Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER–IV • EXAMINATION – SUMMER • 2014

Subject Code: 741601 Date: 04-06-2014

Subject Name: Advanced Transport Phenomena

Time: 02:30 pm - 05:00 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) Derive equation of motion with usual notations. **07**

(b) Discuss about heat transfer coefficient for condensation of pure vapors on solid surfaces. **07**

Q.2 (a) A liquid is flowing through horizontal straight pipe at 4.57 m/s. The pipe is having 2 inch nominal diameter. The viscosity of liquid is 4.46 cp and density is 800 kg/m^3. Calculate the mechanical energy friction loss in J/kg for 36.6 m section of pipe. Assume equivalent roughness as 4.6x10^{-5} m and friction factor as 0.0060. **07**

(b) For turbulent flow in ducts discuss following: **07**

i) Estimation of average velocity in a circular tube

ii) Application of Prandtlôs mixing length formula.

OR

(b) An incompressible fluid flows from a small circular tube into large tube in turbulent flow. The cross sectional areas of tubes are S_1 and S_2. Obtain an expression for pressure change between two planes for friction loss associated with the sudden enlargement in cross section. Assume б = S_1/ S_2 which is less than unity. **07**

Q.3 (a) Determine the temperature distribution in an incompressible liquid confined between two coaxial cylinders, the outer one is rotating at a steady angular velocity q. Consider the radius ratio K to be fairly small so that the curvature of the fluid streamlines must be taken into account. Assume steady laminar flow and neglect temperature dependence of physical properties. **07**

(b) Air is flowing past a sphere having diameter of 51 mm and an average temperature of 82.2 ^{o}C. The air is at 1 atm. abs. pressure and 15.6 ^{o}C with a velocity of 12.2 m/s. Evaluate the average heat transfer coefficient for the air flowing past sphere having following data. **07**

k= 0.028 w/m K Density = 1.097 kg/m^3

μ= 1.95 x 10^{-5} Pa.s Npr = 0.704

OR

Q.3 (a) Discuss in detail about definition of heat transfer coefficients. **07**

(b) Write in brief about heat transfer coefficient for forced convection through packed beds **07**

Q.4 (a) A liquid of constant density and viscosity is in a cylindrical container of radius R. The container is caused to rotate about its own axis, the cylindrical axis is vertical. Find the shape of the free surface of the liquid when steady state has been established. **07**

(b) Discuss in brief about heat transfer coefficient for forced convection for flow along flat plate **07**

OR

Q.4	**(a)**	Explain time smoothed temperature profile near a wall	**07**
	(b)	Write in brief about effects of interfacial forces on heat and mass transfer.	**07**
Q.5	**(a)**	Obtain concentration profile equation for diffusion with heterogeneous chemical reaction.	**07**
	(b)	Pure water at 26.1^{o}C flows at the rate of 5.514x10^{-7} m^{3}/s through packed bed of benzoic acid spheres having diameter 6.375 mm. The total surface area of the spheres in the bed is 0.01198 m^{2} and void fraction is 0.436. The tower diameter is 0.0667 m. The solubility of benzoic acid in water is 2.948x10^{-2} kg mol/m^{3}. The properties of water at 26.1^{o}C are Density = 996.7 kg/m^{3} μ= 0.8718 x 10^{-5} Pa. s. Take D_{AB} value as 1.254 x 10 $^{-9}$ m^{2}/s. Calculate mass transfer coefficient k_c.	**07**

OR

Q.5	**(a)**	Develop expression for mole fraction profile and temperature profile for condensation of hot vapor on cold surface in presence of non condensable gas. Assume suitable assumptions.	**07**
	(b)	Discuss in brief about mass transfer in falling films on plane surfaces.	**07**

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