Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV • EXAMINATION – WINTER • 2014

Subject Code: 140503 **Date: 31-12-2014**

Subject Name: Process Heat Transfer

Time: 02:30 pm - 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.**

Q.1 (a) Derive an expression for the critical thickness of insulation for cylindrical pipe. **07**

(b) Prove that for a body whose thermal resistance is zero, the temperature at any time during Newtonian heating and cooling is obtained by the relation, **07**

$$t-ta / ti-ta = \exp[-hA/\rho vc * \tau]$$

Q.2 (a) Differentiate between free and forced convection. Mention the factors on which the heat transfer coefficient depends. **07**

(b) The walls of a house consist of three layers- an outer brickwork of 15 cm thickness and an inner wooden panel of 1.2 cm thickness. The intermediate layer is made of an insulating material of 7 cm thick. The thermal conductivities of brick and wood used are 0.70 W/m ^{0} C and 0.18 W/m ^{0} C, respectively. The inside and outside temperatures of the composite wall are -21 ^{0} C and -15^0 C respectively. If the layer of insulation offers twice the thermal resistance of brick wall, calculate (a) the rate of heat loss per unit area of the wall and (b) the thermal conductivity of insulating material **07**

OR

(b) A copper wire 0.8 mm diameter, at 150^0 C is suddenly dipped into water at 35^0 C .Assume unit surface film coefficient of heat transfer, is 85.5 W/m^{20} C and estimate the time required to cool the wire upto 90^0 C. for copper k = 373 W/m K ; c = 0.38 kJ/kg K, ρ = 9000 kg/m^3 **07**

Q.3 (a) Define fin effectiveness and derive equation for the temperature distribution along the length of the fin. **07**

(b) Discuss in detail about the three modes of heat transfer with general heat transfer law. **07**

OR

Q.3 (a) Discuss in detail various regimes in boiling and define boiling crisis. **07**

(b) State and prove Kirchoff's law of radiation. What restrictive conditions are inherent in the derivation of Kirchoff's law? **07**

Q.4 (a) Derive an expression for the overall heat transfer coefficient of a shell and tube heat exchanger. **07**

(b) What is mean by fouling factor? How does it affect the performance of a heat exchanger? **07**

OR

Q.4 (a) Discuss Reynolds analogy between heat and momentum transfer. **07**

(b) Define steam economy and discuss vapor recompression methods to enhance the steam economy of an evaporator. **07**

Q.5	**(a)**	Write short note on boiling point elevation in evaporators.	**07**
	(b)	Define following terms : Reflectivity, Absorptivity, Transmittivity, Grey body, Monochromatic emissive power, Black body and specular body	**07**

OR

Q.5	**(a)**	In a food processing plant, a brine solution is heated from -12 ^{0}C to -6.5^{0}C in a double pipe parallel flow heat exchanger by water entering at 35 ^{0}C and leaving at20 ^{0}C 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 KJ/kg K	**07**
	(b)	Distinguish between mechanism of dropwise and filmwise condensation. In a design of condensers, which type of condensation is selected and why?	**07**

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