Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2018

Subject Code: 2171911 **Date: 15/11/2018**

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)**	Give some examples of conduction with internal heat generation.	**03**
	(b)	Explain the terms: Fin efficiency and Fin effectiveness.	**04**
	(c)	Discuss various regimes of pool boiling with neat sketch.	**07**
Q.2	**(a)**	Define Biot number. State its importance in transient heat conduction analysis.	**03**
	(b)	What is lumped system analysis and when is it applicable?	**04**
	(c)	Show that maximum temperature in a plane wall with heat generation whose one face is insulated and other face kept at T_w is given by $$T_{max} = \left(\frac{q_g}{2k}\right) l^2 + T_w$$	**07**
		OR	
	(c)	Derive an expression for temperature distribution during steady state heat conduction with internal heat generation and exposed to convection environment in hollow cylinder.	**07**
Q.3	**(a)**	Explain heat transfer from the human body.	**03**
	(b)	What is irregular body? How the heat transfer analysis carried out for irregular bodies.	**04**
	(c)	Explain radial fins of rectangular and parabolic profiles.	**07**
		OR	
Q.3	**(a)**	Give difference between free convection and forced convection with suitable examples.	**03**
	(b)	Explain heat transfer in high velocity flow with neat sketch.	**04**
	(c)	A stainless steel wire (k = 19 W/mk) 3 mm in diameter and one metre long has current flowing, I = 200 A Resistivity, ρ = 70 μ ohm/cm The wire is submerged in liquid at 110 ^{0}C and the surface heat transfer coefficient h is 4 kW/m^{2}K. Calculate the central temperature of wire.	**07**
Q.4	**(a)**	The filament of a 60 W light bulb may be considered as black body radiating into a black enclosure at 60 ^{0}C. The filament diameter is 0.1 mm and length 50 mm. Considering radiation determine the filament temperature.	**03**
	(b)	Explain difference between filmwise and dropwise condenastaion.	**04**

(c) A copper bus bar 25 mm diameter is cooled by air at 30 ^{0}C and flowing past the bus bar with a velocity of 3 m/s. If the surface temperature of bar is not to exceed 80 ^{0}C and the resistivity of copper is 0.0175 x 10^{-6} ohm.m^3/m, calculate the following: **07**

(a) The heat transfer coefficient from the surface of bus bar to air
(b) The permissible current intensity for the bus bar.

Assume $N_u = 0.44\ R_e^{0.5}$ for $10 < R_e < 10^3$

$= 0.22\ R_e^{0.6}$ for $10^3 < R_e < 2 \times 10^5$

Take thermo physical properties of air at 30 ^{0}C are:

$k = 0.02673$ W/mk, $\nu = 16 \times 10^{-6}$ m^2/s

OR

Q.4 **(a)** Differentiate boiling and condensation. **03**

(b) Explain turbulent film condensation. **04**

(c) A 10 cm diameter sphere is maintained at 120 ^{0}C. It is enclosed in a 12 cm diameter concentric spherical surface maintained at 100 ^{0}C. The space between two spheres is filled with air at 200 kPa. **07**
Take properties at film temperature as:

$K_f = 0.0319$ W/mk, $\mu = 2.22 \times 10^{-5}$ kg/ms, Pr = 0.703, $\beta = \frac{1}{T_f + 273}$ k^{-1}

Use relation: $N_u = 0.228\ (G_r\ P_r)^{0.226}$

Calculate the convective heat transfer rate from inner sphere.

Q.5 **(a)** Discuss radiation effects on temperature measurements. **03**

(b) Define shape factor. Discuss salient features of shape factor. **04**

(c) A solid steel ball 5 cm in diameter and initially at 450 ^{0}C is quenched in a controlled environment at 90 ^{0}C with convection coefficient of 115 W/m^{2}K. Determine the time taken by centre to reach a temperature of 150 ^{0}C. Take thermophysical properties as: **07**

C = 420 J/kgK, $\rho = 8000$ kg/m^3, k = 46 W/mK

OR

Q.5 **(a)** Discuss radiation properties of a participating medium. **03**

(b) Explain in brief emmisivity and absorptivity of gases and gas mixtures. **04**

(c) What is Beer's law? Why do surfaces absorb differently for solar or earthbound radiation? **07**

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