Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER–I(New course)• EXAMINATION – WINTER- 2015

Subject Code: 2713009 **Date: 02/01/2016**

Subject Name: Advance Transport Processes

Time:2:30 pm to 5:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Discuss in brief about convective and molecular momentum transport. **04**

(b) Write a short note on Van Karman analogy, Martinelli analogy. **10**

Q.2 **(a)** Derive the Equation of continuity for Cylindrical coordinate with neat sketch? **07**

(b) For heat conduction in Copper electrical wire of radius R having electrical conductivity K_e $ohm^{-1}cm^{-1}$and electric current of density I amp/cm^2. If rate of heat production per unit volume is given by the expression $S_e = I^2/ K_e$. Derive an expression for temperature profile with suitable assumptions ? **07**

Find the voltage drop E, for which temperature rise at the wire axis be $T_{max}-T_0$ =10°C .

Data :

Radius of copper wire 2 mm, Length of wire 5 m.

Lorenz number for copper is $K/Ke.T_0 = 2.23 * 10^{-8}$ $volt^2/K^2$

Surface temperature of wire T_0 = 20°C

OR

(b) Calculate the steady-state mass flux j_{Ay} and mass average velocity of helium for the system at 480K ? The partial pressure of helium is 1 atm at y = 0 and zero at the upper surface of the plate. The thickness Y of the pyrex plate is 0.015 mm, and its density $\rho^{(B)}$ is 2.6 g/cm^3. The solubility and diffusivity of helium in pyrex are reported as 0.0084 volumes of gaseous helium per volume of glass, and D_{AB} = 0.2 $*10^{-7}$ cm^2/s, respectively. Take R= 82.5 cm^3.atm/mole.K **07**

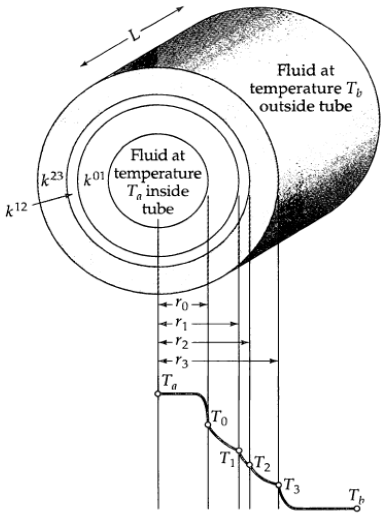
Q.3 Develop the model for "Flow of annulus " in vertical concentric Pipe with suitable assumption. Find expression for shear stress profile, velocity profile and maximum velocity? **14**

OR

Q.3 **(a)** Write about (i) Ostwald De Waele model (ii) Eyring model for fluid in brief ? **10**

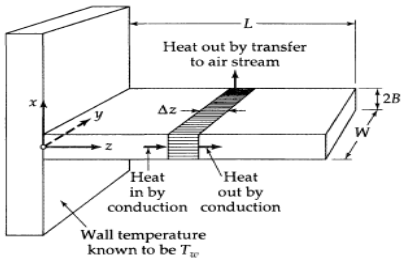
(b) Explain about time smoothened velocity for turbulent flow? **04**

Q.4 Derive an expression for Steady State heat conduction through solid composite cylinder with diagram Shown below? **14**



OR

Q.4 Derive an expression of temperature profile for heat conduction in a cooling fin with wall temperature is T_w and ambient temperature T_a. List the assumption made in deriving expression? Also determine expression for effectiveness of fin. **14**



Q.5 (a) Derive the expression of concentration profile for Steady-state diffusion of A through stagnant B with the liquid vapor interface maintained at a fixed position? **07**

(b) Discuss about scalar, vector and tensor term involved in heat, mass and momentum transfer? **07**

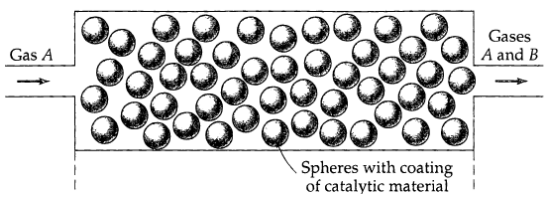
OR

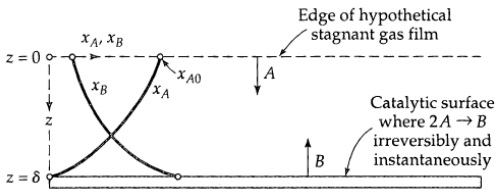
Q.5 (a) Derive an expression for local rate of reaction per unit area of catalytic surface **14**

$$N_{Az} = \frac{2c\mathscr{D}_{AB}}{\delta} \ln\left(\frac{1}{1 - \frac{1}{2}x_{A0}}\right)$$

where z=δ represents Solid catalyst surface.

Gas A produces B on catalyst surface and diffused back to main stream in fixed catalytic reactor with reaction 2A→ B .





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