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Bengaluru

Mid Term Examinations - October 2026

Date: 07/10/2026 **Time:** 09:30 AM - 11:00 AM

Course Code: MEC2509 **Course Name:** Heat and Mass Transfer

Semester: Fifth Semester **Max. Marks:** 50 **Weightage:** 50%

CO - Levels	CO1	CO2	CO3
Marks	6	42	42

PART A: Answer Following Questions. 10 M

Q.N.	Questions	M	CO	BT
1	On a hot summer day, a student leaves the ceiling fan switched on in his closed room and returns in the evening. Will the room be warmer or cooler than the neighboring rooms? Explain the reason for your answer.	2	CO1	BT2
2	Consider a cold canned drink left on a dinner table. Would you model the heat transfer to the drink as one-, two-, or three-dimensional? Would the heat transfer be steady or transient? Also, which coordinate system would you use to analyze this heat transfer problem, and where would you place the origin? Explain.	2	CO1	BT2
3	Fins attached to a surface have an effectiveness of 0.9. Describe whether the addition of these fins increases or decreases the rate of heat transfer from the surface. Justify your answer based on the meaning of fin effectiveness.	2	CO1	BT1
4	Compare the applicability of lumped system analysis in water and air. Which medium is more suitable for lumped system analysis, and why?	2	CO2	BT2
5	Compare the applicability of lumped system analysis in water and air. Which medium is more suitable for lumped system analysis, and why?	2	CO3	BT2

PART B: Answer Any 1 Following Questions. 20 M

Q.N.	Questions	M	CO	BT
6	An aluminum sphere having a diameter of 5.6 cm is initially at a uniform temperature of 355 °C and is suddenly exposed to a convection environment at T =23 °C with a convection heat transfer coefficient of 78W/m^2.°C. Calculate the time for the center of the sphere to cool to a temperature of 73 °C. Express the answer in seconds. (Properties of Aluminium ρ = 2707 kg/m^3, c_p = 896 J/kg·K, and k = 204 W/m·K)	20	CO2	BT3
7	Consider a 1000-W iron whose base plate is made of 0.5-cm-thick aluminum alloy 2024–T6 (ρ = 2770 kg/m3, c_p = 875 J/kg·K, α = 7.3 X 10^{-5} m^2/s). The base plate has a surface area of 0.03 m^2. Initially, the iron is in thermal equilibrium with the ambient air at 22°C. Taking the heat transfer coefficient at the surface of the base plate to be 12 W/m^2·K and as suming 85 percent of the heat generated in the resistance wires is transferred to the plate, determine how long it will take for the plate temperature to reach 140°C. Is it realistic to assume the plate temperature to be uniform at all times?	20	CO2	BT3

PART C: Answer Any 1 Following Questions. 20 M

Q.N.	Questions	M	CO	BT

PTO (Please Turn Over)

8	Consider an airplane cruising at an altitude of 10 km where standard atmospheric conditions are -50°C and 26.5 kPa at a speed of 800 km/h. Each wing of the airplane can be modeled as a 25-m X 3-m flat plate, and the friction coefficient of the wings is 0.0016. Using the momentum-heat transfer analogy, calculate the heat transfer coefficient for the wings at cruising conditions. The properties of air at -50°C and 1 atm are c_p =0.999 kJ/kg-K Pr = 0.7440.	20	CO3	BT3
9	The electrically heated 0.6-m-high and 1.8-m-long windshield of a car is subjected to parallel winds at 1 atm, 0°C, and 80 km/h. The electric power consumption is observed to be 50 W when the exposed surface temperature of the wind shield is 4°C. Disregarding radiation and heat transfer from the inner surface and using the momentum-heat transfer analogy, determine drag force the wind exerts on the windshield. The properties of air at 0°C and 1 atm are ρ = 1.292 kg/m^3, c_p =1.006 kJ/kg-K, Pr = 0.7362.	20	CO3	BT3