CBCS SCHEME - Make-Up Exam

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BAU601

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. Data Hand Book is permitted.

			M	L	C
		Module – 1			
Q.1	**a.**	What are the three fundamental modes of heat transfer? Describe the governing laws associated with each mode in detail.	10	L2	CO1
	b.	Air at 23°C blows over a hot plate made of carbon steel maintained at 260°C. The plate is 60 cm × 75 cm and 2 cm thick. If 300 W is lost from the plate surface by radiation, calculate the heat transfer and inside plate temperature. Assume convection heat transfer coefficient is 25 W/m^2°C and K for carbon steel is 43 W/m°C.	10	L4	CO1
		OR			
Q.2	**a.**	Derive 3D heat conduction equation Cartesian coordinates.	10	L2	CO1
	b.	What is the thickness required of a masonry wall having thermal conductivity of 0.75 W/mK, if the heat transfer rate is to be 80% of the heat transfer rate through a composite structural wall having a thermal conductivity of 0.25 W/mK and a thickness of 100 mm. Both walls are subjected to the same surface temperature.	10	L4	CO1
		Module – 2			
Q.3	**a.**	Derive an expression for the temperature distribution for a Fin when the tip of the fin is insulated.	10	L3	CO2
	b.	Explain the following : i) Efficiency of the fin ii) Effectiveness of the fin.	5	L2	CO2
	c.	Calculate the heat loss rate from the surface of a rectangular fin of length 2 cm on a plane wall. The thickness of the fin is 2 mm and its breadth is 20 cm. Take θ_0 = 200°C; h = 15 W/m^2K ; K = 45 W/m K and assume heat loss from the fin tip is negligible.	5	L4	CO2
		OR			
Q.4	**a.**	Obtain an expression for instantaneous heat transfer and total heat transfer for lumped heat analysis treatment of heat conduction problems.	10	L3	CO2
	b.	Define : i) Biot number ii) Fourier number Explain their significance.	5	L2	CO2
	c.	Using the lumped system analysis, determine the time required for a solid steel ball of diameter D = 5 cm [ρ = 7833 kg/m3 ; Cp = 0.456 kJ/kg°C, K = 54 W/m°C] to cool from 600°C to 200°C if it is exposed to an air stream at 50°C having a heat transfer coefficient of (h = 100 W/m2°C).	5	L4	CO2

		Module – 3			
Q.5	**a.**	Obtain the fundamental relationship between Nusselt, Prandtle and Grashoff's numbers using Buckingham's π-theorem.	10	L2	CO2
	b.	A horizontal pipe 30 cm in diameter is maintained at 260° in a room where the ambient air is at 20°C. Calculate the free convective heat loss per meter length of pipe. Take Nu = 0.53 (Gr pr)0.25.	10	L4	CO2
		OR			
Q.6	**a.**	What are the significance of following numbers in forced convection : i) Reynold's Number ii) Prandtl Number iii) Nusselt Number iv) Grashoff Number	10	L2	CO3
	b.	Air at 27°C and 1 atm flows over a flat plate at a speed of 2 m/s. If the plate is heated over its entire length to a temperature of 60°C, Calculate the heat transferred in : i) The first 20 cm of the plate ii) 4 hr first 40 cm of the plate.	10	L4	CO3
		Module – 4			
Q.7	**a.**	Derive an expression for the effectiveness of a heat exchanges for counter flow arrangements.	10	L3	CO4
	b.	A heat exchanges has 17.5 m^2 area available for heat transfer. It is used for cooling oil at 200°C by using water available at 20°C. The mass flow and specific heat of oil are 10000 kg/hr and 1.9 kJ/kg k and mass flow and specific heat of water are 3000 kg/hr and 4.187 kJ/kg K. If the overall heat transfer co-efficient is 300 W/m^2 K, estimate the outlet temperature oil and water for parallel flow arrangements using LMTD method.	10	L4	CO4
		OR			
Q.8	**a.**	Discuss briefly on Film wise and Drop wise condensation.	10	L3	CO4
	b.	Saturated steam at 80°C condenses a film on a vertical plate at a temperature of 70°C. Calculate the average heat transfer co-efficient and the rate of condensation. Assume that the latent heat of vaporization at 80°C as 2309 kJ/kg.	10	L4	CO4
		Module – 5			
Q.9	**a.**	State and explain : i) Stefan Boltzmann law ii) Kirchoff's law iii) Plank's law iv) Wein's displacement law.	10	L2	CO3
	b.	Two large plates at T1 = 1000 K and T2 = 800 K have emissivities $\in 1 = 0.6$ and $\in 2 = 0.8$ respectively. A radial shielding having an emissivity 0.1 on one end and 0.05 m the other end is placed between the plates. Calculate the heat transfer rate with and without the radiation shield.	10	L4	CO4
		OR			
Q.10	**a.**	Derive an expression for the radiation heat exchange between two large parallel gray planes.	10	L2	CO4
	b.	The temperature of a black surface 0.2m^2 in area is 540°C. Calculate : i) Total rate of energy emission ii) The intensity of normal radiation iii) The wavelength of maximum monochromatic emissive power.	10	L4	CO4

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