate the neat gain rate by the plate through an area of 5 m<sup>2</sup>.
- (c) State and explain Newton's law of viscosity.
- (d) Explain friction factor.

(Turn Over)

(e) Distinguish between tree and forced convection mechanism of heat transfer with suitable example.

(2)

- (f) Define a black surface.
- (g) What is the difference between Nusselt Number and Biot Number?
  - (h) Define view factor.
- (i) Define emmissivity and write the range of its value.
- (i) State and explain Stefan Boltzmann Law.
- (). Prove that one diffusivity is needed to describe the diffusional behavior of a binary mixture, i.e  $D_{AB} = D_{BA}$ .
- (1) State Fick's first law of diffussion and write its limitation.
- (m) Write down the difference between homogeneous and heterogeneous reaction.

(n) Explain types of fluid flow.

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(Continued)

- (a) Write down the characteristics of interfacial reaction.
- 2. Derive Hagen-Poiseulle equation for Laminar, incompressible, steady flow through a straight, circular, horizontal pipe. 10
  - 3. A steel tube (K = 45 W/m.K) of outside diameter 7.6 cm and thickness 1.3 cm, is covered from outside with an insulating material (K = 0.2 W/m.K) of thickness 2 cm. A hot gas at 330 °C, with convention heat transfer coefficients of 200 W/m<sup>2</sup>.k, is flowing inside the tube. The outer surface of the insulation is exposed to ambient air at 30 °C, with convection heat transfer coefficients of 50 W/m<sup>2</sup>.k. Calculate :
    - (a) Heat loss to air from the 5 m long tube
    - (b) Temperature drop ( $\Delta T$ ) across steel tube and insulating layer. 10
- A: What is a lump system ? Derive the expression of unsteady state heat transfer by lumped system analysis. Write the validity criteria of lumped capacitance method.

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(Turn Over)

5. Define intensity of radiation for a black body and derive the relation between emissive power and radiation intensity. 10

4)

- (a) Derive the expression for species diffusion resistance (R) for one dimentional diffusion of species A, through a planes medium of B. Boundary condition : At. X=0,  $X=X_{A,S_1}$  and At. X=L,  $X=X_{A,S_2}$ .
  - (b) Consider the diffusion of hydrogen (species A) in water (speces B) at T = 293 K.
    - (i) Compare the value of mass diffusivity and thermal diffusivity at 293 K.
      - (ii) Calculate Lewis No.
      - (*iii*) Calculate the species flux on molar basis if the concentration gradient at a particular location is  $dC_A/dx = 1$  K mol/m<sup>3</sup>.m. The mole fraction of the hydrogen  $X_A$ , is much less than unity.

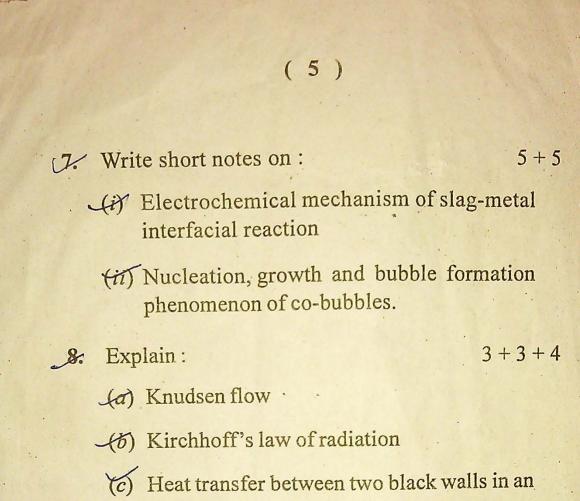
Given :  $D_{AB,298 \text{ K}} = 0.63 \times 10^{-8} \text{ m}^2/\text{s}$ ,  $C_p = 4182 \text{ J/kg k}$ , K = 0.603 W/m.K,  $\rho = 998 \text{ K/m}^3$ 

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enclosure.

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