Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER–IV • EXAMINATION – SUMMER 2013

Subject Code: 741601 Date: 14-05-2013

Subject Name: Advanced Transport Phenomena

Time: 10.30 am - 01.00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **All notations have conventional meaning.**

Q.1 **(a)** Compare and contrast friction factor and its curves, for flow in tubes and flow around spheres **07**

(b) Derive equation of motion with usual notations. **07**

Q.2 **(a)** For a time smoothed velocity profile near a wall, explain logarithmic and power law velocity profile in inertial sub layer. **07**

(b) Briefly outline steps (including equations) for estimation pressure drop required for given flow rate in a horizontal , smooth circular of inside diameter 'D' having mass flow rate of 'w' g/s. **07**

OR

(b) For an incompressible Newtonian fluid, write about estimation of viscous loss (Friction losses) in macroscopic mechanical energy balances **07**

Q.3 **(a)** Develop velocity distribution equation in terms of Grashof Number for a free convection problem **07**

(b) A smooth flat, fin of copper extending out from tube is 70 mm by 70 mm square. Its temperature is uniform at 82.2^{o}C. Cooling air at 15.6^{o}C and 1 atm. flows parallel to the fin at velocity of 12.2 m/s. **07**

i) For laminar flow calculate the heat transfer Coefficient.

ii) If leading edge of the fin is rough, so that all of the boundary layer or film next to fin is completely turbulent, calculate 'h'.

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

(b) For turbulent flow in tubes, discuss about approximate relation for estimation of wall heat flux. **07**

Q.4 **(a)** Define and explain following Dimensionless numbers: **07**
Reynolds Number, Nusselt Number, Prantdl number, Stanton Number and Brinkman number

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

OR

Q.4 **(a)** Develop concentration profile equation for diffusion with heterogeneous chemical reaction **07**

(b) Write a brief note on "Analytical calculation of Heat coefficient for forced convection in tubes and slits **07**

(P. T. O.)

Q.5 **(a)** For simultaneous heat and mass transport, develop expression for mole fraction profile and temperature profile for hot condensable vapor diffusing at steady state through stagnant film of non-condensable gas to cold surface. Neglect radiative heat transfer. List all assumptions made. **07**

(b) Write a brief note on "Computational fluid dynamics" **07**

OR

Q.5 **(a)** Discuss about Mass transfer and mass transfer coefficient in falling films on plane surfaces **07**

(b) Pure water at 26.1^{o}C flows at the rate of 5.514×10^{-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 2.948×10^{-2} kg mol/m^3. The properties of water at 26.1^{o}C are Density = 996.7 kg/m^3 $\mu = 0.8718 \times 10^{-3}$ Pa. s. Take D_{AB} value as 1.254×10^{-9} m^2/s. Calculate mass transfer coefficient. **07**

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