Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

B.Tech.(AE) (2011 Onwards) (Sem.–5)

HEAT TRANSFER

Subject Code : BTAE-503

Paper ID : [A2063]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Write briefly :

a) Distinguish between the concept of heat transfer and thermodynamics.

b) Define thermal diffusivity and briefly explain its significance.

c) Define Fourier's law of heat conduction.

d) Mention two cases where heat is generated internally at uniform rate in conducting medium itself.

e) Discuss some important applications of fins.

f) How does a fin enhance heat transfer at a surface?

g) Distinguish between log mean temperature difference and arithmetic mean temperature difference.

h) State Stefan Boltzmann's law.

i) Distinguish between free and forced convection.

j) Explain briefly the importance of concept of heat transfer in design of internal combustion engines.

SECTION-B

2. Justify the validity of the following statements :

a) Thermal conductivity of a pure metal is always higher than that of its alloys.

b) Thermal conductivity of liquids is generally higher than that of gases and vapours.

3. A 30 cm thick wall of reactor is made up of an inner layer of fire brick (k = 0.85 W/mK) covered with a layer of insulation (k = 0.15 W/mK). The reactor operates at a temperature of 1600 K whilst the ambient temperature is 295 K. Calculate the thickness of fire brick and insulation which gives minimum heat loss. Also work out the heat loss presuming that the insulating material has a maximum temperature of 1475 K. If the calculated heat loss is unacceptable, would the addition of another layer of insulation be a satisfactory solution?

4. What do you understand by a black body and a gray body as applied to radiation problems? Explain how radiation steaming out of a small hole in a large hollow body can be considered as black body radiation.

5. Define the Nusselt number. How it is related to temperature gradient in the fluid immediately in contact with the solid surface? Mention the various approaches which have been suggested for estimating the value of Nusselt number.

6. Explain briefly the temperature distribution and thermal stresses in piston and cylinder head.

SECTION-C

7. A horizontal steel shaft, 30 mm diameter and 600 mm long, has its first bearing located 100 mm from the end connected to the impeller of a centrifugal pump. If the impeller is immersed in a hot liquid metal at 500°C, work out the temperature at the bearings under the conditions :

   a) the shaft is very long

   b) the heat flow through the end of the shaft is negligible

   c) the heat is transferred to the surrounding from the end.

   The temperature and convection coefficient associated with the fluid adjoining the shaft are 35° C and 68 kJ/m^2 -deg. For steel shaft, thermal conductivity, k = 72 kJ/m-hr-deg.

8. A tube type heat exchanger is used to cool hot water from 80°C to 60°C. The task is accomplished by transferring heat to cold water that enters the heat exchanger at 20°C and leaves at 40°C. Should this exchanger operate under counter flow or parallel flow conditions? Also determine the exit temperatures if the flow rates of fluids are doubled.

9. Write brief notes on the following :

   a) Newtonian heating and cooling of solids

   b) Newton Rikhman Law

   c) Emissivity and absorptivity

   d) Critical thickness of insulation