GUJARAT TECHNOLOGICAL UNIVERSITY BE - SEMESTER-VII • EXAMINATION – SUMMER • 2014

Subject Code: 170102

Subject Name: Theory of Heat Transfer

Time: 02:30 pm - 05:00 pm

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 07 heat problems.
- Q.2 (a) With usual notations derive the generalized equation for steady state heat 07 conduction in 3 dimensional Cartesian coordinates.
 - (b) How does drop-wise condensation differ from film condensation? Which mode 07 of condensation is characterized by larger heat transfer rates?

OR

(b) Establish the general differential equation in Cartesian co-ordinates for 3-D 07 unsteady heat conduction by considering an infinitesimal volume element. Deduce there from the conduction equations for the following cases;
(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°C. The ambient air temperature is 40°C & unit surface conductance is 100W/m²K. Calculate the heat dissipation rate by assuming the fin as a rod with the tip of fin is insulated.

OR

- Q.3 (a)Using dimensional analysis, obtain a general form of equation for Forced07Convective heat transfer.
 - (b) Assuming that a man can be represented by a cylinder 400mm in diameter & 07 1.72m high with a surface temperature of 37^oC. Calculate the heat he would lose while standing in a 20km/hour wind at 17^oC. The properties of air at 27^oC are: K=0.0263W/m-K, Pr=0.707,μ=184.6*10⁻⁷ Ns/m², ρ=1.1614kg/m³ 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) 07 Nusselt number.
 - (b) Calculate the following for an industrial furnace in the form of a black body and emitting radiation at 2650°C:
 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.

Date: 03-06-2014

Total Marks: 70

Q.4	(a)	Explain the following with reference to a heat exchanger:	07
		1. Fouling factor,	
		2. Effectiveness of heat exchanger,	
		3. Correction factor for multipass arrangement.	
	(b)	Derive an expression for the Logarithmic Mean Temperature Difference for the	07
		flow in a counter flow heat exchanger.	
0.5	(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	07
		of bubbles. What is the effect of bubble size on boiling?	
	(b)	Distinguish between the conduction, convection and radiation heat transfer.	07
