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SHAHEED BHAGAT SINGH STATE TECHNICAL CAMPUS, FEROZEPUR

ROLL NO: | | | | | | | | | | | | |

Number of pages (2)

Total number of questions: 09

B.Tech. - ME 5th Semester (Reappear)

Heat Transfer

Subject Code: ME-303

Paper ID:

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, if any additional data is required but justify the same.**

PART A (2×10)

Q. 1: Short answer questions. Write in brief.

(a) In which respect, Fourier's law and Ohm's law are similar?

(b) Explain, why the insulated small diameter wire can have more current carrying capacity than an un-insulated one?

(c) What is meant by semi-infinite medium?

(d) Which type of flow have higher heat transfer coefficient, laminar or turbulent, why?

(e) What is significance of Grashof number?

(f) What is NTU of heat exchanger?

(g) Where does film wise condensation generally occur?

(h) State Kirchhoff's law of radiation heat transfer.

(i) Define radiosity and irradiation.

(j) What do you understand by shape factor for radiation heat transfer between two bodies?

PART B (5×4)

Q.2. Derive heat conduction equation for steady state three dimensional cartesian coordinates with uniform heat conductivity and without heat generation.

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Q.3. One end of the long rod is inserted into a furnace with the other end projecting into the outside air. After steady state is reached, the temperature of the rod is measured at two points 10 cm apart and found to be 125°C and 91°C when the ambient temperature is 28°C. If the rod is 2 cm in diameter and h = 15 W/m^2-K, what is the thermal conductivity of the rod?

Q.4. Explain the concept of thermal boundary layer with hydrodynamic boundary layer.

Q.5. Derive Wien's Displacement law: $\lambda_m T = 2.9$ mm-K.

Q.6. Estimate the heat transfer from a 40 W incandescent bulb at 125°C to 25 °C in quiescent air. Approximate the bulb as a 50 mm diameter sphere. What percentage of the power is lost by free convection?

The approximate correlation for the convection coefficient is

$Nu = 0.60\ (Gr \times Pr)^{0.25}$

Where the different parameters are calculated at the mean film temperature and the characteristic length is the diameter of the sphere. Thermo-physical properties of the air at 75°C are: Pr = 0.693, k = 0.03 W/mK and $\nu = 20.55 \times 10^{-6}$ m^2/s.

PART C (10×2)

Q.7. A wire of radius 3 mm and 1.25 m length is to be maintained at 60°C by insulating it by a material of thermal conductivity 0.175 W/m-°C. The temperature of the surrounding air is 20 °C with heat transfer coefficient 8.5 W/m^2-°C. For maximum heat dissipation, determine:

(a) Minimum thickness of insulation and the heat loss.

(b) Percentage increase in heat loss due to insulation.

Q.8. Exhaust gases (C_p=1.12 kJ/kg-°C) flowing through a tubular heat exchanger at the rate of 1200 kg/hr are cooled from 400°C to 120°C. The cooling is affected by water (C_p = 4.18 kJ/kg-°C) that enters the system at 10°C at the rate of 1500 kg/hr. If the overall heat transfer coefficient is 500 kJ/m^2-hr-°C, what heat exchanger area is required to handle the load for (a) parallel flow and (b) counter flow arrangement?

Q.9.

(a) For thermal radiation heat transfer between surfaces, explain salient features/properties of the shape factor.

(b) How filmwise condensation does differ from dropwise condensation? Write the favourable conditions to achieve the same.