Printed Pages : 04 MME-211

(Following Paper ID and Roll No. to be filled in your Answer Books)

PAPER ID : ME13

Roll No.

M. TECH. (Sem.II)

THEORY EXAMINATION 2015-16

ADVANCE HEAT TRANSFER

Time : **3** Hours Total Marks : **100**

Note : 1. Attempt all questions.

2. Assume suitably, any missing data.

3. Be precise in your answer.

1. Attempts any two of the following : (2×10=20)

(a) Explain the graphical analysis of two dimensional steady state of heat conduction.

(b) Explain Reylond's analogy between skin friction and heat transfer for flow across cylinders.

(c) Derive the two special cases of heat conduction through a rectangular fin when

(i) The tip of the fin is insulated

(ii) The fin is infinitely long

2. Attempts any two of the following: (2×10=20)

(a) Derive two dimensional energy equations for thermal boundary layer on a flat plate. Also obtain Pohlhausen solution for the energy equation.

(b) Derive general heat conduction equation in Cartesian co-ordinates. Also deduce the equation for

(i) Steady state conduction

(ii) No heat sources

(iii) No heat source and steady state condition

(c) Write the short notes of the following:

(i) Lambert's cosine law of radiation

(ii) Hottel's method of successive reflection

(iii) Groeber's and Heisler's charts

3. Attempts any two of the following : (2×10=20)

(a) Derive the governing differential equation for temperature distribution of constant cross-sectional area fin. Hence derive expression for temperature distribution for long fin stating the assumption made

(b) (i) Describe the mechanism of heat conduction in solids.

(ii) Identify the modes of heat transfer for the following cases: Heat loss from a thermosflask and Boiling of water in a boiler.

(c) Find the steady state heat flux through the composite slab and the interface temperature of the composite slab having thickness 50 mm and 100 mm in the direction of heat flow. The thermal conductivities of the two materials vary with temperature as given: $K_{50mm}=0.051\ (l + 0.0065\ t)$ and $k_{100mm}=0.042\ (t + 0.0076\ t)$ W/m ^{0}C where temperature is in ^{0}C. The outer temperature of both slabs of the composite slab is 610^{0}C and 305^{0}C respectively.

4. Attempts any two of the following : (2×10=20)

(a) The rate of heat generation per unit volume in a long cylinder of radius R is given by $q_g=a+br^2$ where, a and b are constants and radius r is any radius. The cylinder is undergoing heat transfer with a medium at a temperature t_a and surface heat transfer co-efficient is h. Find the steady state temperature distribution in the solid.

(b) A mercury thermometer placed in oil well is required to measure temperature of compressed air flowing in a pipe. The wall is 140mm long and is made of steel (k=50 W/m°C) of 1 mm thickness. The temperature recorded by the well is

100°C while pipe wall temperature is 50°C. Heat transfer coefficient between the air and well wall is 30W/m^2°C.Estimate true temperature of air.

(c) Two long parallel surfaces, each of emissivity 0.7 are maintained atdifferent temperatures and accordingly have radiation exchangebetween them. It is desired to reduce 75% of this radiant heat transferby inserting thin parallel shields of equal emissivity (0.7) on both sides.What would be the number of shields?

5. Attempts any two of the following : (2×10=20)

(a) By dimensional analysis show that for natural convection heat transfer theNusselt number can be expressed as a function of Grashof number and Prandtl number. Explain with neat sketch Boundary Layer concept and show velocity boundary layer growth due to flow over plate.

(b) By dimensional analysis show that in free convection the Nusselt number can be expressed as a function of Prandtl number and Grashof number.

(c) Derive the relation for temperature variation with respect to time, instantaneous heat transfer rate and total heat transfer using lumped parameter analysis.

*****