Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2024

Subject Code:3170102 Date:01-06-2024

Subject Name:Theory of Heat Transfer

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	How does heat transfer differ from thermodynamics?	**03**
	(b)	What is thermal conductivity? Explain its importance in heat conduction problems.	**04**
	(c)	Derive general heat conduction equation in Cartesian coordinate.	**07**
Q.2	**(a)**	What is meant by transient heat conduction?	**03**
	(b)	Define fin effectiveness. When the use of fins is not justified.	**04**
	(c)	A steam pipe is covered with two layers of insulation, first layer being 3 cm thick and second 5 cm. the pipe is made from steel (k = 58 W/m-K) having ID of 160 mm and OD of 170 mm. The inside and outside film coefficients are 30 and 5.8 W/m^2-K, resp. Draw electrical analogy for system and calculate the heat lost per meter of pipe, if the steam temperature is 300˚C and air temperature is 50 ˚C. The thermal conductivity of two materials is 0.17 and 0.093 W/m-K, resp.	**07**
		OR	
	(c)	Define critical thickness. Derive an expression of critical radius of insulation for the cylinders.	**07**
Q.3	**(a)**	Define Nusselt Number. Explain its significance in convection heat transfer.	**03**
	(b)	A radiator in a domestic heating system operates at a surface temperature of 69^0C. Calculate the heat flux at the surface of the radiator if it behaves as a black body.	**04**
	(c)	Explain the Reynolds-Colburn analogy for laminar flow over a flat plate.	**07**
		OR	
Q.3	**(a)**	What do you mean by hydrodynamically developed flow?	**03**
	(b)	Differentiate between velocity and thermal boundary layer.	**04**
	(c)	Using dimensional analysis, obtain a general form of equation for free Convective heat transfer.	**07**
Q.4	**(a)**	What are Fourier and Biot numbers? Write their significance.	**03**
	(b)	Define heat exchanger and classify in detail.	**04**
	(c)	In a food processing plant, a brine solution is heated from -12^0C to -65^0C in a double pipe parallel flow heat exchanger by water entering at 35^0C and leaving at 20.5^0C at the rate of 9 kg/min. Determine the heat exchanger area for an overall heat transfer coefficient of 860 W/m^2 K. For water CP= 4.186×10^3 J/kgK.	**07**
		OR	

Q.4	**(a)**	Explain the following terms with reference to heat exchanger : (i) NTU(ii) Effectiveness.	**03**
	(b)	Explain correction factor for multi-pass arrangement heat exchanger? Also define fouling factor?	**04**
	(c)	In a shell and tube heat exchanger, 6 kg/s of oil flow through the shell side. The oil enters at 105 °C and leaves at 40 °C. Water flows in the tubes, entering at 32 °C and leaving at 50 °C. In addition, Cp_{oil} = 2282 J/kg.K and U = 416 W/m^2-K. Determine number of tubes, if outer diameter of tubes is 100 mm, length of each tube is 1.9 m and take correction factor as 0.85.	**07**
Q.5	**(a)**	State & explain Kirchoff's identity.	**03**
	(b)	Define : (i) Absorptivity , (ii) Gray Body, (iii) Total Emissive Power and (iv) Black body	**04**
	(c)	Define total emissive power (Eb) and intensity of radiation (Ib). Show that, Eb = $\pi \times$Ib.	**07**
		OR	
Q.5	**(a)**	Differentiate between dropwise and filmwise condensation.	**03**
	(b)	Enumerate the factors on which the rate of emission of radiation by a body depends.	**04**
	(c)	Write a note on Nucleate boiling?	**07**

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