Total No. of Questions :10]

SEAT No. :

P3923

[Total No. of Pages :2

[4958] - 1096

T. E. (Chemical)

TRANSPORT PHENOMENA

(2012 Course) (End - Sem) (Semester - II)

Time : 2½ Hours] *[Max. Marks :70*

Instructions to the candidates:

1) ***Answer Q1 or 2, Q3 or 4, Q5 or 6, Q7 or 8, Q9 or 10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
5) ***Assume suitable data, if necessary.***

Q1) Derive the expression of velocity and average velocity for flow of falling film with variable viscosity, $\mu = \mu_0 e^{-ax/\delta}$. **[10]**

OR

Q2) Liquefied gases are sometimes stored in well insulated spherical containers vented to the atmosphere. Develop an expression for steady state heat transfer rate through the walls of such container with inner and outer radius as r_0 and r_1 and temperatures are T_0 and T_1 respectively. Assume that thermal conductivity of insulation varies linearly with temperature from k_0 at T_0 to k_1 at T_1. **[10]**

Q3) The solute HCl is diffusing through a thin film of water 2 mm. Concentration of HCl at point 1 is 12 wt% (density = 1061 kg/m^3) and at point 2 is 6 wt% (density = 1030 kg/m^3). Diffusivity of HCl in water is 2.5×10^{-9} m^2/s. Calculate flux of HCl in kmol/m^{2}s. **[10]**

OR

Q4) a) Explain Bingham model of non-Newtonian fluid. **[4]**

b) Explain procedure to solve heat transfer problems. **[3]**

c) Explain mass balance equation. **[3]**

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Q5) a) Use Navier- Stokes equation of motion to determine velocity distribution for laminar flow of Newtonian fluid through vertical pipe. **[12]**

b) Explain dimensional form of equation of change and dynamic similarity. **[6]**

OR

Q6) a) Derive Newton's second law of motion. **[12]**

b) What do you mean by partial time, total time and substantial time derivative? **[6]**

Q7) a) What pressure gradient is required to cause N, N-diethylaniline to flow in a horizontalsmooth tube of inside diameter 3 cm at a rate of 1.1 lit/s at 20°C. Density of diethylaniline is 935 kg/m^3 and viscosity is 1.95 cp. Assume friction factor f = 0.0063. **[8]**

b) Derive Blake Kozeny and Burke Plummer equation for flow of fluid in a packed column. **[8]**

OR

Q8) a) Explain friction loss in pipe fittings due to sudden expansion and contraction. **[8]**

b) Explain macroscopic momentum balance equation. **[8]**

Q9) a) Explain Chilton-Colburn analogy. **[8]**

b) Explain Martinnelli's analogy. **[8]**

OR

Q10)a) Explain transfer coefficients at high transfer rates by film theory. **[8]**

b) A spherical water droplet, 0.05 cm in diameter is falling at velocity of 215 cm/sec through dry, still air at 1 atm pressure. Estimate the instantaneous rate of evaporation from the drop if the drop surface is at 21°C and air at 60°C. The vapor pressure of water at 21°C is 0.0247atm. Assume Pseudo steady state condition and $k_{xm} = 1.35 \times 10^{-3}$ mol s^{-1} cm^{-2}. **[8]**