Roll No. .....

24356

B. Tech. 6th Semester (ME)

Examination – May, 2014

Heat Transfer

Paper : ME-306-F

Time : Three hours] *[Maximum Marks : 100*

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Question number 1 is ***compulsory*** and attempt ***five*** questions in total selecting at least ***one*** question from each Section.

1. (a) Define thermal diffusivity and explain its physical significance. $10 \times 2 = 20$

(b) Write the Fourier rate equation for heat transfer by conduction.

(c) Define the term fin effectiveness.

(d) How does transient heat conduction differ from steady state heat conduction ?

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

(f) State and explain Stefan Boltzmann law.

(g) What are the limitations of LMTD Methods ?

(h) What do you mean by laminar film condensation ?

(i) What does the view factor represents.

(j) What is the utility of extended surfaces ?

SECTION – A

2. Derive 3D general heat conduction equation in cylindrical Coordinates. 20

3. A thin sphere of radius r_1 is maintained at a temperature t_2 by internal heating in surrounding at temperature t_2. The sphere is covered with an insulating layer conductivity *(k)* and radius *(r)*. Give a physical explanation for the fact that certain thickness of insulation may increase the rate of heat flow rather than reduce it. Further, prove that for maximum heat loss, $r = {}^{2k}/_{h}$, where h is the heat transfer coefficient based on unit area of outer surface. 20

SECTION – B

4. A plane wall of thickness 10 cm and thermal conductivity 25 W/m-deg has a volumetric heat generation of 0.3×10^6 W/m^3. The wall is insulated on one side and other side is exposed to fluid at 90°C

temperature. Determine the maximum temperature in the wall if the convective heat transfer coefficient between the wall and fluid is 500 W/m^2 K. 20

5. The surface temperature of earth at a certain locality is measured over 48 hour period and found to range from 25°C to 35°C. Find the amplitude of temperature variation and time lag of temperature wave at a depth of 10 cm. Assume that a sinusoidal variation exists at the surface and that the earth has an average thermal diffusivity of $1.39 \times 1\,0^{-3}$ m^2/hr. 20

SECTION – C

6. A thermos flask has a double walled bottle and the space between the walls is evacuated so as to reduce the heat flow. The bottle surfaces are silver plated and emissivity of each surface is 0.025. If the contents of the bottle are at 375 K, find the rate of heat loss from the thermos bottle to the ambient air at 300 K. What thickness of cork (k=0.03W/m=deg) would be required if some insulating effect is to be achieved by use of cork ? 20

7. Write short notes on : 10 + 10 =20

(i) Correlation for free convection.

(ii) Thermal and hydrodynamic boundary layers.

SECTION – D

8. Derive the relationship between the effectiveness and the number of transfer units for a counter flow heat exchanger. 20

9. Write short notes on : 10 + 10 = 20

(i) Bubble growth and nucleate boiling.

(ii) Laminar film condensation on vertical plate.
