Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – WINTER • 2014

Subject Code: 161906 **Date: 08-12-2014**

Subject Name: Heat and Mass 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)** A spherical heater of 20 cm dia and 60^0c temp. is immersed in a tank of water at 20^0c. Determine the value of convective heat transfer coefficient. At mean film temperature of 40^0c the thermo physical properties of water are, density 992.2 kg/m^3 , Pr = 4.34, k = 0.633 w/m-deg β = 0.00041 per degree Kelvin and v = 0.659 * 10^6 m^2/sec. Use the general co relation Nu = 2 + 0.43 $(Gr\ Pr)^{0.25}$ **07**

(b) A steam condenser is transferring 250 KW of thermal energy at a condensing temperature of 65^0c. the cooling water enter the condenser at 20^0c with a flow rate of 7500 kg/hr. calculate the log mean temperature difference. If overall heat transfer co efficient for condenser surface is 1250 w/m^2-deg, what surface area is required to handle this load. **07**

Q.2 **(a)** A furnace emits radiation at 2000 K. treating it as a black body radiation calculate the **07**

(1) Monochromatic radiant flux density at 1μ wave length.

(2) Wave length at which emission is maximum and corresponding radiant flux density.

(3) Total emissive power,

(b) Derive equation of heat transfer by conduction through composite wall. **07**

OR

(b) Derive equation of heat transfer by conduction through a multi layer cylindrical wall. **07**

Q.3 **(a)** Derive equation of NTU for parallel flow heat exchanger. **07**

(b) Define shape factor. Discuss salient features of shape factor. **07**

OR

Q.3 **(a)** State and explain Stefan boltzman law. **07**

(b) Derive equation of LMTD for parallel flow heat exchanger. **07**

Q.4 **(a)** Differentiate between mechanisms of heat transfer by free convection and force convection. Mention some areas where these mechanisms are predominant. **07**

(b) What do you understand by hydrodynamic and thermal boundary layer? Illustrate with reference to flow over a flat heated plate. **07**

OR

Q.4 **(a)** By dimensional analysis show that in free convection the Nusselt number can be expressed as a function of Prandtl number and Grashof number. **07**

(b) Prove that intensity of normal radiation is 1/π times the emissive power. **07**

Q.5	**(a)**	State and explain Fick's law of diffusion.	**07**
	(b)	An electronic semiconductor device generates 0.16 kj/hr of heat. To keep the surface temperature at the upper safe limit of 75^0c. it is desired that the generated heat should be dissipated to the surrounding environment which is at 30^0c. The task is accomplished by attaching aluminum fins, $0.5mm^2$ square and 10 mm to the surface. Calculate the number of fins if thermal conductivity of fin material is 690 kj/m-hr-deg and the heat transfer coefficient is 45 kj/m2-hr-deg. Neglect the heat loss from the tip of the fin.	**07**

OR

Q.5	**(a)**	Derive equation of heat dissipation from a fin insulated at the tip.	**07**
	(b)	A hot fluid is being conveyed through a long pipe of 4 cm outer dia. And covered with 2 cm thick insulation. It is proposed to reduce the conduction heat loss to the surroundings to one-third of the present rate by further covering with some insulation. Calculate the additional thickness of insulation.	**07**

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