Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER–I(New course)• EXAMINATION – WINTER- 2015

Subject Code: 2711101 **Date: 01/01/2016**

Subject Name: Advanced thermodynamics and heat transfer

Time:2:30 pm to 5:00 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 do you understand by the entropy principle? And what are the important characteristics of entropy?	**07**
	(b)	Explain Clausius theorem and Inequality of Clausius in brief.	**07**
Q.2	**(a)**	Explain Gouy–Stodola theorem with its application.	**07**
	(b)	Discuss exergy balance for a closed system.	**07**
		OR	
	(b)	Explain second law efficiency of a process.	**07**
Q.3	**(a)**	The thermal conductivity of a material varies linearly with temperature; derive the one- dimensional, steady state heat conduction equation with internal heat generation by writing the energy balance for a differential volume element in cylindrical coordinate system.	**07**
	(b)	What do you mean by critical radius of insulation? Deduce the expression for it. Explain it concept with help of material and surface resistances.	**07**
		OR	
Q.3	**(a)**	The inside and outside surfaces of a hollow sphere of radii r_1 and r_2 are maintained at constant temperatures T_1 and T_2 respectively. The thermal conductivity of insulating material varies with temperature as $k = k_o\left(1+\alpha T+\beta T^2\right)$, where k_o is constant. Derive an expression for heat flow through the sphere.	**07**
	(b)	What is lumped capacity? What are the assumptions for lumped capacity analysis? What are Fourier and Biot numbers?	**07**
Q.4	**(a)**	Define Following: (i) Critical Reynolds Number (ii) Prandtl Number (iii) Grashof Number (iv) Nusselt Number (v) Stanton Number (vi) Peclet Number (vii) Graetz Number.	**07**
	(b)	Derive the integral momentum equation for the boundary layer over a flat plate.	**07**
		OR	
Q.4	**(a)**	Enumerate the applications of boiling heat transfer. Explain briefly the physical mechanism of boiling.	**07**
	(b)	Introducing Nusselt's simplification, obtain an expression for the heat transfer coefficient in filmwise condensation over a vertical plate.	**07**
Q.5	**(a)**	Describe the phenomenon of radiation from real surfaces.	**07**
	(b)	Define radiation intensity, prove that the intensity of radiation is given by $I_b = E_b/\pi$	**07**
		OR	
Q.5	**(a)**	What are the shape factors and why are they used? Show that the shape factor F_{12} between two parallel circular discs.	**07**
	(b)	Write a short note on the radiation shields? Where is it used?	**07**

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