PVP 20

Code: 20ME3501

III B.Tech - I Semester – Regular Examinations - DECEMBER 2022

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	a)	Derive a general heat conduction equation in rectangular coordinate system.	L2	CO1	7 M
	b)	A plane wall is 150mm thick and its wall area is $4.5m^2$. Its conductivity is 9.35W/m-K and temperatures are steady at 150^0C and 45^0C on both sides. Determine the heat transfer rate in flow direction.	L2	CO1	7 M
		OR			
2	a)	Derive a three-dimensional generalized heat conduction equation in a cylindrical coordinate system.	L2	CO1	7 M
	b)	List out the applications of heat transfer in various fields.	L2	CO1	7 M
		UNIT-II			
3	a)	Derive the expression for heat transfer in case of a rectangular plate fin of uniform cross section with insulated end.	L3	CO2	7 M
	b)	What are heisleir charts? Under what conditions heislier charts are used in heat transfer problems.	L3	CO2	7 M

OR					
4	a)	Two fins are identical except the diameter of one is twice that of the other. Compare their efficiencies and effectiveness.	L3	CO2	7 M
	b)	A 1.0 mm diameter wire is maintained at a temperature of 400^0C and exposed to a convective environment at 40^0C with $h=50W/m^2K$. Calculate thermal conductivity which just causes an insulation thickness of 0.2 mm produce a critical radius. How much of this insulation must be added to reduce the heat transfer by 75%.	L3	CO2	7 M
UNIT-III					
5	a)	Using Buckingham Π-Theorem obtain relation for natural convection in terms of dimensionless numbers.	L3	CO2	7 M
	b)	Water at 38ºC flows over a wide, 6m long, heated plate at 0.06m/s. For a surface temperature of 93ºC, determine: i. The hydrodynamic boundary layer thickness δ at the end of the plate. ii. The total drag on the surface per unit width. iii. The thermal boundary layer thickness δ_t at the end of the plate. iv. The local heat transfer coefficient h_x at the end of the plate and v. The total heat flux from the surface per unit width.	L3	CO2	7 M
OR					
6	a)	Explain the phenomena of natural convection over a vertical hot plate. Sketch the temperature and velocity boundary layer profiles.	L3	CO2	7 M

	b)	Water flows in a duct having a cross section 5 x 10 mm with a mean bulk temperature of 20ºC. If the duct wall temperature is constant at 60ºC and fully developed laminar flow is experienced, calculate the heat transfer per unit length.	L3	CO2	7 M
UNIT-IV					
7	a)	Explain the regimes of pool boiling.	L2	CO3	7 M
	b)	Saturated steam at a temperature of 65^0C condenses on a vertical surface at 55^0C. Determine the thickness of the condensate film at locations 0.2m and 1.0m from the top. Also calculate condensate flow rate at these locations.	L3	CO3	7 M
OR					
8	a)	Derive LMTD of parallel flow and counter flow heat exchangers.	L2	CO3	7 M
	b)	Refrigeration is designed to cool 250 kg/h of hot liquids of heat 3350 J/kgK at 120ºC using a parallel flow arrangement. 1000kg/h of cooling water is available for cooling purpose at a temperature of 10ºC. If the overall heat transfer co-efficient is 1160W/m^2K and the surface area of the heat exchanger is 0.25m^2. Calculate the outlet temperature of the cooled liquid and water and also effectiveness of the heat exchanger.	L3	CO3	7 M
UNIT-V					
9	a)	What is Stefan-Boltzmann Law? Explain the concept of total emissive power of a surface.	L4	CO1	7 M
	b)	Two large parallel planes having emissivity's of 0.25 and 0.5 are maintained	L4	CO4	7 M

		at temperatures of 1000K and 500K, respectively. A radiation shield having an emissivity of 0.1 is placed between the two planes. Calculate i. The heat-transfer rate per unit area if the shield were not present, ii. The heat-transfer rate per unit area with the presence of the shield and iii. The temperature of the shield.			
OR					
10	a)	State Planck's distribution law and describe how monochromatic emissive power varies with wavelength.	L4	CO1	7 M
	b)	A black body of total area $0.045m^2$ is completely enclosed in a sphere bounded by 5cm thick walls. The walls have a surface area $0.5m^2$ and the thermal conductivity is $1.1W/m^oC$ if the inner surface of the enveloping wall is to be maintained at 215^oC and the outer wall surface is at 30^oC calculate the temperature of the black body.	L4	CO4	7 M