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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2024 Supplementary Examinations

Programme: B.E. **Semester: VI**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME6DCFHT **Max Marks: 100**
Course: Fundamentals of Heat Transfer

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Heat Transfer Data Hand Book is permitted.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	State the assumptions and derive general 3-dimensional heat conduction equation in Cartesian co-ordinates.	*CO2*	*PO1*	**10**
	b)	A metallic steam pipe (k=45 W/m^{0}C) 5 cm ID and 6 cm OD is lagged with a 2.75 cm radial thickness of high temperature insulation having thermal conductivity of 1.1 W/m^{0}C. The surface heat transfer coefficient for inside and outside are 4650 W/m^{2}K and 11.5 W/m^{2}K respectively. If steam temperature is at 200^{0}C and the ambient temperature is 25^{0}C. Determine heat loss per meter length of pipe and temperature at the interfaces.	*CO2*	*PO2*	**10**
		OR			
2	a)	Derive an expression for temperature distribution for a infinite long fin of uniform cross section.	*CO2*	*PO1*	**08**
	b)	Write the significance of Biot number and Fourier number in transient heat conduction.	*CO3*	*PO1*	**04**
	c)	A stainless steel rod of outer dia. 1 cm originally at a temperature of 320^{0}C is suddenly immersed in a liquid at 120^{0}C for which the convective heat transfer coefficient is 100W/m^{2}K. Determine the time required for the rod to reach a temperature of 200^{0}C.	*CO3*	*PO1*	**08**
		UNIT - II			
3	a)	Explain the formation of velocity and thermal boundary layers for flow over a flat plate. Draw the profile curves.	*CO4*	*PO1*	**10**
	b)	Atmospheric air at 25^{0}C flows over both the surfaces of a flat plate 1 m long with a velocity of 5 m/s. The plate is maintained at a uniform temperature of 75^{0}C. Determine, i) the velocity boundary layer thickness, the shear stress and heat flux at the trailing edge of the plate, ii) the drag force on the plate and the total heat transfer from the plate to air.	*CO4*	*PO4*	**10**

			OR			
	4	a)	Explain the physical significance of Reynolds number, Grashoff number, Prandtl number, Nusselt number and Peclet number.	*CO4*	*PO1*	**10**
		b)	Lubricating oil at a temperature of 60^0C enters a 1cm diameter tube with a velocity of 2.5 m/s. The tube surface is maintained at 30^0C. Calculate the length of tube required to cool the oil to 45^0C. Assume the oil has the following average properties, ρ=865 kg/m^3, μ=7.75x10^{-3} kg/ms, C=1.6 kJ/kgK, k=0.12 W/mK. Use Nu=0.023Re$^{0.8}$Pr$^{0.4}$.	*CO4*	*PO2*	**10**
			UNIT - III			
	5	a)	With the application of dimensional analysis for a free convection obtain the correlation, Nu=C Gr^a Pr^b	*CO4*	*PO1*	**12**
		b)	A hot plate 1 m x 0.5 m at 130^0C is kept vertically in still air at 20^0C. Find, i) heat transfer coefficient and ii) heat lost to surroundings.	*CO4*	*PO2*	**08**
			UNIT - IV			
	6	a)	State and explain, Planck's law, Wien's displacement law, and Kirchoff's law.	*CO6*	*PO1*	**09**
		b)	Explain the concept of black body.	*CO6*	*PO1*	**04**
		c)	The temperature of black surface of 0.2 m^2 area is 540^0C. Calculate, i) Total rate of energy emission, ii) Intensity of normal radiation, and iii) Wavelength of maximum monochromatic emission power.	*CO6*	*PO1*	**07**
			UNIT - V			
	7	a)	Derive the expression for LMTD for a counter flow heat exchanger. List out the assumptions made.	*CO5*	*PO1*	**10**
		b)	Oil at 100^0C (Cp=3.6kJ/kgK) flows at a rate of 30000 kg/hr and enters a parallel flow heat exchanger. Cooling water (Cp= 4.2 kJ/kgK) enters a heat exchanger at 10^0C at rate of 50000 kg/hr, the area of HE is 10 m^2, U=1000 W/m^{2}K. Calculate the outlet temperature of oil and water.	*CO5*	*PO2*	**10**

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