Registration No: | | | | | | | | | | |

Total Number of Pages: 02 **M.TECH**

P2MMBC01

2nd Semester Regular Examination 2016-17
TRANSPORT PHENOMENA IN METALLURGY
BRANCH: METALLURGICAL AND MATERIALS ENGG
Time: 3 Hours
Max Marks: 100
Q.CODE: Z386

Answer Part-A which is compulsory and any four from the rest
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: ***Short answer type*** **(2 x 10)**

a) What is Newtonian fluid? Give an example.
b) What is momentum balance? Write an equation of momentum balance under steady state condition.
c) What is Navier Stokes Equation? Give an application of this equation.
d) What is friction coefficient? It units.
e) What is Fourier's Law of conduction? Write its expression.
f) What is Newton's Law of cooling? Write its expression.
g) What is Prandtl number? Give its physical signification.
h) Define mass transfer coefficient and its units.
i) Define Fick's second law of diffusion. Write its expression
j) State difference between vacancy diffusion and ring diffusion.

Q2 a) Consider the flow between two parallel plates separated by a gap thickness 'h' containing a Newtonian fluid of viscosity μ. The lower plate is stationary and the upper plate moves at a fixed speed 'V'. Determine shear stress acting on the plates under steady state condition. **(10)**

b) Differentiate between the viscous momentum and convective momentum using control volume. **(10)**

Q3 a) Derive the equation of continuity by considering the stationary volume element ΔX, ΔY, ΔZ within a fluid of constant density moving with a velocity having the components v_x v_y and v_z respectively under steady state condition. **(10)**

b) Two parallel flat plates are separated by distance 0.005cm apart having lubrication oil of viscosity 0.2 Kg/m-s in between. If the lower plate is stationary and upper plate moves with a velocity of 0.5 m/s. Calculate the shear tress required to keep the upper plate in motion. **(10)**

Q4 a) Consider the composite wall of furnace made of steel plate of thickness 3.5 cm covered with a 1.25cm layer of insulating materials of K=0.035 W/m.K. The temperature inside the furnace is at T_i, 500^oC and temperature of air outside T_o is 15^oC. The thermal conductivity of the steel is 41 W/m-K and the values of heat transfer coefficient h_i and h_o are respectively 150 W/m^{2}K and 30 W/m^{2}K. Calculate the rate of loss of heat per unit length of wall. **(10)**

b) Explain the mechanisms of heat conduction in solids. **(10)**

Q5 **a)** The temperature of the inner and outer surface of a glass window in a room are respectively 25 ^{o}C nad 0^{o}C. The glass is 5 mm thick and has thermal conductivity 0.84 W/m-K. Calculate the rate of loss of heat from the room by conduction through the glass window per unit area. **(10)**

b) What is black body radiation? Explain the basic characteristics of black body. **(10)**

Q6 **a)** Using Buckingham's π Theorem, dimensional analysis the heat transfer coefficient for fully developed forced convection in a tube is a function of the variables h= f(V,ρ,η, K, C_p,D). **(10)**

b) State the difference between the Biot number and Fourier Number. **(10)**

Q7 **a)** Explain concentration profile at various times for Fe-C (0.44%C) and Fe-C-Si (0.48%C and (3.8%Si)) alloys welded together and annealed. **(10)**

b) Explain the different mass transfer mechanisms in solids. **(10)**