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GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– V (New) EXAMINATION – WINTER 2019

Subject Code: 2151909 **Date: 25/11/2019**

Subject Name: Heat Transfer

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary. Use of steam table, heat transfer tables and charts are permitted.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Distinguish between natural and forced convection heat transfer	**03**
	(b)	A double pipe counter flow heat exchanger, 10000 kg/h of an oil having a specific heat of 2095 J/Kg K is cooled from 80 ℃ to 50 ℃ by 8000 kg/h of water entering at 25 ℃. Determine the heat exchanger area for an overall heat transfer co efficient of 300 $W/m^2.K$. Take Cp of water as 4180 J/Kg K.	**04**
	(c)	Assuming that a man can be represent by a cylinder of 30 cm in diameter and 1.7 m high with a surface temperature of 30 ℃, calculate the heat he would be loss while standing in a 36 km/h wind at 10 ℃. Use $Nu_D = 0.027 (Re_D)^{0.805}(Pr^{1/3})$ And physical properties of air at 20 ℃ are k=0.00259 W/mk Pr=0.707, $\upsilon = 0.000015\ m^2/s$	**07**
Q.2	**(a)**	Define following: 1) Nusselt number 2) Reynolds number	**03**
	(b)	Determine the heat loss from an insulated steel pipe, carrying hot liquid, to the surrounding per meter length of the pipe, given the following particular. I.D. of the pipe=10 cm Wall thickness = 1 cm Thickness of the insulation = 3 cm Temperature of hot liquid = 85 ℃ Temperature of surroundings = 25 ℃ Thermal conductivity of steel = 58 W/Mk Thermal conductivity for insulating material = 0.2 W/Mk Inside heat transfer coefficient = 720 W/m^2 K Outside heat transfer coefficient = 9 W/m^2 K	**04**
	(c)	Derive equations of temperature distribution and heat dissipation for Fin insulated at tip.	**07**
		OR	
	(c)	Derive general heat conduction equation in Cartesian coordinates	**07**
Q.3	**(a)**	What is difference between conduction, convection and radiation mode of heat transfer	**03**
	(b)	Calculate the rate of heat loss for a red brick wall of length 5 m, height 4 m and thickness 0.25 m. the temperature of the inner surface is 110 ℃ and that of outer surface is 40 ℃. The thermal conductivity of red brick, k=0.7 W/Mk. Calculate also the temperature at an interior point of the wall, 20 cm distance from the inner wall.	**04**
	(c)	Using dimensional analysis, obtain a general form of equation for forced Convective heat transfer.	**07**

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OR

Q.3	**(a)**	Explain in brief about thermal conductivity.	**03**
	(b)	Define Prandtl number. What is the physical interpretation when its value is lesser or greater than one? Show with neat sketches.	**04**
	(c)	Define Grashof number. Explain concept of thermal boundary layer.	**07**
Q.4	**(a)**	Define absorptivity, emissivity and monochromatic emissive power.	**03**
	(b)	"It is true that insulation is provided to reduce heat transfer rate but due to insulation heat transfer rate is not reduced always" Justify the statement analytically.	**04**
	(c)	Define total emissive power (E_b) and intensity of radiation (I_b). Show that $E_b = \pi \times I_b$	**07**

OR

Q.4	**(a)**	Explain shape factor for radiation.	**03**
	(b)	State and prove Kirchoff's law for radiation.	**04**
	(c)	A pipe carrying steam having an outside diameter of 20 cm runs in a large room and is exposed to air at a temperature of 30 ℃. The pipe surface temperature is 400 ℃. Calculate the loss of heat to the surrounding per meter length of pipe due to thermal radiation. The emissivity of pipe surface is 0.8. What would be the loss of heat due to radiation if the pipe is enclosed in a 40 cm diameter brick conduit of emissivity 0.91.	**07**
Q.5	**(a)**	Justify that good absorber is also good emitter for radiation heat transfer.	**03**
	(b)	Explain drop wise and film wise condensation	**04**
	(c)	Derive an expression for log mean temperature difference of parallel flow heat exchanger.	**07**

OR

Q.5	**(a)**	Why is counter-flow Heat Exchanger more effective than a parallel flow heat exchanger.	**03**
	(b)	Discuss the various regimes of boiling.	**04**
	(c)	Derive equation of effectiveness for parallel flow heat exchanger	**07**

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