Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – SUMMER • 2014

Subject Code: 160202 Date: 21-05-2014

Subject Name: Automobile Heat Transfer

Time: 10:30 am - 01:00 pm Total Marks: 70

Instructions:

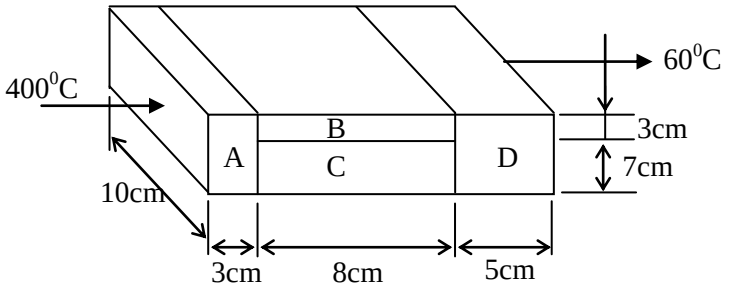
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Show by dimensional analysis for the free convection, Nu = Ǿ(Gr,Pr). **07**

(b) Derive the expression for LMTD for parallel flow heat exchangers. **07**

Q.2 **(a)** Find the heat flow rate through a composite wall as shown in the figure 1. Assume one-dimensional flow. K_A = 150 W/m^{0}C; K_B = 30 W/m^{0}C; K_C = 65W/m ^{0}C; K_D = 50W/m ^{0}C. **07**

Figure 1➥



(b) Derive the most general heat conduction equation in Cartesian coordinate system. **07**

OR

(b) What is lumped system analysis? What are the assumptions made in the lumped system analysis and when is it applicable? Prove that the temperature distribution in a body at time t during a Newtonian heating or cooling is given by , **07**

$$\frac{T-T_\infty}{T_i-T_\infty}=e^{-BiFo} \quad .$$

Q.3 **(a)** What is the function of radiator in an automobile? Explain with a neat sketch construction of a radiator. Which are the main parameters that affect the performance of a radiator? **07**

(b) A steel ball 50mm in diameter and at 900^{o}C is placed in still atmosphere of 30^{0}C. Calculate the initial rate of cooling of the ball in ^{0}C/min. Neglect internal thermal resistance. Take; **07**
ρ=7800 Kg/m^3, C=2kJ/kg^{0}C (for steel) ,h=30W/m^{20}C.

OR

Q.3 **(a)** Discuss the modes of condensation. Why dropwise condensation is preferred? What are the practical difficulties in retaining dropwise condensation on a surface? **07**

(b) The temperatures on the two surfaces, of a 25mm thick steel plate (k=48 W/m^{0}C) having a uniform volumetric heat generation of 30*10^6 W/m^3, are 180^{0}C & 120^{0}C. Neglecting the end effects, determine the value and position of the maximum temperature and temperature distribution across the plate. **07**

Q.4 **(a)** What do you mean by critical thickness of insulation? Explain its physical significance and derive the equation for the same for cylindrical shaped body. **07**

(b) An electricity carrying wire of 0.00325m radius at a temperature of 60^0C is to be insulated by a material having k=0.174W/m^{0}C and convection heat transfer coefficient (h_0) = 8.722W/m$^{2\,0}$C. The ambient temperature is 20^0C. For maximum heat loss, what is the minimum thickness of insulation and heat loss per meter length? Also find percentage increases in heat dissipation too. **07**

OR

Q.4 **(a)** Derive an expression for the temperature distribution and heat dissipation from an infinite long fin. **07**

(b) Assuming that a man can be represented by a cylinder 350mm in diameter and 1.65m high with a surface temperature of 28^0C. Calculate the heat he would lose while standing in a 30km/hour wind at 12^0C. The properties of air at 20^0C are: $\nu=15*10^{-6}$m^2/sec, K=$2.59*10^{-2}$W/m-K , Pr=0.707. Take $Nu_{avg}=0.027(Re)^{0.805}(Pr)^{1/3}$ **07**

Q.5 **(a)** Write short notes on the following: (a) Absoptivity, (b) grey body, (c) Intensity of radiation and, (d) black body. **07**

(b) Explain the circumstances under which natural convection occurs. Differentiate between natural and forced convection. **07**

OR

Q.5 **(a)** What is a radiation shield? When it is used? Also write the expression for radiation heat transfer between two parallel plates with one shield. **07**

(b) Write a short note on heat pipe stating principle of operation, types and applications. **07**

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