Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VII (New) EXAMINATION – WINTER 2019

Subject Code: 2171911 **Date: 23/11/2019**

Subject Name: Advance 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.**

Q.1	**(a)**	What are Heisler charts? How these charts are used to obtain temperature distribution?	**03**
	(b)	Define Biot number and Fourier number? State their significances?	**04**
	(c)	Draw the boiling curve and identify the burnout point on the curve. Explain how burnout is caused. Why is the burnout point avoided in the design of boilers?	**07**
Q.2	**(a)**	With suitable examples, explain in brief about periodic variation and non-periodic variation transient heat transfer.	**03**
	(b)	Explain all the different mechanisms of heat transfer from the human body (a) Through the skin, and (b) through the lungs.	**04**
	(c)	What is an irregular boundary? What is a practical way of handling irregular boundary surfaces with the finite difference method?	**07**
		OR	
	(c)	What is lumped system analysis? Derive equation for lumped parameter analysis.	**07**
Q.3	**(a)**	Differentiate clearly between boiling and condensation.	**03**
	(b)	Define the following terms used in the finite difference formulation: Node, Nodal Network, Volume Element, and Nodal Spacing.	**04**
	(c)	Explain radial fins of rectangular and parabolic profiles.	**07**
		OR	
Q.3	**(a)**	Differentiate clearly between dropwise condensation and filmwise condensation.	**03**
	(b)	Explain in brief about free convection and force convection with suitable examples.	**04**
	(c)	Define fin efficiency and fin effectiveness. Why is the insulated-tip solution important for the fin problems?	**07**
Q.4	**(a)**	What do you mean by extended surfaces? Under what circumstances, one should opt for extended surfaces?	**03**
	(b)	Write a short note on Emissivity and absorptivity of gases and gas mixtures.	**04**
	(c)	25mm thick steel plate (K= 48 W/mk) with uniform heat generation of $300*10^5 W/m^3$ having surface temperatures of 453k and 393k respectively. Determine : a) The temperature distribution across the plate, b) The position and value of maximum temperature, c) The flow of heat from each surface of the plate.	**07**
		OR	
Q.4	**(a)**	Explain the function of extended surfaces with classification.	**03**
	(b)	Define mean bulk temperature and mean film temperature with their significances.	**04**

(c) An ordinary egg can be approximated as a 50mm diameter sphere with approximately 75% water. The egg is initially at a uniform temperature of 5°C and is dropped into boiling water at 95°C. Taking the convection heat transfer coefficient to be h=1200W/m^2 ^{0}C, determine how long it will take for the center of the egg to reach 70°C. Take thermal conductivity and diffusivity of eggs at the average temperature of 37.5°C; k =0.627W/m^{0}C , A_1 = 1.9958, α = 0.151×10^{-6} m^2/s and λ_1= 3.0753. **07**

Q.5 **(a)** What is Beer's law? Why do surfaces absorb differently for solar or earth bound radiation? **03**

(b) What do you mean by 'heat generation'? With suitable examples, explain in brief about 'uniform heat generation'. **04**

(c) Explain effect of radiation on measurement of temperature by a bare thermometer. A bare thermometer measuring the temperature of a gas body reads 600K. The surrounding walls are at 500K. The thermometer bulb is 3mm in diameter and is spherical, its surface emissivity being 0.7. The convective heat transfer coefficient over the surface is 40W/m^{2}K. Determine the gas temperature and error involved. **07**

OR

Q.5 **(a)** What is latent heat? How is the latent heat loss from the human body affected by (a) skin wetness and (b) Relative humidity of the environment? **03**

(b) Derive Nusselt theory of laminar condensation on vertical plate. **04**

(c) A thermocouple (ε=0.6) is used to measure the temperature of flue gases in a large duct. The temperature of the duct wall is 20^{0}C and the temperature measured by the thermocouple is 500^{0}C. The convective heat transfer coefficient is 200W/m^{20}C. Determine the true gas temperature and error involved. **07**

A thin radiation shield (ε=0.3) is enveloped to minimize the error. Estimate the error for the above case.

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