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

Total Number of Pages : 02 **B.Tech.**
PCMT4205

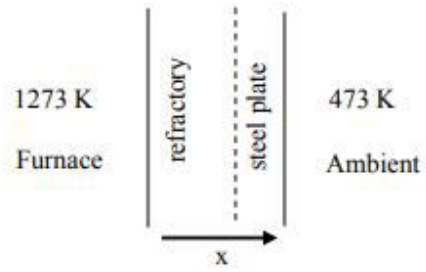
4th Semester Back Examination 2017-18
TRANSPORT PHENOMENON
BRANCH : METTA, MME
Time : 3 Hours
Max Marks : 70
Q.CODE : C672

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.
Answer all parts of a question at a place.

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

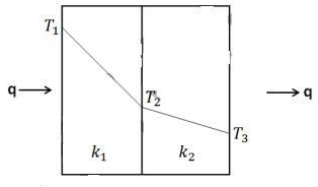
a) Write down the differential heat balance equation for an unsteady state with heat generation?
b) What is the unit and dimension of kinematic viscosity?
c) Find out the flow rate in m^3/s for laminar flow through pipe of diameter 4 cm having centerline velocity of 1.5 m/s.
d) State Fick's second law of diffusion with proper mathematical expression.
e) What is Grashof number?
f) Briefly explain the significance of Reynold's number.
g) Differentiate between Newtonian and Non-Newtonian fluid.
h) State and write the mathematical expression of Bernouli's equation.
i) What is emissivity? Give examples of matter at the extreme end of emissivity.
j) Difference between black body and grey body.

Q2 **a)** The lining of a box-type furnace is made up of a refractory layer and steel plate as shown in the figure. Steady state temperature at the surface of the refractory is 1273 K and that at the outer steel surface is 473 K. If the steady-state heat flux through the refractory-steel plate composite is 1600 W.m-2, and heat flow is along x-direction. What is the value of thermal contact resistance ($W^{-1}.m^2$ .K) between refractory and steel? **(5)**



Given data: Thermal conductivity of refractory = 1.2 $W.m^{-1}K^{-1}$ Thickness ofrefractory lining = 80 mm Thermal conductivity of steel = 32 $W.m^{-1}K^{-1}$ Thickness of steel plate = 4 mm

b) Consider a steady state heat flux across a rectangular slab composed of two layers of equal width as shown in the figure below. The thermal conductivities are in the ratio of $k2{:}k1 = 10$. If the first layer experiences a temperature drop ($T1 - T2$) of 50 K, what is the temperature drop ($T2 - T3$), in K, across the second layer? **(5)**



Q3 **a)** The velocity distribution near the solid wall at a section in a laminar flow is given by u = 5 sin (5πy). If the μ = 5 poise. Find the shear stress in N/m2 at y = 0.05 m? **(5)**

b) Derive the Navier stokes equation in Cartesian coordinate. **(5)**

Q4 **a)** A steel plate of 20 mm thick and $1m^2$ surface area is quenched from a temperature of 8000 C in water at 300^0 C. calculate the time required to obtain the temperature of 4000 C. Given h = 60 $Wm^{-2}K^{-1}$, k = 30 $Wm^{-1}K^{-1}$, α = 0.023 m^2h^{-1}. **(5)**

b) Explain lumped heat capacity method for transient conduction of heat. **(5)**

Q5 **a)** Briefly explain the significance of transport phenomena in metallurgy. **(5)**

b) Explain the mechanism of slag interfacial reaction? **(5)**

Q6 **a)** Briefly explain nucleation, growth and bubble formation phenomena. **(5)**

b) Derive Hagen-Poiseuille equation of momentum transfer. **(5)**

Q7 **a)** Derive Navier-Stoke's equation along x-axis. **(5)**

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

Q8 **Write short answer on any TWO :** **(5 x 2)**

a) Biot number

b) Kirchoff's law of thermal radiation

c) Lambert's law

d) Nusselt number