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

Total No. of Questions : 09

B.Tech.(ME) (2011 Onwards) (Sem.–6)

HEAT TRANSFER

Subject Code : BTME-602

Paper ID : [A2362]

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

Q1. Write briefly :

a) Define Thermal conductivity. How it is different from apparent thermal conductivity?

b) What is meant by critical thickness of insulation? How it is calculated in case of cylinder?

c) Define Stefan Boltzman's law.

d) Why thin fins are preferred over a thick fin?

e) What is the limitation of LMTD method?

f) Define shape factor of radiation. Calculate all the shape factors of an isosceles vertical triangle.

g) Define Grashoff Number. What are the forces associated with it?

h) Define effectiveness and NTU of a heat exchanger.

i) Define hydrodynamic boundary layer. Which non dimensional number governs the relative magnitude of hydrodynamic and thermal boundary layers?

j) State Buckingham pi theorem. What are repeating variables, how they are selected?

SECTION-B

Q2. Explain different phases of flow boiling.

Q3. Derive three dimensional heat conduction equations in spherical coordinates. Reduce the equation to one dimension, steady state without internal heat generation.

Q4. Derive relation of emissive power for non-black long parallel plates.

Q5. Prove by dimensional analysis for natural convection, $Nu = \Phi (Gr, Pr)$.

Q6. The temperature rise of cold fluid in a heat exchanger is 20°C and temperature drop of hot fluid is 30°C. The effectiveness of heat exchanger is 0.6. The heat exchanger area is $1m^2$ and U = 60 W/m^2 °C. Find the rate of heat transfer.

SECTION-C

Q7. The rate of heat generation in a slab of thickness 160 mm (k = 180 W/m°C) is 1.2×10^6 W/m^3. If the temperature of each of the surface is 120°C, determine :

i) The temperature at the mid and quarter plane.

ii) The heat flow rate and temperature gradients at the mid and quarter planes.

Q8. Air at 20°C and at atmospheric pressure flows at a velocity of 5.5 m/s past a flat plate with a sharp leading edge. The entire plate surface is maintained at a temperature of 70°C. Assuming that the transition occurs at a critical Reynolds No. of 5×10^5, find the distance from the leading edge at which the boundary layer changes from laminar to turbulent. At the location, calculate the following :

a) Thickness of hydrodynamic boundary layer.

b) Thickness of thermal boundary layer.

c) Local & average convective heat transfer coefficients.

d) Heat transfer rate from both sides per unit width of plate.

Q9. Write short notes on :

a) Hydrodynamic and thermal boundary layer.

b) Intensity of radiation and solid angle.

c) Temperature measurement of flow by fins.