AQ – 2746

First Semester M. Tech. (Chemical Engineering) Examination

TRANSPORT PHENOMENA

[CE]

P. Pages : 2

Time : Three Hours] [Max. Marks : 80

Note : (1) Answer **six** questions.
(2) Question No. **one** is compulsory.
(3) Assume suitable data wherever necessary.
(4) Diagrams and Chemical equations should be given wherever necessary.
(5) Use of slide rule, logarithmic tables, Steam tables, Mollier's Chart, Drawing instrument, Thermodynamic table for moist air, Psychrometric Charts and Refrigeration charts is permitted.
(6) Mobile are strickly prohibited.
(7) Use pen of Blue/Black ink/refill only for writing the answer book.

1. Select a suitable hypothetical control in space and prove that equation of continuity satisfies the laws of conservation of mass. 15

2. Show that F = m.a represents the rate of change of momentum of a fluid under the influence of an external force. Derive equation for over – all momentum balance in x and y directions. 13

3. Define the terms point velocity, average velocity, bulk velocity, and maximum velocity in momentum transfer. How does the bulk velocity of a fluid flowing through a circular pipe vary with the maximum velocity ? Assume a turbulent velocity profile. 13

4. Explain the meaning of the terms Diffusivity and gradiant of concentration in Transpert phenomena show its similarity using flux approach. 13

5. (a) Calculate the shear stress and velocity gradient from the following data for alcohol at 0^0C. Distance between plates = 5 mm, Relative velocity 10 m/s viscosity = 1.77 cp. 8

(b) Compute the momentum flux for a situation of lower plate moving at 1 m/s and top plate stationary, the viscosity is 1 cp and the plates are separated by 1 mm. 5

6. The velocity vector for an incompressible flow is given by

$$V = (6xt + yz^2)\,i + (3t + x.y^2)\,j + (xy - 2xyz - 6tz)\cdot K$$

(i) verify the validity of equation

(ii) calculate the acceleration vector at point (2 , 2 , 2) for t = 2. 13

7. A small capillary tube with an inside diameter of 2.2×10^{-3} m and 0.317 m length is used for the measurement of flow rate of a liquid. If the measured velocity is 0.275 m / sec. Calculate the pressure drop. Assume density as 990 kg / m^3 and dyamic viscosity is 1.13×10^{-3} Pa. sec. calculate frictional losses. 13

8. Derive conservation of mass for an unsteady state three dimensional flow in differential form. Simplify the equation for a steady state in compressible flow. 13

9. Calculate the average thermal conductivity, thermal resistance, heat loss from the wall and the temperature at 150 mm from the hot surface of wall maintained at 900^0C. Outside surface temperature is 30^0C. Dimensions of the wall are 6 m x 6 m with a thickness of 300 mm. Conductivity varies with temperature as K = 0.9 (1+ 0.001 t) w/mk. 13

10. Discuss the salient features of different analogies proposed by

(i) Reynold's analogy

(ii) Prandtl-Taylor analogy

(iii) Chilton – Colburn analogy. 13