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CBCS SCHEME

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BME601

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
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 Transfer data Hand Book is permitted

		Module – 1	M	L	C
Q.1	a.	Derive on expression for temperature distribution and heat transfer in 1-D conduction heat transfer through SLAB.	10	L3	CO1
	b.	An exterior wall of a house may be approximated by a 10 cms layer of common brick (K=0.7w/m°c) followed by 4cms layer of gypsum plaster (K = 0.48w/m°c) Find thickness of loosely packed rock wool insulation (K =0.065 w/m°c) that should be added to reduce the heat loss (or gain) through the wall by 80%.	10	L3	CO1
		OR			
Q.2	a.	Explain basic laws of heat transfer.	6	L2	CO1
	b.	Discuss the expression for temperature distribution and the rate of heat transfer for an one dimensional hollow sphere.	4	L2	CO1
	c.	A 600 mm outer diameter sphere storing a liquid is provided with two insulating layers, a high temperature insulation of conductivity 0.35 w/m°c and a low temperature insulation of thermal conductivity 0.07w/m°c. The thickness of the former is 100mm. The temperature drop across high temperature insulation is required to be 2 ½ times that across the low temperature insulation, calculate the thickness of the latter.	10	L3	CO1
		Module – 2			
Q.3	a.	Derive the 1 D fin equation for a fin of uniform cross section. By integrating the fin equation, obtain the expression for the temperature variation in a long fin.	10	L3	CO2
	b.	A 1m long, 5cm diameter cylinder placed in an atmosphere of 40°c is provided with 12 longitudinal straight fins (K = 75W/mk) 0.75mm thick. The fin protrudes 2.5cm from the cylinder surface. The heat transfer coefficient is 23.3 W/m² K. Calculate the rate of heat transfer if the surface temperature of the cylinder is 150°c.	10	L3	CO2
		OR			
Q.4	a.	Obtain an expression for temperature distribution and total heat transfer for lumped heat analysis treatment of transient heat conduction.	10	L3	CO2
	b.	A 10cm diameter apple, approximately spherical in shape, is taken from a 20°c environment and placed in a refrigerator whose temperature is 5°c and average convective heat transfer coefficient over the surface of apple is 6w/m² °c. Calculate the temperature at the center of the apple after a period of 1 hour. Thermo physical properties of apple are ρ =998 kg/m³, C = 4180J/Kg K, K = 0.6W/m-K.	10	L3	CO2

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		Module – 3			
Q.5	a.	Explain explicit scheme of solution to the one dimensional transient heat conduction problem without heat generation.	10	L2	CO3
	b.	Derive the relation between radiation intensity and emissive power.	10	L3	CO3
		OR			
Q.6	a.	Explain (i) Stefan Boltzmann law (ii) Kirchhoff's law (iii) Plancks law (iv) Wien's displacement law (v) Block body.	10	L2	CO3
	b.	Thin polished copper plate with an emissivity of 0.04 is inserted as radiation shield between two dull steel plates with emissivity of 0.8. Determine the percentage decrease in radiant energy transfer due to the presence of shield. Find percentage reduction if the copper plate gets oxidised with an emissivity of 0.6.	10	L3	CO3
		Module – 4			
Q.7	a.	With reference to fluid flow over a flat plate, discuss the concept of velocity boundary layer and thermal boundary layer.	10	L2	CO4
	b.	Air at 0°c and 20m/s flows over a flat plate of length 1.5m that is maintained at 50°c. Calculate the average heat transfer coefficient over the region where flow is laminar. Find the overage heat transfer coefficient and the heat loss for the entire plates per unit width.	10	L3	CO4
		OR			
Q.8	a.	Explain the significance of the following i. Grashof Number ii. Nusselt Number iii. Stanton Number iv. Prandtt Number v. Reynolds Number	10	L2	CO4
	b.	The water is heated in a tank by dipping vertically a plate (30cm × 30cm) size. The temperature of plate surface is maintained at 140°c. Assuming the temperature of surrounding water at 20°c. Find out the heat lost from the plate per hour.	10	L3	CO4
		Module – 5			
Q.9	a.	Explain in detail the regimes of pool boiling.	10	L2	CO5
	b.	One hundred tubes of 12mm in diameter are arranged in a square array and are exposed to steam at atmospheric pressure. Calculate the mass of steam condensed per unit length of the tube if the tube wall temperature is maintained at 98°c. The properties of water at mean temperature density = 960 Kg/m³. Absolute viscosity = 282×10^{-6} Kg/m-s, Thermal conductivity = 0.61W/m–Kg, h_{fg} = 2255 KJ/Kg.	10	L3	CO5
		OR			
Q.10	a.	Derive an expression for LMTD for a counter flow heat exchanger.	10	L3	CO5
	b.	Water (C_p=4200 J/Kg °c) enters a counter flow double pipe heat exchanger at 38°C flowing at 0.076 kg/S. It is heated by oil (C_p=1880 J/Kg°C) flowing at the rate of 0.152 Kg/S from an inlet temperature of 116°C. For an area of 1m² and U = 340 W/m² °C, determine the total heat transfer rate.	10	L3	CO5

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