Exam. Code: 0909
Sub. Code: 6710

1129

B.E. (Biotechnology) Fifth Semester
BIO-514: Transport Phenomena

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section.

x-x-x

I. Answer the following:-

a) The ratio of inertial forces to viscous forces is known as __________. (1)

b) Lewis number is defined as ___________. (1)

c) Diffusion of components between the phases at equilibrium is______. (1)

d) What are the different parameters affecting the convective mass transport? (1)

e) Discuss "Diffusion controlled reactions". (2)

f) What is the transport property for momentum transfer, write the units. (2)

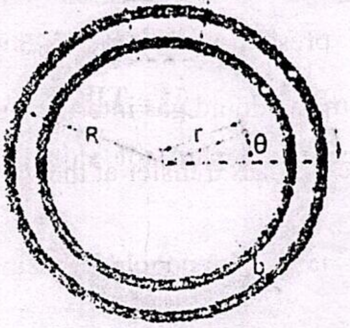
g) Metal wall of same thickness and cross sectional area have thermal conductivities k, 2k and 3k respectively. The temperature drop across the wall for the same heat transfer will be in the ratio _____: ______: ________. (2)

UNIT – I

II. In a gas absorption experiment a viscous fluid of density p and viscosity u flows upwards through a small circular tube of radius R and then downward on the outside. Set up a momentum balance over a shell of thickness Δr in the film to find the velocity distribution in the falling film of thickness δ. Neglect end effects. (10)

III. For the flow of an incompressible Newtonian fluid between two coaxial cylinders, the inner surface of the cylinder is maintained at a temperature T_o while at the outer surface the flux is zero. The volume heat source resulting from friction between adjacent layers of the fluid (viscous dissipation) can be designated as S_v. Make an energy balance over a shell of thickness Δx, width W and length L to derive an equation for temperature profile in the slit. Assume the slit width b is small with respect to the radius R of the outer cylinder.

Outer cylinder rotating with angular velocity Ω



(10)

P.T.O.

IV. a) Starting with the general equation of motion, $\frac{\partial}{\partial t}(\rho\bar{v}) = -[\bar{\nabla}.\rho\bar{v}\bar{v}] - \bar{\nabla}p - [\bar{\nabla}.\bar{\tau}] + \rho\bar{g}$ deriv the Navier-Stokes equation. (Assume constant density and viscosity)

b) Glycerine at 27°C is flowing through a horizontal tube of 0.1 inch inside diameter an .1 foot length. For a pressure drop of 40 psi, the volume flow rate is 0.00398 ft^3/min The density of glycerine at 27°C is 1.261 g/cm^3. Find the viscosity of glycerine (5,5)

UNIT – II

V. The power requirement by an agitator in a tank is a function of diameter of the agitato number of rotations of the impeller per unit time, viscosity of the liquid and density of th liquid. Use Buckingham's method to obtain a relation between power and the othe variables. The power consumption is found experimentally to be proportional to th square of the speed of rotation. By what factor would the power be expected to increase i the impeller diameter is doubled? (10)

VI. Using shell energy balance derive an expression for the temperature profile, rate of hea transfer and the overall heat transfer coefficient for heat conduction through composit walls made up of layers of three different materials with varying thicknes (x_1-x_0, x_2-x_1, x_3-x_2) and thermal conductivity (k_{01}, k_{12}, k_{23}). The heat transfer coefficien of the fluid at x = x_0 and x = x_3 may be taken as h_o and h_3 respectively. Assume W be th width and H be the height of the composite wall. (10)

VII. Liquid A is evaporating into vapor B in a tube of infinite length. The liquid level i maintained at a fixed position at all times. The entire system is maintained at a constan temperature and pressure and the vapors A and B are assumed to form an ideal ga mixture. The solubility of B in A is negligible. The gas phase concentration of A at th liquid-gas interface expressed as mole fraction is x_{A_1} while the concentration of A in th gas mixture away from the liquid gas interface is x_{A_2}. Using shell mass balance obtain a expression for the rate of mass transfer at the gas liquid interface. (10)

x-x-x