Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- VIth SEMESTER–EXAMINATION – MAY- 2012

Subject code: 160202 **Date: 11/05/2012**

Subject Name: Automobile Heat Transfer

Time: 10:30 am – 01:00 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)** With usual notations derive the generalized equation for steady state heat conduction in 3 - dimensional Cartesian coordinates. **07**

(b) Explain the following terms.(i) Efficiency of fin (ii) Effectiveness of fin (iii) Biot number **07**

Q.2 **(a)** Derive an expression for the temperature distribution and heat dissipation from a fin insulated at the tip. **07**

(b) Explain the concept of critical thickness of insulation. How to decide the thickness of insulation for electrical wires and steam pipes. **07**

OR

(b) An electrical cable of 5 mm radius is applied a uniform sheathing of plastic insulation (k = 0.175 W/m-deg). The convective film coefficient on the surface of bare cable as well as insulated cable was estimated as 11.65 W/m^{2}deg and a surface temperature of 55 ^{o}C was noted when the cable was directly exposed to ambient air at 15 ^{o}C. For keeping the wire as cool as possible, find the thickness of insulation. Also determine the surface temperature of insulated cable if the intensity of current carried by the conductor remains unchanged. **07**

Q.3 **(a)** Briefly explain the significance of following dimensionless numbers. Reynolds number, Grashof number and Prandtl number. **07**

(b) A nuclear reactor with its core constructed of parallel vertical plates 2.25m high and 1.5m wide has been designed on free convection heating of liquid bismuth. The maximum and lowest temperature of bismuth is 975 ^{o}C and 325 ^{o}C. estimate the maximum possible heat dissipation from both sides of each plate. The thermo physical properties of bismuth at 650^{o}C are k = 13.02 W/m-deg , $\rho = 10^4$ kg / m^3,c_p = 150.7 J / kg-deg, μ = 3.12 kg/m-hr. Use co relation Nu = 0.13 (Gr Pr)$^{1/3}$ **07**

OR

Q.3 **(a)** Show by dimensional analysis that Nusselt number is a function of Grashof number and Prandtl number for natural convection heat transfer. **07**

(b) Estimate the heat transfer from a 40W incandescent bulb at 125 ^{o}C to 25 ^{o}C in quiescent air. Approximate the bulb as a 50mm diameter sphere. What percentage of power is lost by free convection? The thermo physical properties of air at 75^{o}C are k = 0.03 W/m-deg , $\nu = 20.55 \times 10^{-6}$ m^2/s , Pr = 0.693. Use co relation Nu = 0.60 (Gr Pr)$^{1/4}$ **07**

Q.4 **(a)** State any three laws of radiation. **07**

(b) 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**

OR

Q.4 **(a)** Write a short note on heat pipe stating principle of operation, types and application. **07**

(b) A furnace emits radiation at 2000 K. Treating it as a black body radiation, calculate: **07**

(i) Monochromatic radiant flux density at 1 μ wavelength.

(ii) Wavelength at which the emission is maximum and the corresponding radiant flux density.

(iii) Total emissive power.

Q.5 **(a)** Briefly explain about different types of heat exchangers. Draw a neat sketch of 4,2 counter flow heat exchanger. **07**

(b) Derive the relationship between effectiveness and number of transfer units for a counter flow heat exchanger. **07**

OR

Q.5 **(a)** Explain the following terms: **07**

1) NTU
2) Effectiveness of heat exchanger
3) Overall heat transfer coefficient.

(b) Derive an expression for log mean temperature difference for a parallel flow heat exchanger. **07**

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