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

Total number of printed pages – 2

B. Tech

CPME 6307

Sixth Semester (Special) Examination – 2013

HEAT TRANSFER

BRANCH : MECH

QUESTION CODE : E 324

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) Mention the two mechanism of conduction heat transfer.

   (b) Why negative sign is used in Fourier's law ?

   (c) Differentiate between natural convection and forced convection.

   (d) What is the mode of heat transfer in vacuum ? Define black body and gray body.

   (e) What do you mean by fin efficiency ?

   (f) What is Biot number. Give its physical significance.

   (g) Write the Dittus-Boelter correlation.

   (h) What do you mean by flow boiling ?

   (i) Classify heat exchanger according to the direction of fluid flow.

   (j) Why radiation shields are used ?

2. (a) Derive general heat conduction equation in Cartesian coordinates. 7

   (b) Define the following terms : 3

   (i) heat

   (ii) heat transfer

   (iii) thermodynamics.

P.T.O.

3. An egg with mean diameter of 40 mm and initially at 20° C is placed in a boiling water pan for 4 minutes and found to be boiled to the consumers taste. For how long should a similar egg for same consumer be boiled when taken from s refrigerator at 5° C ? Take the following properties for egg : k = 10 W/m° C, ρ =1200 kg/m^3, c = 2 kJ/kg°C and h = 100 w/m^2 °C. Use lump theory. 10

4. The wall in a furnace consists of 125 mm thick refractory bricks and 125 mm thick insulating fire bricks separated by an air gap. A 12 mm thick plaster covers the outer wall. The inner surface of the wall is 1100° C and the ambient air is at 25° C. the heat transfer coefficient on the out side wall to the air is 17 W/m^{2}K, and the resistance to heat flow of the air gap is 0.16 K/W. the thermal conductivities of the refractory brick and plaster are 1.6,0.3 and 0.14 W/mK, respectively. Calculate : 10

   (a) the rate of heat loss per unit area of wall surface
   (b) the interface temperatures throughout the wall and
   (c) the temperatures at the outer surface of the wall.

5. A liquid (Cp=0.8 kJ/kg K) is entering a counter flow heat exchanger at 25° C at a rate of 2.5 kg/s. It is heated to 750° C by another fluid (Cp=1 kJ/kg K) with a flow rate of 2 kg/s entering at 1000° C. With these things remaining same, what will be percentage change in the area of heat exchanger if the fluid is heated up to 600° C instead of 750° C ? 10

6. (a) Explain the effect of extended surfaces on the heat transfer. 3
   (b) Derive expressions for temperature distribution and heat dissipation in a straight fin of rectangular profile for the adiabatic tip condition. 7

7. Two very large parallel planes with emissivities 0.3 and 0.8 exchange radiative energy. Determine the percentage reduction in radiative energy transfer when a polished aluminum radiation shield having 0.04 emissivity is placed between them. 10

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

   (a) Lumped heat capacity method
   (b) Boiling curve showing different boiling regimes
   (c) Critical insulation
   (d) Modes of heat transfer.