Roll No:

BTECH
(SEM V) THEORY EXAMINATION 2024-25
HEAT & MASS TRANSFER

TIME: 3 HRS   **M.MARKS: 70**

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1.   **Attempt *all* questions in brief.**   **2 x 07 = 14**

Q no.	Question	CO	Level
a.	Define heat transfer and its importance in engineering.	1	K1
b.	List the factors affecting thermal conductivity.	1	K1
c.	Explain how extended surfaces enhance heat transfer.	2	K2
d.	Differentiate between steady-state and transient heat conduction.	2	K2
e.	State the relation between fluid friction and heat transfer in forced convection.	3	K1
f.	State Planck's law and its significance.	4	K1
g.	State the significance of fouling factors in heat exchangers.	5	K1

SECTION B

2.   **Attempt any *three* of the following:**   **07 x 3 = 21**

Q no.	Question	CO	Level
a.	Use the concept of critical radius to determine whether adding insulation increases or decreases heat loss.	1	K3
b.	Summarize the errors that occur in temperature measurement due to thermometer wells.	2	K2
c.	Apply the empirical heat transfer relation to calculate the heat transfer coefficient for natural convection over a vertical plate.	3	K3
d.	Determine the heat transfer rate between two non-black surfaces in an enclosure using the radiation network approach.	4	K3
e.	Describe the principle behind the LMTD method and also Compare dropwise and filmwise condensation.	5	K2

SECTION C

3.   **Attempt any *one* part of the following:**   **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Compare the heat conduction equations in rectangular, cylindrical, and spherical coordinates.	1	K4
b.	A plane wall is 150 mm thick and its wall area is 4.5 m². If its conductivity is 9.35 W/m°C and surface temperatures are steady at 150°C and 45°C, determine: (i) Heat flow across the plane wall. (ii) Temperature gradient in the flow direction.	1	K3

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4. **Attempt any *one* part of the following:**   **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Identify the key assumptions made in the lumped capacitance method.	2	K1
b.	A 50cm × 50 cm copper slab 6.25 mm thick has a uniform temperature of 300°C. Its temperature is suddenly lowered to 36°C. Calculate the time required for the plate to reach the temperature of 108°C. Take ρ= 9000kg/m³, c = 0.38 kJ/kg°C, k = 370W /m°C and h = 90W /m²°C.	2	K3

5. **Attempt any *one* part of the following:**   **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Differentiate between laminar and turbulent flow heat transfer in natural convection.	3	K4
b.	Explain the analogy between momentum and heat transfer in turbulent flow over a flat surface.	3	K2

6. **Attempt any *one* part of the following:**   **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Compare the emissive properties of black bodies and gray bodies with examples. Also assess the impact of surface geometry on shape factors in radiation heat transfer.	4	K4
b.	A small sphere (outside diameter = 60 mm) with a surface temperature of 300° C is located at the geometric centre of a large sphere (inside diameter = 360 mm) with an inner surface temperature of 15° C. Calculate how much of emission from the inner surface of the large sphere is incident upon the outer surface of the small sphere; assume that both sides approach black body behaviour. What is the net interchange of heat between the two spheres?	4	K3

7. **Attempt any *one* part of the following:**   **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Differentiate between the NTU and LMTD methods in terms of their applicability and advantages.	5	K5
b.	Two fluids, A and B exchange heat in a counter-current heat exchanger. Fluid A enters at 420°C and has a mass flow rate of 1 kg/s. Fluid B enters at 20°C and has a mass flow rate of 1 kg/s. Effectiveness of heat exchanger is 75%. Determine: (i) The heat transfer rate. (ii) The exit temperature of fluid B. Specific heat of fluid A is 1 kJ/kg K and that of fluid B is 4 kJ/kg K.	5	K3