

Roll No. ....

Total Pages : 04

BT-5/D-14

8536

HEAT TRANSFER

ME-305-E

Time : Three Hours] [Maximum Marks : 100

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. Use of tables and charts is allowed.

**Unit I**

- 1. (a) State by giving illustrations that in practice the transfer of heat is the combined effect of conduction, convection and radiation. **10**
- (b) Determine the steady state heat transfer rate through a wall, 5m long × 4m high × 0.25 m thick, with its two faces maintained at uniform temperature of 100°C and 30°C. The wall is made of fire brick having thermal conductivity = 0.7 W/m-deg. **10**

(2-05) L-8536

P.T.O

- 2. The cylindrical head of an engine is 1m long and has an outside diameter of 50 mm. Under typical operating conditions, the outer surface of the head is at a temperature of 150°C and is exposed to ambient air at 40°C with a convective coefficient of 80 kJ/m<sup>2</sup>-hr-deg. The head has been provided with 12 longitudinal straight fins which are 0.75 mm thick and protrude 2.5 cm from the cylindrical surface. Workout the increase in heat dissipation due to addition of fins. Also calculate the temperature at the centre of fin.

It may be presumed that the fins have insulated tips and that the thermal conductivity of the cylinder head and fin material is 260 kJ/m-hr-deg.

**Unit II**

- 3. A hot plate 1m×0.5m at 180°C is hept in still air at 20°C with 0.5 m side vertical. The plate has a mass of 20 kg. and is made of material having, specific heat 400 J/kg-deg. If the convection takes place from both sides of the plate, determine heat transfer coefficient, initial rate of cooling the plate, and time required in cooling the plate from 120° to 80°C. **20**

4. Air at atmospheric pressure and 20°C flows past a flat plate with a velocity of 4 m/s. The plate is 30 cm wide, is heated uniformly throughout its entire length and is maintained at a surface temperature of 60°C. Make calculations for the following parameters at 40 cm distance from the leading edge :

- (a) thickness of hydrodynamic and thermal boundary layer
- (b) local and average friction coefficient
- (c) local and average heat transfer coefficient
- (d) total drag force on the plate.

Take following thermo-physical properties of air at mean film temperature of 40°C :

$$\rho = 1.18 \text{ g/m}^3, \nu = 17 \times 10^{-6} \text{ m}^2/\text{s}, c = 1007 \text{ J/kg-deg. and } k = 0.0272 \text{ W/m-deg.} \quad 20$$

### Unit III

5. (a) State and explain Wein's displacement law. 10
- (b) Explain the terms absorptivity, reflectivity

and transmissivity of radiant energy. How are they related to each other for a black body and an opaque body ? 10

6. Define Lambert's cosine law of radiation and prove that the intensity of radiation is always constant at any angle of emission for a diffused surface. 20

### Unit IV

7. Derive the relationship for between the effectiveness and number of transfer units for a counter flow heat exchanger. 20
8. Explain the following terms : 10×2=20
- (a) Logarithmic mean temperature difference
  - (b) Classification and applications of heat exchangers.