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

Total number of printed pages – 3

B. Tech

PCME 4305(New)

Sixth Semester (Back) Examination – 2013

HEAT TRANSFER

BRANCH : PLASTIC

QUESTION CODE : B 266

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) Give three broad classes of heat exchangers.

   (b) Why are baffles used in shell and tube kind of heat exchanger ?

   (c) How does shape factor influence heat transfer ?

   (d) Ice is considered as a black body. Explain.

   (e) What is the difference between natural convection and forced convection heat transfer ?

   (f) What do you mean by lumped heat analysis ?

   (g) What is the difference between Biot number and Nusselt number ?

   (h) Which law states about the convection heat transfer process ? Mention that.

   (i) What is the value of transmissivity for an opaque body ?

   (j) Show the boiling curve with salient points in it.

2. (a) What is conduction heat transfer ? 3

   (b) State the assumptions and derive the 3 dimensional heat conduction equation in Cartesian coordinate. 7

3. (a) Define fin effectiveness. How is it different from fin efficiency ? 4

(b) Derive an expression for the temperature distribution for a pin fin, when the tip of the fin is insulated. 6

4. Steam at 350°C flowing in a pipe (k = 80 W/mK) of 5 cm inner diameter and 5.6 cm outer diameter is covered with 3 cm thick insulation of k = 0.05 W/mK. Heat is lost to the surroundings at 5°C by natural convection and radiation, the combined h being 20 W/m^{2}K. Taking the heat transfer coefficient inside the pipe as 60 W/m^{2}K, determine 10

(a) the rate of heat loss from the steam per unit length of pipe

(b) the total resistance

(c) the temperature drops across the pipe and the insulation.

5. Air at atmospheric pressure and 100°C enters a 2 m long tube (4 cm diameter) with a velocity of 9 m/s. A 1 kW electric heater is wound on the outer surface of the tube. Find 10

(a) the mass flow rate of air

(b) the exit temperature of air.

(c) the wall temperature at outlet. Assume that the rate of heat absorption by air per unit area is uniform throughout length of the tube. Take R=0.287 kJ/kgK and cp = 1.005 kJ/kgK.

6. (a) Explain : 4

(i) Steafn-Boltzmann's constant

(ii) Kirchoff's law

(iii) Plank's law.

(b) Two large parallel plates with $\varepsilon = 0.5$ each, are maintained at 400 and 200°C respectively. Two equally large radiation shields with surface emissivity of 0.05 are introduced in parallel to the plates. Find the percentage reduction in net radiative heat transfer. 6

7. Water (cp=4.187kJ/kgK) is heated at the rate of 1.4kg/s from 40°C to 70°C by an oil (cp=1.9kJ/kgK) entering at 110°C and leaving at 60°C in a counter flow heat exchanger. If U_o=350W/m^2K, calculate the surface area required.

Using the same entering fluid temperatures and the same oil flow rate, calculate the exit temperatures of oil and water and the rate of heat transfer, when the water flow rate is halved. 10

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

(a) Nusselt number, Reynolds number and Prandtl number

(b) Nucleate boiling and film boiling

(c) Black body, white body and gray body

(d) Thermal conductivity, thermal rasitance and thermal conductance.