CBCS SCHEME

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BME601

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of Heat and Mass transfer Data book are permitted.

		Module – 1	M	L	C
Q.1	a.	Derive an expression for Temperature distribution and rate of heat transfer through plane wall.	10	L3	CO1
	b.	Explain different boundary conditions as applicable to heat transfer analysis.	10	L2	CO1
		OR			
Q.2	a.	Explain the experimental method of determining the thermal conductivity of a metal rod.	10	L2	CO1
	b.	The wall of a house in cold region consists of three layers, an outer brick work 15 cm thick, the inner wooden panel 1.2 cm thick, the intermediate layer is insulator of 7 cm thick. The K for brick and wood are 0.7 and 0.18 W/mK. The inside and outside temperature of wall are 21 and $-15^\circ C$. If insulation layer offer twice the thermal resistance of the brick wall, calculate, (i) Heat loss per unit area. (ii) 'K' of insulator.	10	L3	CO1
		Module – 2			
Q.3	a.	Derive an expression for the temperature distribution for a long fin of uniform cross section with insulated tip.	10	L3	CO3
	b.	A rod (K = 200 W/mK) 5 mm in diameter and 5 cm long has its one end maintained at 100°C. The surface of the rod is exposed to ambient air at 25°C with convection heat transfer co-efficient of 100 W/m^{2}K. Assuming the other end is insulated. Determine (i) the temperature of rod at 20 mm distance from the end at 100°C (ii) Heat dissipation rate from the surface of rod (iii) Effectiveness.	10	L3	CO3
		OR			
Q.4	a.	Obtain an expression for temperature distribution of solid in lumped heat transfer analysis in dimensional numbers.	10	L3	CO3
	b.	A 15 mm diameter mild steel sphere of K = 42 W/m°C is exposed to cooling air flow at 20°C with h = 120 W/m^2°C. Determine the following : (i) Time required to cool from 550°C to 90°C. (ii) Instantaneous heat transfer rate 2 minutes after start of cooling.	10	L3	CO3

		Module – 3			
Q.5	a.	Explain the formulation of differential equation 1-D steady state heat conduction.	10	L2	CO3
	b.	Consider steady state heat conduction in a square region of side 2b, in which energy is generated at a constant rate of g w/m^3. The boundary conditions for the problem are shown in Fig. Q5 (b). Write the finite difference equations for nodes 1, 3 and 5 in this Fig. Q5 (b).	10	L3	CO3

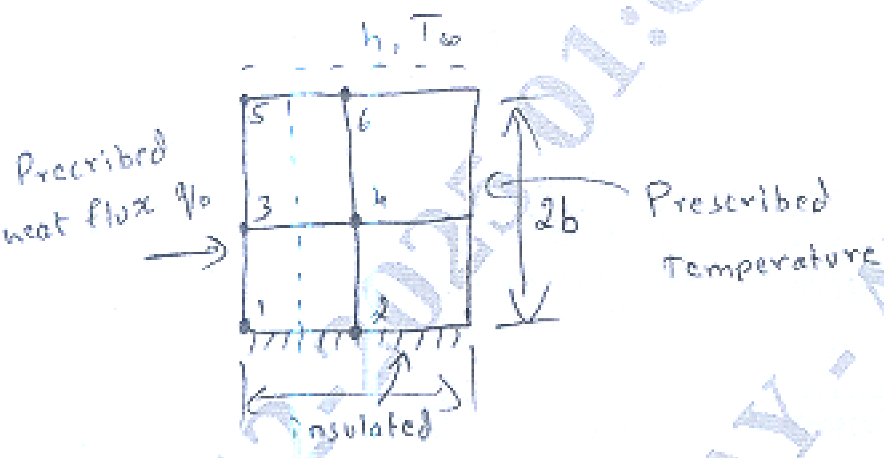

Fig. Q5 (b)

		OR			
Q.6	a.	State and explain the following laws of radiation : (i) Steafan Boltzman law (ii) Kirchoff's law (iii) Planck's law (iv) Wein's displacement law (v) Lambert's cosine law	10	L2	CO3
	b.	Calculate the net radiant heat exchange per unit area for two large parallel plates at a temperature of 427°C and 27°C respectively. $\in_{hot\ plate} = 0.9$, $\in_{cold\ plate} = 0.6$. If a polished alluminium shield is placed between them. Find the percentage reduction in the heat transfer $\in_{shield} = 0.04$.	10	L3	CO3
		Module – 4			
Q.7	a.	Explain with sketch : (i) Velocity Boundary layer (ii) Thermal Boundary layer	10	L2	CO2
	b.	Air at a temperature of 20°C flows through a rectangular duct with a velocity of 10 m/s. The duct is $30cm \times 20cm$ in size and air leaves at 34°C. Find the heat gain by air when it is passed through 10 m long.	10	L3	CO2
		OR			
Q.8	a.	Explain the physical significance of, (i) Reynolds number (ii) Prandtl number (iii) Nusselt number (iv) Grashoff's number (v) Stanton number	10	L2	CO2
	b.	Considering the body of a man as a vertical cylinder of 300 mm diameter and 170 cm height. Calculate the heat generated by the body in one day. Take the body temperature as 36°C and ambient temperature as 14°C.	10	L3	CO2

Module – 5					
Q.9	a.	Derive an expression for LMTD for a parallel flow heat exchanger.	10	L3	CO4
	b.	An oil cooler for a large diesel engine is to cool engine oil from 60°C to 45°C using sea water at an inlet temperature of 20°C with a temperature raise of 15°C. The design heat load is 140 kW and the mean overall heat transfer coefficient based on the outer surface area of the tube is 70 $W/m^2{}^\circ C$. Calculate the heat transfer surface area for single pass counter flow and parallel flow arrangements.	10	L3	CO4
OR					
Q.10	a.	Explain with a neat sketch the Regimes of pool Boiling process.	10	L2	CO4
	b.	A vertical plate 30 cm × 30 cm is exposed to steam at atmospheric pressure. The plate temperature is 98°C. Calculate the heat transfer and the mass of steam condensed per hour.	10	L2	CO4

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