SHAHEED BHAGAT SINGH STATE TECHNICAL CAMPUS, FEROZEPUR

ROLL NO :

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Reappear

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B.Tech. – ME 5th Sem (Old Reappear) for 2010 Batch onl

Heat Transfer

Subject Code : ME-303

Paper ID :

Batch:2004 onwards/2011onwards/2015 onwards[Tick Relevant]

Time allowed: 3 Hrs

Max Marks:60

Important Instructions:

- Section A is compulsory
- Attempt any four questions from section B
- Attempt any two questions from section C
- Assume any missing data

1) **Section-A** is **compulsory**
2) Attempt any **four** questions from **Section-B** and any **two** questions from **Section-C**
3) Any missing data may be assumed appropriately

Section – A

[Marks: 02 each]

Q1.

a) How does the heat transfer differ from the thermodynamics?
b) What do you understand by thermal conductance in heat conduction?
c) Write two examples of unidirectional heat conduction with heat generation.
d) Write the condition, when use of fins to increase heat transfer is not beneficial.
e) What does mean by thermal time constant?
f) What is physical significance of Grashof number?
g) Why drop wise condensation is preferred?
h) Define effectiveness of heat exchanger?
i) How do you differentiate between black body and gray body?
j) State Lambert's cosine law.

Section – B

[Marks: 05 each]

Q2. Derive an expression to find critical thickness of insulation of a cylinder.

Q3. One end of a long rod 3 cm in diameter is inserted into a furnace with the outer end projecting into the outside air. Once the steady state is reached the temperature of the rod is measured at two points, 15 cm apart and found to be 140°C and 100°C, when the atmospheric air temperature is 30°C with convection coefficient of 20W/m^2-K. Calculate thermal conductivity of rod material.

Q4. Air at 27°C and 1 atm flows over a heated plate of 1 m width with a velocity of 2 m/s. The plate is at uniform temperature of 60°C. Calculate the heat transfer rate from surface of first 0.2 m of the plate. Use the relation: $Nu = 0.0332\ Re^{1/2}\ Pr^{1/3}$ Properties of air at mean film temperature: $\rho = 1.16$ kg/m^3, $C_p = 1.007$ kJ/kg-K, $k_f = 0.027493$ W/m-K, $\nu = 17.36 \times 10^{-6}$ m^2/s.

Q5. Explain the phenomenon of boiling in detail with plot of boiling regimes in diagram.

Q6. Prove that the intensity of normal radiation is $1/\pi$ times the total emissive power.

Section – C

[Marks: 10 each]

Q7. A furnace has a composite wall constructed of a refractory material for the inside layer and an insulating material on the outside. The total wall thickness is limited to 60 cm. The mean temperature of the gases within the furnace is 850°C, the external air temperature is 30°C and the temperature at the inter face of the 2 materials of the furnace wall is 500°C. The thermal conductivities of the refractory and the insulating materials are 2 and 0.2 W/m-K respectively. The combined coefficient of the heat transfer between the gases and inside the refractory surface is 200 W/m^{2}K and between outside surface and atmosphere is 40 W/m^{2}K. Find:

(a) the required thickness of each material

(b) the temperature of the surface exposed to gases and that of surface exposed to air and

(c) the rate of heat loss to atmosphere in kW/m^2.

Q8. (a) Derive log mean temperature difference for parallel flow heat exchanger.

(b) A polished metal pipe 5 cm outside diameter and 370K temperature at the outer surface is exposed to the ambient conditions at 295K temperature. The emissivity of the surface is 0.2 and convection coefficient of heat transfer is 11.35 W/m^2-K. Calculate the heat transfer by radiation and natural convection per meter length of the pipe. Take thermal radiation constant $\sigma_b = 5.67 \times 10^{-8}$ W/m^2-K^4. Calculate the overall coefficient of heat transfer taking the combined mode of convection and radiation?

Q.9. Write short notes any two:

(a) Hydrodynamic and thermal boundary layer

(b) Radiation shields

(c) Radiation shape/view factor and its special properties