Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER • 2014

Subject Code: 170102 Date: 03-06-2014

Subject Name: Theory of Heat Transfer

Time: 02:30 pm - 05:00 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)** Explain the Phenomenon of boiling and also mention some applications. **07**

(b) What is meant by thermal resistance? Explain the electrical analogy for solving heat problems. **07**

Q.2 **(a)** With usual notations derive the generalized equation for steady state heat conduction in 3 - dimensional Cartesian coordinates. **07**

(b) How does drop-wise condensation differ from film condensation? Which mode of condensation is characterized by larger heat transfer rates? **07**

OR

(b) Establish the general differential equation in Cartesian co-ordinates for 3-D unsteady heat conduction by considering an infinitesimal volume element. Deduce there from the conduction equations for the following cases; **07**
(i) Steady state 1-D flow with heat generation at uniform rate within material.
(ii) Unsteady 2-D flow without heat generation.

Q.3 **(a)** Distinguish between natural and forced convection heat transfer. **07**

(b) A steel fin (k=55 W/m K) with a cross section of an equilateral triangle, 5mm in side is 80mm long. It is attached to a plane wall maintained at 350^0C. The ambient air temperature is 40^0C & unit surface conductance is $100 W/m^2K$. Calculate the heat dissipation rate by assuming the fin as a rod with the tip of fin is insulated. **07**

OR

Q.3 **(a)** Using dimensional analysis, obtain a general form of equation for Forced Convective heat transfer. **07**

(b) Assuming that a man can be represented by a cylinder 400mm in diameter & 1.72m high with a surface temperature of 37^0C. Calculate the heat he would lose while standing in a 20km/hour wind at 17^0C. **07**
The properties of air at 27^0C are:
K=0.0263W/m-K , Pr=0.707,μ= $184.6*10^{-7}$ Ns/m^2, ρ=1.1614kg/m^3
Take $Nu_{avg}=0.027(Re)^{0.805}(Pr)^{1/3}$

Q.4 **(a)** Explain the physical significance of (a) Reynolds number (b) Prandtl number (c) Nusselt number. **07**

(b) Calculate the following for an industrial furnace in the form of a black body and emitting radiation at 2650^0C: **07**
1) Monochromatic emissive power at 1.2μm length, 2) wavelength at which the emission is maximum, 3) maximum emissive power, 4)total emissive power , & 5) total emissive power of the furnace if it is assumed as a real furnace with emissivity equal to 0.9.

OR

Q.4	**(a)**	Explain the following with reference to a heat exchanger: 1. Fouling factor , 2. Effectiveness of heat exchanger , 3. Correction factor for multipass arrangement.	**07**
	(b)	Derive an expression for the Logarithmic Mean Temperature Difference for the flow in a counter flow heat exchanger.	**07**
Q.5	**(a)**	Discuss the electrical analogy for radiant heat transfer.	**07**
	(b)	State any three laws of radiation.	**07**

OR

Q.5	**(a)**	Discuss the various regimes of boiling and explain the condition for the growth of bubbles. What is the effect of bubble size on boiling?	**07**
	(b)	Distinguish between the conduction, convection and radiation heat transfer.	**07**

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