013501

December 2023
B.Tech. (ME) - Vth SEMESTER
Heat and Mass Transfer (PCC-ME-501-21)

Time : 3 Hours]   [Max. Marks : 75

Instructions :

1. It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.

2. Answer any four questions from Part-B in detail.

3. Different sub-parts of a question are to be attempted adjacent to each other.

4. Use of heat and mass transfer data book and scientific calculator is allowed.

PART–A

1. (a) What are the main factors influencing the value of the convective heat transfer coefficient? (1.5)

   (b) What is the emissivity function and geometric view factor function? (1.5)

   (c) What is the use of finite difference technique in heat transfer analysis? (1.5)

   (d) In practical problems, the selection of a large number of nodes may be unnecessary. Why? (1.5)

(e) What is fin efficiency? (1.5)

(f) What is the relationship between temperature and thermal conductivity in gases? (1.5)

(g) How is the Nusselt number calculated? (1.5)

(h) Define irradiation and radiosity. (1.5)

(i) Why is a counterflow heat exchanger more effective than a parallel-flow heat exchanger? (1.5)

(j) What is meant by subcooled and saturated boiling? (1.5)

PART-B

2. Derive an expression for the temperature distribution in a hollow cylinder with heat sources that vary according to the linear relation

$$q = a + br.$$

with q_i the generation rate per unit volume at $r = r_i$. The inside and outside temperatures are $T = T_i$ at $r = r_i$ and $T = T_o$ at $r = r_o$. (15)

3. What is meant by a hydrodynamic boundary layer? Define Reynolds number. Why Reynolds number is important to calculate heat transfer by convection? Derive the expression for calculating the boundary-layer thickness. (15)

4. What is the effectiveness-NTU method? Derive expression to calculate heat exchanger effectiveness by using this method. (15)

5. What is the view factor? What is its importance in heat transfer analysis? Consider a diffuse circular disk of diameter D and area A_j and a plane diffuse surface of area $A_i \ll A_j$. The surfaces are parallel, and A_i is located at a distance of L from the centre of A_j. Obtain an expression for the view factor F_{ij}. (15)

6. (a) What is the difference between an ordinary differential equation and a partial differential equation? How partial differential equation problem can be converted into an ordinary differential equation problem? In heat transfer analysis, discuss the uses of these equations. (10)

(b) Explain the construction and working of a heat pipe with suitable diagrams. (5)

7. Write short notes on the following :
(i) Wein's displacement law.
(ii) Pool boiling curve.
(iii) Approximate solution by the use of Heisler charts.
(iv) Thermocouple error in temperature measurement.
(v) Expression for calculating Friction coefficient (C_f) in convection heat transfer. (3×5=15)