Paper / Subject Code: 52508 / 6) Advanced Transport Phenomenon

Wednesday,December 11,2019	10:30 am - 01:30 pm	1T00518 - B.E.(CHEMICAL)(SEM VIII) (CBSGS) / 52508 - 6) Advanced Transport Phenomenon	78218

Time: 3 Hours **Max Marks: 80**

N.B.
1. Question No. 1 is compulsory.
2. Attempt any **three** out of remaining **five** questions.
3. Assume any suitable data if necessary and indicate it clearly.

Q. 1 Answer the following (any four)

a. Write the different equations for determination of viscosity of liquids and gases. **5**

b. Explain diffusion. What factors may cause diffusion to occur? **5**

c. Explain temperature and pressure dependence of thermal conductivity. **5**

d. Explain Newtons law of viscosity in three dimensional form. **5**

e. Estimate the viscosity of N_2 at 50^0 C and 854 atm, given M = 28 gm/gmole, P c = 33.5atm and T c = 126.2 K. **5**

Q. 2

a. Derive the equation for Newtonian fluid over an inclined plate **10**

b. Heavy oil is passed through a pipe of 5.08×10^{-2} m diameter. The pressure drop over the pipe is 68.958 kN/m^2. The viscosity of oil is 200 Cp and density is 800 kg/m^3. The length of the pipe is 3.048 m. **10**
Calculate the volumetric flow rate of oil in lit/min.
Calculate and plot momentum flux profile across the pipe.

Q. 3

a. Derive an expression for Heat conduction with an electric heat source. **10**

b. A current of 250 amp is passing through stainless steel wire having a diameter of 5.08 mm. The wire is 2.448 m long and has a resistance of 0.0843 Ω.The outer surface held is constant at 427.6 K. The thermal conductivity is 22.5 W/m K. Calculate the centrelinetemperature at steady state. **10**

Q. 4

a. Calculate the thermal conductivities of NO and CH_4 at 300 K and atmospheric pressure. **10**
(Given: R = 1.987 cal/gmol.K)

Component	M	C_p	$\mu \times 10^7$	σ (A^0)	$\Omega_\mu = \Omega_k$
CH4	16.04	8.55	1116	3.78	1.186
NO	30.01	7.15	1929	3.47	1.0908

b. A copper wire 10 mm diameter and 4.6 m long has a voltage drop of 0.6 volts, find the maximum temperature in the wire if the ambient air temperature is 298.15 K and the heat transfer coefficient h is 32.37 W/m^2 K **10**
Lorenz constant for copper = 223×10-8 volt^2/K^2
Thermal conductivity of copper at 298.15 K = 384.1 W/m K

Q. 5

a. Derive an expression for Diffusion through stagnat gas film. **10**

b. A value of DAB = 0.151 cm2/sec has been found for the system CO2-air at 293K and 1atm. Calculate DAB at 1500K by the following methods. a) Slattery Equations, b) Chapman Enskog Equation **10**
Data: For non polar gas pairs, b = 1.823, $(\Omega D^{AB})_{1500} = 0.734$, $(\Omega D_{AB})_{293} = 1.047$

Q. 6

a. Derive an expression for diffusion diffusion with heterogeneous chemical reaction. **12**

b. Estimate D_{AB} for the system Argon-Oxygen at 293.2 K and 1 atm pressure. **08**

Component	M	Tc	Pc
A (Argon)	39.94	151.2	48.0
B (Oxygen)	32.00	154.4	49.7

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