Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) • EXAMINATION – WINTER 2016

Subject Code: 2170102 Date:21/11/2016

Subject Name: Theory of Heat Transfer

Time:10.30 AM to 1.00 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 general heat conduction equation in cylindrical coordinates.	**07**
	(b)	A 2 kW resistance heater wire whose thermal conductivity is k = 15 W/m °C has a diameter of D = 4mm and a length of L = 0.5m and is used to boil water. If the outer surface temperature of the resistance wire is T_s = 105°C, determine the temperature at the centre of the wire.	**07**
Q.2	**(a)**	Derive equation of temperature distribution and heat dissipation for fin non-insulated at tip.	**07**
	(b)	Under what circumstances from the heat transfer point of view, will the use of finned walls be better?	**07**
		OR	
	(b)	What is the critical thickness of insulation on a small diameter wire and a steam pipe? Explain its physical significance in both the cases and derive an expression for the same.	**07**
Q.3	**(a)**	Derive an expression for the Logarithmic Mean Temperature Difference for the flow in a counter flow heat exchangers.	**07**
	(b)	A counter flow heat exchanger is employed to cool 0.55 kg/s (C_p = 2.45 kJ/kg °C) of oil from 115 °C to 40 °C by the use of water. The inlet and outlet temperature of cooling water are 15 °C and 75 °C respectively. The overall heat transfer coefficient is expected to be 1450 W/m^2°C. Using Ɛ-NTU method, calculate (i) The mass flow rate of water, (ii) The effectiveness of the heat exchanger, (iii) The surface area required.	**07**
		OR	
Q.3	**(a)**	Define Reynold's number, Nusselt number, Prandtl number and Grashoff number. Explain their importance in heat transfer.	**07**
	(b)	Using dimensional analysis obtain a general form of equation for natural convective heat transfer.	**07**
Q.4	**(a)**	Draw and explain boiling curve for water. Explain nucleate boiling.	**07**
	(b)	Define heat exchanger effectiveness and explain its significance.	**07**
		OR	
Q.4	**(a)**	What are the fouling factors? Explain their effect in heat exchanger design.	**07**
	(b)	Why is counter flow heat exchanger more effective than a parallel flow heat exchanger? And what is LMTD correction factor?	**07**
Q.5	**(a)**	State and explain the Wien displacement law. Show that $E_{b\lambda}$ will be maximum when λ_{max} .T = 2900μk.	**07**
	(b)	What is Absorptivity, reflectivity and Transmissivity? And also explain the concept of Black body.	**07**
		OR	
Q.5	**(a)**	Explain Kirchhoff's law and Lambert's cosine law of radiation.	**07**

(b) The total incident radiant energy upon a body which partially reflects, absorbs, and transmits radiant energy is 2200 W/m^2, of this amount, 450 W/m^2 is reflected and 900 W/m^2 is absorbed by the body. Find the transmissivity τ? **07**

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