VIT
Vellore Institute of Technology

Continuous Assessment Test – I

Programme Name & Branch: B.Tech & SMEC

Course Name & Code: Heat Transfer & MEE2005

Class Number: VL2019201002247 **Slot: C2** **Exam Duration: 90 min** **Maximum Marks: 50**

General Instruction(s): **(i)** Heat and Mass Transfer data book is allowed. (ii) Scientific Calculator is allowed. (iii) Assume appropriate data, if necessary. (iv) Answer all the questions.

SECTION –A (2×10 = 20 Marks)

S.No

1. Find the critical radius of insulation for hard vulcanized rubber surrounding a pipe and it is exposed to room air at 20°C with h = 3.0 W/(m^2K). Calculate the heat loss from a 200°C, 2.5 cm radius pipe when covered with the critical radius of insulation and without insulation. If suppose you have to reduce the cost, assume all the insulating materials cost/m^2 will be same, which insulating material you can choose based on data available in heat transfer data book?

2. Carbon steel (AISI 1010) shafts of 0.1-m diameter are heat treated in a gas-fired furnace whose gases are at 1200 K and provide a convection coefficient of 100 W/(m^2K). If the shafts enter the furnace at 300 K, how long must they remain in the furnace to achieve a centreline temperature of 800 K?

SECTION –B (2×15 = 30 Marks)

1. A composite wall separates combustion gases at 2600°C from a liquid coolant at 100°C, with gas and liquid-side convection coefficients of 50 W/(m^2.K). and 1000 W/(m^2.K). The wall is composed of a 10 mm thick layer of beryllium oxide on the gas side and a 20 mm thick slab of stainless steel (AISI 304) on the liquid side. The contact resistance between the oxide and the steel is steel is 0.05 m^2. K/W.
   i) What is the heat loss per unit surface area of the composite? (12 marks)
   ii) Sketch the temperature distribution from the gas to the liquid. (3 marks)

2. A long cylindrical rod of diameter 200 mm with thermal conductivity of 0.5 W/(m.K) experiences uniform volumetric heat generation of 24,000 W/m^3. The rod is encapsulated by a circular sleeve having an outer diameter of 400 mm and a thermal conductivity of 4 W/(m.K). The outer surface of the sleeve is exposed to cross flow of air at 27°C with a convection coefficient of 25 W/(m^2.K).
   (a) Find the temperature at the interface between the rod and sleeve and on the outer surface. (10 marks)
   (b) What is the temperature at the center of the rod? (5 marks)