Roll No.											

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – May/June 2026

Date: 18-05-2026 **Time:** 01:00pm – 04:00pm

School: SOE	**Program:** B. Tech. MECHANICAL ENGINEERING	
Course Code: MEC3003	**Course Name:** Heat and Mass Transfer	
Semester: VI	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Marks	**8**	**20**	**22**	**24**	**26**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	Define "Overall Heat Transfer Coefficient" () in the context of a heat exchanger	**2 Marks**	**L2**	**CO1**
2.	Recall Fourier's Law of Conduction and its mathematical expression.	**2 Marks**	**L2**	**CO1**
3.	Define "Thermal Diffusivity" and state its physical importance.	**2 Marks**	**L2**	**CO1**
4.	State the three different boundary conditions applied to heat transfer in fins.	**2 Marks**	**L2**	**CO1**
5.	Identify the difference between "Hydrodynamic Entry Length" and "Thermal Entry Length".	**2 Marks**	**L2**	**CO3**
6.	Describe the Stefan-Boltzmann Law for thermal radiation.	**2 Marks**	**L2**	**CO4**
7.	Define "Emissivity" and "Absorptivity" of a surface.	**2 Marks**	**L2**	**CO4**
8.	State Kirchhoff's Law of Radiation.	**2 Marks**	**L2**	**CO5**
9.	Explain the significance of the "LMTD Correction Factor" in heat exchangers.	**2 Marks**	**L2**	**CO5**
10.	Define the term "Molar Flux" in mass transfer.	**2 Marks**	**L2**	**CO5**

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	Explain the physical significance of the Fourier Number in unsteady heat conduction.	**10 Marks**	**L2**	**CO2**
	b.	Summarize the use of "Heisler Charts" for solving transient heat conduction problems.	**10 Marks**	**L2**	**CO2**
Or					
12.	**a.**	Interpret how internal heat generation affects the temperature distribution in a solid cylinder.	**10 Marks**	**L2**	**CO2**
	b.	Discuss the selection criteria for fin materials and shapes in high-performance cooling systems.	**10 Marks**	**L2**	**CO2**

13.	**a.**	Classify fluid flows based on the Reynolds Number for flow over a flat plate.	**10 Marks**	**L2**	**CO3**
	b.	Describe the concept of the "Thermal Boundary Layer" and its thickness.	**10 Marks**	**L2**	**CO3**
Or					
14.	**a.**	Interpret the significance of the Nusselt Number in convective heat transfer.	**10 Marks**	**L2**	**CO3**
	b.	Discuss the empirical correlations used for determining heat transfer in flow across a cylinder.	**10 Marks**	**L2**	**CO3**

15.	Heat Transfer Through a Composite Wall "Two-by-four" wood studs have actual dimensions of 7.13 x 13.21 cm and a thermal conductivity of 0.9 W/m °C. A typical wall for a house is constructed as shown in Figure below. Calculate the overall heat-transfer coefficient and R value of the wall by plotting the Thermal resistance diagram for the same.	**20 Marks**	**L3**	**CO4**

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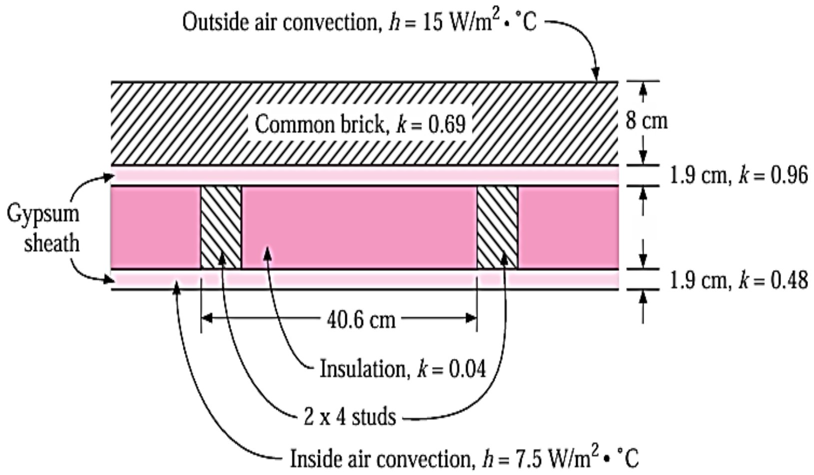
<tr><td></td><td>
</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Or</td></tr>
<tr><td>16.</td><td>Two large parallel black plates are maintained at temperatures of 800 K and 400 K. To reduce the net radiation heat exchange, a radiation shield with an emissivity of 0.05 on both sides is placed between the two plates. Calculate the following parameters.
1. Determine the net radiation heat exchange per unit area between the two plates without the radiation shield.
2. Calculate the net radiation heat exchange per unit area after the radiation shield is placed between the plates.
3. Compute the equilibrium temperature of the radiation shield in Kelvin.
Evaluate the percentage reduction in the net radiation heat transfer achieved by installing the shield.</td><td>20 Marks</td><td>L3</td><td>CO4</td></tr>
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<tr><td>17.</td><td>Appraise a counter-flow heat exchanger cooling oil (Cp=2.1 kJ/kgK) from 120°C to 60°C using water (Cp=4.18 kJ/kgK) entering at 25°C. Assume mass of oil and water are 2 and 1.5 kg respectively, U = 400 W/m²K.
1. Compute the total heat transfer rate
2. Determine the final exit temperature of the cooling water.
3. Calculate the Log Mean Temperature Difference (LMTD).
4. Determine the required surface area for the heat exchanger.</td><td>20 Marks</td><td>L4</td><td>CO5</td></tr>
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18.	Evaluate a parallel-flow heat exchanger using the epsilon-NTU method (U = 250 W/m^2·K, A = 10 m^2, Th_in = 150°C, Tc_in = 30°C, m_h = 1 kg/s, m_c = 2 kg/s) **1.** Determine the heat capacity rates (Ch, Cc) for both fluids. **2.** Compute the Capacity Ratio (C) and the Number of Transfer Units (NTU). **3.** Calculate the heat exchanger effectiveness **4.** Determine the actual heat transfer rate (Q) and final fluid exit temperatures.	**20 Marks**	**L4**	**CO5**