Code No: R1632034 **R16** SET - 1

III B. Tech II Semester Supplementary Examinations, November -2019

HEAT TRANSFER

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**
4. Heat transfer data book allowed

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PART –A (14 Marks)

1. a) Why the metals are good conductors of both heat and electricity, while some non-metallic crystalline solids are very good conductors of heat but very poor conductors of electricity? Explain. [2M]
   b) What is the significance of Biot number? [2M]
   c) Distinguish between natural and forced convective heat transfers. [2M]
   d) What do you understand by hydrodynamic and thermal boundary layers? [3M]
   e) Why the heat transfer coefficients in condensation and boiling very high are compared to those in forced convection without phase change? [3M]
   f) What is meant by view factor and why is it so important in calculation of radiation heat transfer? [2M]

PART –B (56 Marks)

2. a) Explain the effect of variable thermal conductivity and deduce expression for heat transfer in a slab considering $k=k_0(1+\alpha T)$, where k_0 and α are constants. [7M]
   b) Consider a 20 mm thick plate with uniform heat generation of 80 MW/m^3. The left and right faces are kept at constant temperatures of 160^{0}C and 120^{0}C respectively. The plate has a constant thermal conductivity of 200W/m K. Determine: [7M]
      i) the expression for temperature distribution in the plate,
      ii) the location and value of maximum temperature, and
      iii) the rate of heat transfer at the plate centre.

3. a) Two fins are identical except the diameter of one is twice that of the other. Compare their efficiencies and effectiveness. [6M]
   b) Consider two very long, slender rods of the same diameter but of different materials. One end of each rod is attached to a base surface maintained at 100^{0}C, while the surfaces of the rods are exposed to ambient air at 20^{0}C. By traversing the length of each rod with a thermocouple, it was observed that the temperatures of the rods were equal at the positions X_A=0.15 m and X_B=0.075 m, where X is measured from the base surface. If the thermal conductivity of rod A is known to be k_A=72W/mK, determine the value of k_B for the rod B. [8M]

4. a) Explain the concept of momentum and energy equation. [7M]
   b) Discuss the detailed classification of convective heat transfer. [7M]

5. a) Consider two identical flat plates one above another in quiescent air. [6M]
      i) In one situation, the bottom plate is at 100^{0}C and the top one is at 500^{0}C.
      ii) In another situation, the bottom plate is at 500^{0}C and the top one is at 100^{0}C. State in which case the rate of heat transfer is expected be higher and why?
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b) Atmospheric air, T_∞=300 K and with a free stream velocity, U_∞=30 m/s flows over a flat plate parallel to a side of length 2 m and is maintained at a uniform temperature of T_w=400 K. Determine: i) The average heat transfer coefficient over the region where the boundary layer is laminar; ii) The average heat transfer coefficient over the entire length L=2m of the plate. [8M]

6. a) Under what conditions is the effectiveness-NTU method definitely preferred over the LMTD method in the analysis of a heat exchanger? [6M]

b) A counter flow heat exchanger has an overall heat transfer coefficient of 225W/m^2K and a surface area of 33m^2. The hot fluid[c_p=3.56kJ/kg K] enters at 94^{0}C and flows at the rate of 2.52kg/s. The cold fluid[c_p=1.67kJ/kg K] enters at 16^{0}C and flows at the rate of 2.27kg/s. Determine the rate of heat transfer. [8M]

7. a) State Planck's distribution law and describe how monochromatic emissive power varies with wavelength? [6M]

b) Derive the expression for surface resistance and shape resistance using electrical analogy. [8M]

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