PAPER ID-310140

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/m^3, c = 0.38 kJ/kg°C, k = 370W /m°C and h = 90W /m^2°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