

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 60⁰c temp. is immersed in a tank of water at 20⁰c. Determine the value of convective heat transfer coefficient. At mean film temperature of 40⁰c the thermo physical properties of water are, density 992.2 kg/m³ , Pr = 4.34, k = 0.633 w/m-deg $\beta = 0.00041$ per degree Kelvin and $\nu = 0.659 \times 10^{-6}$ m²/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 65⁰c. the cooling water enter the condenser at 20⁰c 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/m²-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 1 μ 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 $1/\pi$ 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°C , it is desired that the generated heat should be dissipated to the surrounding environment which is at 30°C . 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 $45\text{ kJ/m}^2\text{-hr-deg}$. 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**
