Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3171911 Date:12-01-2023

Subject Name:Advanced Heat Transfer

Time:10:30 AM TO 01:00 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)**	Write the general heat conduction equation for Cartesian co-ordinates. From it derive equation for following conditions: i) Steady state with internal heat generation ii) Unsteady state without internal heat generation	**03**
	(b)	List common applications of finned surfaces.	**04**
	(c)	Explain finite difference method for two dimensional steady heat conduction.	**07**
Q.2	**(a)**	What do you mean by thermal contact resistance? List any two factors that affect thermal contact resistance	**03**
	(b)	From the general equation derive the equation of heat dissipation for infinitely long fin.	**04**
	(c)	A stainless steel wire of length 2 m and diameter 2.5 mm is submerged in a fluid at 50 °C and an electric current of intensity 300 amps passes through it. If conductance at wire surface is 4 kW/m^2-deg, workout the steady state temperature i) at the centre and ii) at surface of wire. Take conductivity of wire as 20 W/m-deg and resistivity as 70 x 10^{-6} ohm-cm.	**07**
		OR	
	(c)	Explain the analytical method for two dimensional steady state heat conduction in rectangular plate.	**07**
Q.3	**(a)**	Define: Nusselt Number, Reynolds Number, Prandtl Number	**03**
	(b)	Explain lumped capacity? Also write the assumptions for the same in detail?	**04**
	(c)	The water in a tank at 20 °C is heated by passing the steam through a pipe of 50 cm long and 5 cm in diameter. If the pipe surface temperature is maintained at 80 °C. Find the heat loss from the pipe per hour. Properties of water at 50 °C are $\mu = 0.55 \times 10^{-3}$, $\rho = 988.1 kg/m^3$, $\nu = 0.556 \times 10^{-6}$, $\beta = 5.1 \times 10^{-4}$, K = 0.64 W/ m-K, Cp = 4200 J/kg -K	**07**
		OR	
Q.3	**(a)**	Discuss Heat transfer in high velocity flow.	**03**
	(b)	Write the correlations for free convection for vertical plates.	**04**
	(c)	Discuss the hydrodynamic boundary layer on flat plate.	**07**
Q.4	**(a)**	Define condensation. What is film condensation and drop wise condensation?	**03**
	(b)	What are the effects of non-condensable gases in condensing equipments?	**04**
	(c)	One hundred tubes of 12 mm in diameter are arranged in a square array and are exposed to steam at atmospheric pressure, calculate the mass of	**07**

steam condensed per unit length of tube if the tube wall temperature remains at 98 °C. Take $\mu = 282 \times 10^{-6}$, $\rho = 960$ kg/m^3, K = 0.61 W/ m-K, $h_{fg} = 2255$ kJ/kg and Ts = 100 ° C.

OR

Q.4	**(a)**	List the applications where heat transfer with phase change is to be considered	**03**
	(b)	Derive the equation of critical diameter of bubble.	**04**
	(c)	Discuss different boiling regimes in the boiling process.	**07**
Q.5	**(a)**	Write the statement of Kirchoff's low and define emissivity.	**03**
	(b)	Black body of 0.2 m^2 area has effective temperature of 800 K. Calculate the total rate of energy emission and the intensity of normal radiation.	**04**
	(c)	Derive the equation of heat flow between infinite long parallel plates.	**07**

OR

Q.5	**(a)**	Define intensity of the radiation. How the solid angle is measured?	**03**
	(b)	Write a short note on green house effect.	**04**
	(c)	Discuss the salient features of radiation from gases and vapors.	**07**

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