

Total No. of Questions : 12]

SEAT No. :

P1367

[Total No. of Pages : 4

[4858] - 113

**T.E. (Mechanical) (Mechanical S/W) (Automobile)**

**HEAT TRANSFER**

**(2008 Pattern)**

*Time : 3 Hours]*

*[Max. Marks : 100*

*Instructions to the candidates:*

- 1) *Answer three questions from Section - I and three questions from Section - II.*
- 2) *Answers to the two sections should be written in separate answer books.*
- 3) *Draw neat diagrams wherever necessary.*
- 4) *Assume suitable data, wherever necessary.*
- 5) *Figures to the right indicate full marks.*

**SECTION - I**

- Q1)** a) Differentiate between : **[6]**
- i) Steady and Unsteady state heat transfer
  - ii) Conduction and Convection
- b) Derive a general three dimensional heat conduction equation in Cartesian coordinate system. Reduce it as **[10]**
- i) Poisson equation,
  - ii) Fourier equation,
  - iii) Laplace equation.

OR

- Q2)** a) A steel tube of 5 cm inner diameter and 8 cm outer diameter ( $k = 16 \text{ W/mK}$ ), is covered with an insulation of 3 cm thickness ( $k = 0.3 \text{ W/mK}$ ). A hot gas at  $350^\circ\text{C}$  with  $h = 400 \text{ W/m}^2\text{K}$  flows inside the tube. Outer surface of the insulation is exposed to air at  $30^\circ\text{C}$  with  $h = 60 \text{ W/m}^2\text{K}$ . Calculate the heat loss from the tube for 20 meter length. Also calculate the temperature at the interface of insulation and steel. **[8]**

***P.T.O.***



- b) A solid copper sphere of 10 cm diameter ( $\rho = 8954 \text{ kg/m}^3$ ,  $C_p = 383 \text{ J/kgK}$ ,  $k = 386 \text{ W/mK}$ ) is initially at a temperature of  $250 \text{ }^\circ\text{C}$  is suddenly immersed in a well stirred fluid which is maintained at a uniform temperature of  $50 \text{ }^\circ\text{C}$ . The heat transfer coefficient between the sphere and the fluid is  $h = 200 \text{ W/m}^2\text{K}$ . Verify, whether lumped heat capacity method is applicable. If yes, determine the temperature of the copper sphere 5 minutes after the immersion. [8]

### SECTION - II

- Q7)** a) Two large parallel plates with  $\varepsilon = 0.5$  each, are maintained at different temperatures and are exchanging heat only by radiation. Two equally large radiation shields with surface emissivity 0.05 are introduced in parallel to the plates. Find the percentage reduction in net radiative heat transfer. [8]
- b) Explain : [10]
- i) Shape factor
  - ii) Emissivity
  - iii) Wien's Law
  - iv) Radiosity
  - v) Lambert's cosine law

OR

- Q8)** a) A filament of a 75 W light bulb may be considered as a black body radiating into a black enclosure at  $70 \text{ }^\circ\text{C}$ . The filament diameter is 0.1 mm and length is 5 cm. Considering the radiation, determine the filament temperature. [4]
- b) Determine the rate of heat loss by radiation from a steel tube of outside diameter 70 mm and 3 m long at a temperature of  $227 \text{ }^\circ\text{C}$  if the tube is located within a square brick conduit of 0.3 m side and at  $27 \text{ }^\circ\text{C}$ . Take  $\varepsilon_{\text{steel}} = 0.79$  and  $\varepsilon_{\text{brick}} = 0.93$  [8]
- c) Explain the concept of surface resistance and space resistance. [6]
- Q9)** a) Explain the significance of : [8]
- i) Nusselt Number,
  - ii) Prandtl Number,
  - iii) Reynolds Number,
  - iv) Grashoff Number

