VIT

Vellore Institute of Technology

SCHOOL OF MECHANICAL ENGINEERING

Continuous Assessment Test - I

B.Tech (*BEM, BMA, BME*), Fall Semester, 2019 - 20

Course Code	: MEE 2005	**Duration**	: 90 Minutes.
Course Name	: Heat Transfer	**Max. Marks**	: 50
Faculty-In-Charge	: Prof. R. Kamatchi	**Slot**	: A2+TA2+V3
Class Number	: VL2019201001337		

General instruction(s):

Use of HMT data book is permitted

Assume any missing data

Answer all questions

5 X 10 = 50 Marks

1. Derive three dimensional heat conduction equation with heat generation in cylindrical coordinates systems. Deduce the heat conduction equation for the following special cases from the general heat conduction equation: (i) steady state; (ii) Transient & no heat generation; (iii) steady-state, no heat generation.

2. Fig. 1 shows two slabs, each 120 mm thick, have thermal conductivities of 14.5 W/mK and 210 W/mK respectively.

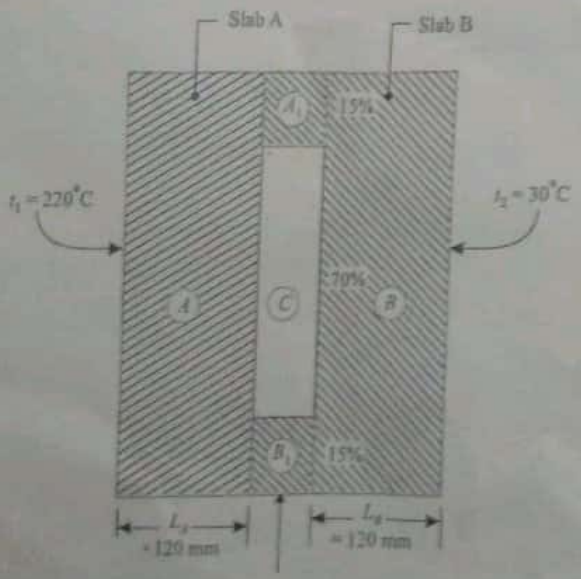

Fig. 1

These are placed in contact, but due to roughness, only 30% of the area is in contact and the gap in the remaining area is 0.025 mm thick and is filled with air. If the temperature of the face of the hot surface is at 220°C and the outside surface of the other slab is at 30°C, determine:

i. Heat flow through the composite system

ii. The contact resistance and temperature drop in contact

Assume: thermal conductivity of air, A_1 and B_1 are 0.032, 14.5 and 210 W/mK respectively.

3. A small electric heating application uses wire of 2 mm diameter with 0.8 mm thick insulation (k = 0.12W/mK). The heat transfer coefficient on the insulated surface is 35 W/m^2K. Determine the critical thickness of insulation in this case and the percentage change in the heat transfer rate if the critical thickness is used, assuming the temperature difference between the surface of the wire and surrounding air remains unchanged.

4. A copper bar (conductor) 80 mm × 6 mm in cross-section (k = 370 W/mK) is lying in an insulation trough so that the heat transfer from one face and both the edges is negligible. It is observed that when a current of 5000 A flows through the conductor, the bare face has a constant temperature of 45°C. If the resistivity of copper is 2×10^{-8} ohm-m, determine:

   i. The maximum temperature which prevails in the bar and its location

   ii. The temperature at the centre of the bar.

5. A household electric iron has a steel base [ρ = 7840 kg/m^3, c_p = 450 J/kg°C and k = 70 W/m°C] which weighs 1 kg. The base has an ironing surface of A = 0.025 m^2 and is heated from the other surface with a 250 W heating element. Initially the iron is at a uniform temperature of T_i = 20°C. Suddenly the heating starts, and the iron dissipates heat by convection from the ironing surface into an ambient at T_∞ = 20°C with a heat transfer coefficient h = 50 W/m°C. Calculate the temperature of the iron t = 5 min after the start of heating.

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