PVP 23

Code: 23ME3601

III B.Tech - II Semester - Regular Examinations – APRIL 2026

HEAT TRANSFER
(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 10 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each Question carries 10 marks.
4. All parts of Question paper must be answered in one place.

BL – Blooms Level CO – Course Outcome

PART – A

		BL	CO
1.a)	Enumerate some important areas which are covered under the discipline of heat transfer.	L2	CO1
1.b)	What are the applications of fins?	L1	CO1
1.c)	What is the physical significance of the Nusselt number?	L2	CO2
1.d)	Describe the physical mechanism of convection. How is the convection heat transfer coefficient related to this mechanism?	L2	CO2
1.e)	Define the prandtl number.	L1	CO3
1.f)	What is meant by hydrodynamic boundary layer?	L1	CO3
1.g)	What are the factors affecting Nucleate boiling?	L2	CO4
1.h)	Define heat exchanger effectiveness and explain its significance.	L1	CO4
1.i)	List out any two shape factor algebra.	L1	CO5
1.j)	Distinguish between a black body and gray body.	L2	CO5

PART – B

			BL	CO	Max. Marks
UNIT-I					
2		A spherical container of negligible thickness holding a hot fluid at 140^0C and having an outer diameter of 0.4 m is insulated with three layers of each 50 mm thick insulation of k_1 = 0.02 W/m K, k_2 = 0.06 W/m K and k_3 = 0.16 W/m K. (Starting from inside). The outside surface temperature is 30^0C. Determine (i) the heat loss and (ii) interface temperatures of insulating layers.	L3	CO1	10 M
OR					
3	a)	What do you mean by critical radius of insulation and obtain critical radius of insulation for insulated cylinder.	L2	CO1	5 M
	b)	State and explain: (i) efficiency of fins (ii) effectiveness of fins	L2	CO1	5 M
UNIT-II					
4		A wall [α = 0.46 x 10^{-5} m^2/s, k =0.65 W/m ^{0}C, density = 2300 kg/m^3] of 10.0 cm thick is initially at a uniform temperature of 300^0C is suddenly placed in a controlled environment at 30^0C. The convection heat-transfer coefficient is 60 W/m^2 ^{0}C. Calculate the center temperature at 20min. and 60 min. after the exposure to the environment.	L3	CO2	10 M

OR					
5	a)	What is the significance of Biot number and Fourier number?	L2	CO2	5 M
	b)	What is the significance of Reynolds number and how flows are determined by Reynolds number?	L2	CO2	5 M
UNIT-III					
6	a)	What is convective heat transfer? Distinguish between free and forced convection.	L2	CO3	5 M
	b)	Explain thermal boundary layer with neat sketch.	L2	CO3	5 M
OR					
7		A 350 mm long glass plate is hung vertically in the air at 24^0C while its temperature is maintained at 80^0C. Calculate the boundary layer thickness at the trailing edge of the plate. If a similar plate is placed in a wind tunnel and air is blown over it at a velocity of 6m/s. Find the boundary layer thickness at its trailing edge, Also determine the average heat transfer coefficient for natural and forced convection.	L2	CO3	10 M
UNIT-IV					
8		Explain in detail about boiling regimes with a neat sketch?	L2	CO4	10 M
OR					

9		A counter flow heat exchanger is employed to cool 0.55 kg/s (C_p = 2.45 kJ/kg ^{0}C) of oil from 115^{0}C to 40^{0}C by the use of water. The inlet and outlet temperatures of cooling water are 15^{0}C and 75^{0}C respectively. The overall heat transfer coefficient is expected to be 1450 W/m^2 ^{0}C. Using NTU method calculate the following: i) The mass flow rate of water ii) The effectiveness of the heat exchanger iii) The surface area required.	L3	CO4	10 M
		UNIT-V			
10	a)	What is Stefan Boltzmann Law? Explain the concept of total emissive power of a surface.	L2	CO5	5 M
	b)	State and explain Kirchhoff's identity. What are the conditions under which it is applicable?	L2	CO5	5 M
		OR			
11		Two circular discs of diameter 20cm are placed 2m apart. Calculate the radiant heat exchange for these discs if these are maintained at 800^{0}C and 300^{0}C respectively and their corresponding emissivity's are 0.3 and 0.5	L3	CO5	10 M