



School: School of Engineering and Technology
 Program/s: B.Tech Mechanical
 Year: 3rd Semester: 1st
 Examination: End Semester Examination
 Examination year: November 2023

Course Code: ME 302 Course Name: Heat and Mass Transfer
 Date: 22/11/2023
 Time: 13:00 pm to 15:00 pm

Total Marks: 40
 Total Pages: 1

Instructions:

- Write each answer on a new page.
- Use of a calculator is permitted/not permitted.

Q. No.	Details	Marks	COs*	BTL*
Q1	Derive the equation of critical thickness of insulation for the cylindrical section.	5	CO1	BT1, BT2, BT3.
Q2	<p>Solve the following Examples.</p> <p>A. A large concrete slab 1 m thick has one dimensional temperature Distribution $T = 4 - 10x + 20x^2 + 10x^3$ Where T is temperature and x is distance from one face towards other face of wall. If the slab material has thermal diffusivity of $2 \times 10^{-3} \text{ m}^2/\text{hr}$, what is the rate of change of temperature at the other face of the wall? (4 Marks)</p> <p>B. The composite wall of an oven consists of three materials, two of which are of known thermal conductivity, $k_A = 20 \text{ W/m K}$ and $k_C = 50 \text{ W/m K}$, and known thickness, $L_A = 0.30 \text{ m}$ and $L_C = 0.15 \text{ m}$. The third material, B, which is sandwiched between materials A and C, is of known thickness, $L_B = 0.15 \text{ m}$, but unknown thermal conductivity k_B. Under steady-state operating conditions, measurements reveal an outer surface temperature of $= 20^\circ\text{C}$, an inner surface temperature of $= 600^\circ\text{C}$, and an oven air temperature of $= 800^\circ\text{C}$. The inside convection coefficient h is known to be $25 \text{ W/m}^2\text{K}$. What is the value of k_B? (5 Marks)</p> <p>C. A composite wall of a furnace has 3 layers of equal thickness having thermal conductivities in the ratio of 1:2:4. What will be the temperature drop ratio across the three respective layers? (3 marks)</p> <p>D. A wall of thickness 0.6 m has width has a normal area 1.5 m^2 and is made up of material of thermal conductivity 0.4 W/mK. The temperatures on the two sides are 800°C. What is the thermal resistance of the wall? (3 Marks)</p>	15	CO1	BT1, BT2, BT3
Q3	<p>Attempt any Three</p> <p>A. Explain the difference between Regenerative and Recuperative Heat Exchanger and mentioned their applications.</p> <p>B. Explain compact heat exchangers with neat sketch.</p> <p>C. Write difference between boiling and evaporation.</p> <p>D. Discuss Nusselt Number and Biot Number.</p>	15	CO1	BT1, BT2, BT3
Q4	Explain with neat sketch Hydro-dynamic boundary layer and thermal boundary layer.	5	CO1	BT1, BT2, BT3