

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI • EXAMINATION – SUMMER 2013****Subject Code: 160202****Date: 27-05-2013****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) What is Fourier's law of heat conduction and provide its electrical analogy? Derive the expression for critical thickness of insulation for sphere. **07**

- (b)** The wall of a cold storage consists of three layers: an outer layer of ordinary bricks, 25 cm thick, a middle layer of cork 10 cm thick and inner layer of cement, 6 cm thick. The thermal conductivities of these materials are 0.7, 0.043, and 0.72 W/m. K, respectively. The temperature of the outer surface of the wall is 30 °C and that of inner is -15 °C. Calculate **07**
- i. Steady state rate of heat gain per unit area.
 - ii. Temperature at the interfaces of the wall.
 - iii. What additional thickness of cork should be provided to reduce the heat gain by 30% from the present value?

Q.2 (a) What is an extended surface and its applications. Explain the significance of fin efficiency and effect of Biot number on fin effectiveness. **07**

- (b)** Derive the general equation for steady state temperature distribution for a heat generating plane wall having both sides equal temperature and find maximum temperature. **07**

OR

- (b)** A flat plate is kept in an air stream at temperature 20 °C. The velocity of the air is 3 m/s. The plate measures 50 x 20 cm and is maintained at a uniform temperature of 100 °C. Calculate and compare the heat loss from the plate when the air flows parallel to 50 cm length and parallel to 20 cm width. Also calculate the percentage increase in heat loss. Take $Nu_x = 0.3329(Re_x)^{1/2}(Pr)^{1/3}$ **07**

The thermo physical properties of air at the mean temperature of 60 °C are as follows :

Density, $\rho = 1.06 \text{ kg / m}^3$. Kinematic viscosity, $\nu = 18.97 \times 10^{-6} \text{ m}^2/\text{s}$:
Conductivity, $k = 2.894 \times 10^{-2} \text{ W/m. K}$, Prandtl number = 0.7

Q.3 (a) Using Buckingham's π theorem, show that for forced convection $Nu = f(Re, Pr)$ **07**

- (b)** What is natural convection? Explain briefly hydrodynamics and thermal boundary layer for the fluid flow over a flat plate. What is the effect of Prandtl numbers on these layers? **07**

OR

Q.3 (a) Derive the energy equation for thermal boundary layer in usual notation. **07**

- (b)** What is physical mechanism of condensation? Which type of condensation is preferred? How to increase heat transfer in film condensation? **07**

- Q.4 (a)** Explain briefly any three of the following **07**
 [i] Planck's distribution law
 [ii] Wien's displacement law
 [iii] Surface irradiation
 [iv] Kirchhoff's law of radiation
- (b)** An industrial furnace in the form of a black body emits radiation at 3000K **07**
 temperature. Calculate the followings
 [i] Monochromatic emissive power at 1.0×10^{-6} m wave length.
 [ii] Wave length at which the emission is the maximum.
 [iii] Total emissive power.
 [iv] Maximum spectral emissive power.
 [v] Compare the total emissive power of the furnace, if it is assumed as a real surface having emissivity equal to 0.8.
- OR**
- Q.4 (a)** Calculate the net radiation heat exchange per sq. meter area for two large **07**
 parallel plates at temperatures of 427 °C and 27 °C respectively. The emissivity of hot plate is 0.9 and cold plate is 0.6. If a polished aluminium shield of emissivity 0.04 is placed between them, find the percentage reduction in the heat transfer and also the temperature of the shield.
- Q.4 (b)** Explain heat exchanger effectiveness, fouling and NTU. **07**
- Q.5 (a)** Derive an expression for logarithmic mean temperature difference **07**
 (LMTD) for counter flow heat exchanger.
- (b)** Describe in brief construction and working of radiators used in cooling of I **07**
 C Engines. Which are the main parameters used in their design
- OR**
- Q.5 (a)** What are the functions of cap which is used on a radiator. Explain **07**
 construction and working of a radiator cap.
- (b)** Write short notes on any three of the following **07**
 [i] Nucleate boiling
 [ii] Air cooled heat exchangers
 [iii] Plate fin heat exchangers
 [iv] Engine cooling system
 [v] Heat pipes
