PVP 20

Code: 20ME3501

III B.Tech - I Semester – Regular / Supplementary Examinations
NOVEMBER 2023

HEAT TRANSFER
(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This paper contains questions from 5 units of Syllabus. Each unit carries 14 marks and have an internal choice of Questions.
2. All parts of Question must be answered in one place.

BL – Blooms Level CO – Course Outcome

			BL	CO	Max. Marks
		UNIT-I			
1		Derive the general heat conduction equation in Cartesian coordinate system.	L2	CO1	14 M
		OR			
2	a)	i) How do the thermal conductivity of gases and liquids vary with temperature? ii) Define thermal conductivity and explain its significance in heat transfer.	L2	CO1	6 M
	b)	The inner and outer surfaces of a 0.5-cm-thick 2-m x 2-m window glass in winter are 10°C and 3°C, respectively. If the thermal conductivity of the glass is 0.78 W/m·°C, determine the amount of heat loss, in kJ, through the glass over a period of 5 hours.	L2	CO1	8 M
		UNIT-II			
3	a)	Derive the temperature distribution and heat transfer rate through a long fin with insulated tip.	L3	CO2	7 M

	b)	What are extended surfaces and explain their practical applications?	L2	CO2	7 M
		OR			
4	a)	i) What is the difference between the fin effectiveness and the fin efficiency? ii) Explain how the fins enhance heat transfer from a surface. Also, explain how the addition of fins may actually decrease heat transfer from a surface.	L2	CO2	6 M
	b)	A infinite aluminum cylinder of diameter D= 20 cm is initially at a uniform temperature T_i = 200°C. The cylinder is now placed in water at 15°C where heat transfer takes place by convection, with a heat transfer coefficient of h =120 $W/m^2 \cdot °C$. Determine the temperature at the center of the cylinder and 5 cm from the end surface 5 min after the start of the cooling.	L3	CO2	8 M
		UNIT-III			
5	a)	Draw the boundary layer over the flat plate and explain the salient features.	L2	CO2	7 M
	b)	A 40-cm-diameter, 110-cm-high cylindrical hot water tank is located in the bathroom of a house maintained at 20˚C. The surface temperature of the tank is measured to be 44˚C and its emissivity is 0.4. Taking the surrounding surface temperature to be also 20˚C, determine the rate of heat loss from all surfaces of the tank by natural convection.	L3	CO2	7 M
		OR			

6	a)	Differentiate between mechanisms of heat transfer by free and forced convection. Mention some of the areas where these mechanisms are predominant.	L2	CO2	6 M
	b)	A flat plate 1m wide and 1.5 m long is to be maintained at 90^0C in air when free stream temperature is 10^0C. Determine the velocity at which air must flow over the plate so that the rate of energy dissipation from the plate is 3.75kW.	L3	CO2	8 M
		UNIT-IV			
7	a)	What is the difference between evaporation and boiling? What is the difference between pool boiling and flow boiling?	L2	CO3	7 M
	b)	Explain filmwise and dropwise condensations.	L2	CO3	7 M
		OR			
8	a)	i) Define effectiveness. ii) What advantage does the effectiveness-NTU method have over the LMTD method? iii) Why is a counter-flow exchanger more effective than a parallel-flow exchanger?	L2	CO3	7 M
	b)	A shell-and-tube heat exchanger operates with two shell passes and four tube passes. The shell fluid is ethylene glycol (C_p = 2360 J/kg K) which enters at 140^0C and leaves at 80^0C with a flow rate of 4500 kg/h. Water flows in the tubes, entering at 35^0C and leaving at 85^0C. The overall heat-transfer coefficient for this arrangement is 850 W/$m^2 \cdot ^0$C. Calculate the flow rate of water required and the area of the heat exchanger.	L3	CO3	7 M

UNIT-V					
9	a)	i) Define the properties emissivity and absorptivity, explain when these two properties are equal to each other?. ii) Define the properties reflectivity and transmissivity.	L2	CO4	6 M
	b)	Derive an expression for the shape factor in case of a radiation exchange between two surfaces.	L3	CO4	8 M
OR					
10	a)	What is meant by the radiation shape factor? What are radiation shields and give their applications.	L2	CO4	6 M
	b)	A thin aluminum sheet with an emissivity of 0.15 on both sides is placed between two very large parallel plates which are maintained at uniform temperatures T_1=900 K and T_2=650 K and have emissivities €$_1$= 0.5 and €$_2$= 0.8 respectively. Determine the net rate of radiation heat transfer between the two plates per unit surface area of the plates and compare the result with and without the shield.	L3	CO4	8 M