VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA
DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
SESSION 2015 - 16 (Supplementary June ~ July 2016)

Total Pages—5

(Set-Q_2)

B.Tech - 5th(M & M)
Transport Phenomena

Full Marks : 70

Time : 3 hours

Q. No. 1, which is compulsory and
any **five** from the rest of the questions

The figures in the right-hand margin indicate marks

1. Answer the following (any *ten*) : 2 × 10

   (*a*) Define momentum diffusivity.

   (*b*) What is Newtonian fluid ?

   (*c*) State the Bernoulli's Equation.

   (*d*) What is viscous momentum ?

   (*e*) Define Biot number ?

   (*f*) State Kirchhof's law.

(*Turn Over*)

(*g*) What is View factor ?

(*h*) Define mass transfer coefficient.

(*i*) Define Fick's second law of diffusion.

(*j*) What is ring diffusion ?

(*k*) What is drag force ?

(*l*) Define kinetic viscosity.

(*m*) What is Navier stokes equation ?

(*n*) What is Grashof number ?

(*o*) What is friction factor ?

2. Write short notes on any *two* of the following : 5×2

(*i*) Continuity Equation

(*ii*) Overall heat transfer coefficient

(*iii*) Convective mass transfer

(*iv*) Buckingham's π Theorem

(*v*) Characteristic of black body radiation.

3. (*a*) Derive the velocity distribution for the flow of fluid between two fixed parallel plates. 5

(*b*) Determine the shear stress at plate walls caused by the water flowing between the parallel plates under pressure drop of 1Psi. If the separation between plates is 0.1 ft and length of plate is 10 ft. Viscosity of water is 1cP. 5

4. (*a*) A Newtonian fluid of laminar flow is flowing in a narrow slit formed by two parallel walls separated by 2B apart. It is understood that B<<W<<L. Derive a differential momentum balance. 5

(*b*) Derive a relationship of friction factor for a incompressible fluid flowing through cylindrical tube as

$$f = \frac{16}{\mathrm{Re}}$$

where f is the friction factor and Re is the Reynolds Number. 5

5. (*a*) Differentiate between natural convection and forced convection of heat transfer. 5

(*b*) Heat flows by conduction from outer surface to inner surface through a slab of thickness 0·5 m with $T_1 = 500$ K and $T_2 = 300$ K. Draw the temperature profile of slab at varying the value of thickness. 5

6. (*a*) Consider heat conduction in a semi-infinite steel slab initially at a uniform temperature of 25°C. After 5 minutes, the temperature of slab is raised instantaneously to 50°C. Calculate the distance beneath the surface at which the local temperature is 30°C. Given $k = 43$ W.m^{-1}.K^{-1}, $\alpha = 1{\cdot}2 \times 10^{-5}$ m^2/s. 5

(*b*) Based on applying conservation of energy to a differential control volume of stationary medium through which energy transfer is exclusively by conduction. Derive a differential equation whose solution provides the temperature distribution in a stationary medium. 5

7. (*a*) Explain the mechanisms of mass transfer in solids. 5

(*b*) A steel plate with 0.2% carbon is exposed to a carburizing atmosphere at 1223K. Carburizing atmosphere maintains 0·5% carbon on the surface of steel. If diffusivity of carbon in steel is D_C 1·2 × 10^{-11} m^2/s. Calculate the concentration of carbon at 1 mm away from the surface after 1 hour. 5

8. (*a*) Define Sherwood number, Reynolds number and Schmidt number ? 5

(*b*) Show that $Sh = f(Re, Sc)$ using the dimensional analysis of mass transfer by forced convection in a circular pipe. 5

9. (*a*) Explain the principles of Pitot tube. 5

(*b*) Derive Kozeny-Carman and Burker plummer equation using packed bed correlation. 5