Code: 9D17102

M.Tech I Semester Supplementary Examinations February/March 2018

CONDUCTION & RADIATION HEAT TRANSFER

(Refrigeration & Air Conditioning)

(For students admitted in 2012, 2013, 2014, 2015 & 2016 only)

Time: 3 hours Max. Marks: 60

Answer any FIVE questions

All questions carry equal marks

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1 (a) Derive an expression for one dimensional steady state heat transfer through a rectangular slab.

(b) Explain in detail various boundary conditions used in solving various heat transfer problems.

2 A rectangle of 1 m x 2 m (with 1 m on the x-direction) has all edges except y = H edge at 100℃. The y = H edge is at 300℃. Determine the temperature at the points (0.5, 1.0) and (0.5, 1.5).

3 A composite material is embedded in a high thermal conductivity material maintained at 400℃ . The upper surface is exposed to a convection environment at 30℃ with h = 25 W/m^2 C. Determine the temperature distribution and heat loss from the upper surface for steady state.

4 Two spheres of 0.2 m diameter and 0.1 m diameter with surface temperatures of 400℃ and 40℃ are buried in soil at a centre distance of 1 m. The conductivity of the soil is 0.52 W/mK. Determine the heat exchange between the spheres.

5 A large industrial furnace is supported on a long column of fireclay brick, which is 1 m by 1 m on a side. During steady state operation, installation is such that three surfaces of the column are maintained at 500 K while the remaining surface is exposed to an airstream for which T_{inf} = 300 K and h = 10 W/m^2K. Using a grid of $\Delta x = \Delta y$ = 0.25 m, determine the two-dimensional temperature distribution in the column and the heat rate to the airstream per unit length of column.

6 Two parallel plates 0.5 by 1.0 m are spaced 0.5 m apart. One plate is maintained at 1000℃ and the other at 500℃. The emissivity's of the plates are 0.2 and 0.5, respectively. The plates are located in a very large room, the walls of which are maintained at 27℃. The plates exchange heat with each other and with the room, but only the plate surfaces facing each other are to be considered in the analysis. Find the net transfer to each plate and to the room.

7 A furnace in the form of a cube of 2 m side has gas in it at 1500 K. The analysis of gas is 16% CO_2, 10% H_2O and the rest are non radiating gases. Determine the emissivity of the gas body. The total pressure is 1 atm.

8 A cubical furnace 0.5 m on side has interior walls that are essentially black. Inside furnace the gas is 20% carbon dioxide by volume and 80% nitrogen at a total pressure of 1 atm and a temperature of 1500 K. The walls of the furnace are to be maintained at 300℃. Calculate the amount of cooling required to maintain the walls at the specified temperature.

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