Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2022

Subject Code:3170102 Date:10/06/2022

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)**	Distinguish between the conduction, convection and radiation modes of heat transfer with suitable example.	**03**
	(b)	Write a note on Nucleate boiling?	**04**
	(c)	A cylinder cement tube radii 0.05 cm and 1 cm has a wire embedded into it along its axis. To maintain a steady temperature difference of 120^0C between the inner and outer surfaces, a current of 5 ampere is made to flow in the wire. Make calculations for the amount of heat transfer per meter length and the thermal conductivity of cement. Take resistance of wire equal to 0.1 ohm per cm of length.	**07**
Q.2	**(a)**	Explain the following terms: (a) Thermal diffusivity (b) Thermal Conductivity (c) Thermal contact resistance	**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)	Define critical thickness? Explain critical radius for cylinder? Derive an expression of critical radius of insulation for the cylinders.	**07**
		OR	
	(c)	Derive general heat conduction equation in Cartesian coordinates.	**07**
Q.3	**(a)**	Define Nusselt Number. Explain its significance in convection heat transfer.	**03**
	(b)	Define fin effectiveness. When the use of fins is not justified.	**04**
	(c)	Explain the Reynolds-Colburn analogy for laminar flow over a flat plate.	**07**
		OR	
Q.3	**(a)**	What are Fourier and Biot numbers? Write their significance.	**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)**	Define heat exchanger and classify in detail.	**03**
	(b)	Differentiate between dropwise and filmwise condensation.	**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 $C_P = 4.186 \times 10^3$ 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)	Cold liquid (sp.heat 2.95 kJ/kgK) at 10 kg/min is to be heated from 25^0C to 55^0C in a heat exchanger. The task is accomplished by extracting heat from hot water (sp.heat 4.186 kJ/kgK) available at mass flow rate 5 kg/min and inlet temperature 85^0C.Should the thermal engineer make design calculation based on parallel flow or counter flow configuration? State the reason.	**07**
Q.5	**(a)**	Explain the following: (i) Grey Body,(ii) Spectral Intensity of Radiation & (iii) Black body.	**03**
	(b)	State & explain Kirchhoff's identity.	**04**
	(c)	Derive an expression for rate of radiation exchange, when a radiation shield is inserted between two large parallel plates.	**07**
		OR	
Q.5	**(a)**	State and Prove Kirchoff's law of radiation?	**03**
	(b)	Enumerate the factors on which the rate of emission of radiation by a body depends.	**04**
	(c)	Define total emissive power (**Eb**) and intensity of radiation (**Ib**). Show that, $\mathbf{Eb = \pi \times Ib}$.	**07**

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