VIT
Vellore Institute of Technology

Final Assessment Test – November 2019

Course: MEE2005 - Heat Transfer

Class NBR(s): 1280 / 2247 Slot: C2+TC2+V5

Time: Three Hours Max. Marks: 100

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION, IS EXAM MALPRACTICE

General Instruction: Use of heat and mass transfer data book is permitted

PART – A (2 X 20 = 40 Marks)
Answer ALL Questions

1. Write the general form of heat equation for a plane wall and with the justified assumptions derive the temperature distribution of one dimensional steady state with heat generation, for a 2L thickness plate, whose left and right face uniformly maintained at T_1 and T_2 temperature.
2. Design a counter flow concentric tube heat exchanger is used to cool the lubricating oil for a large industrial gas turbine engine. The known conditions are flow rate of cooling water through the inner tube (D_i=25 mm) is 0.2 kg/s, while the flow rate of oil through the outer annulus (D_o = 45 mm) is 0.1 kg/s. The oil and water enter at temperatures of 100 and 30°C, respectively. Assume the outlet temperature of the oil is to be 60°C. Find the length and other parameters for heat exchanger fabrication.

PART – B (4 X 15 = 60 Marks)
Answer any FOUR Questions

3. A long aluminium cylinder 5.0 cm in diameter and initially at 200°C is suddenly exposed to a convection environment at 70°C and h = 525 W/m^2°C. Calculate (a) Temperature at a radius of 1.25 cm, 2.25 cm, 3.25 cm and 4.25 cm, draw the temperature distribution. (b)Total heat lost per unit length 1 min after the cylinder is exposed to the environment.
4. A power plant company decide to recover the waste heat from flue gas, such that tube in tube heat exchanger is selected and design for hot flue gases at 700 K flow inside a SS tube of 25 mm ID with 1.6 mm wall thickness. A 50 mm tube is placed around the 25 mm diameter tube and high-pressure water at 150°C flows in the annular space between the tubes. If the flow rate of water is 1.5 kg/s and the total heat transfer is 17.5 kW, Find the length of the heat exchanger for a maximum gas mass flow of 0.8 kg/s. Take the properties of the flue gas are the same as those of air at atmospheric pressure and 700 K.
5. A thin silicon chip and an 8 mm thick aluminium substrate are separated by a 0.02 mm thick epoxy joint. The chip and substrate are each 10 mm on a side, and their exposed surfaces are cooled by air, which is at a temperature of 25°C and provides a convection coefficient of 100 W/m^{2}K. If the chip dissipates 10W/m^2 under normal conditions, will it operate below a maximum allowable temperature of 85°C?
6. Air at 20°C blows over carbon steel (1% Carbon) hot plate 50 by 75 cm maintained at 250°C. The convection heat-transfer coefficient is 25 W/m^2°C. Calculate the convective heat transfer. If the plate is 2 cm thick and that 300 W is lost from the plate surface by radiation, calculate the inside plate temperature.

7.a) A mercury-in-glass thermometer having ϵ = 0.9 hangs in a metal building and indicates a temperature of 20°C. The walls of the building are poorly insulated and have a temperature of 5°C. The value of h for the thermometer may be taken as 8.3 W/m^2 °C. Calculate the true air temperature. **[7]**

b) Air at 1 atm and 27°C is forced through a horizontal 25 mm diameter tube at an average velocity of 30 cm/s. The tube wall is maintained at a constant temperature of 140°C. Calculate the heat-transfer coefficient for this situation if the tube is 0.4 m long. **[8]**

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