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B.Tech. (Sem. - 5th)

HEAT TRANSFER

SUBJECT CODE : ME - 303

Paper ID : [A0815]

[Note : Please fill subject code and paper ID on OMR]

: 03 Hours Maximum Marks : 60

uction to Candidates:

1) Section - A is **Compulsory**.
2) Attempt any **Four** questions from Section - B.
3) Attempt any **Two** questions from Section - C.

Section - A

(10 × 2 = 20)

a) Define the phenomenon of thermal conduction. Define thermal conductivity. Also give its SI unit.

b) What are the reasons for different thermal conductivity of metals and non-metals?

c) What is conduction shape factor? What is the significance of studying that?

d) Explain the phenomenon of natural convection.

e) Give expression for :
   (i) Stanton number.
   (ii) Grashoff number.

f) Write the significance of defining :
   (i) Reynolds number.
   (ii) Prandtl number.

g) Distinguish between film type and drop-wise condensation.

h) What is Kirchoff's law of thermal radiation?

i) Define gray body? How the concepts of defining gray body help the analysis of radiation problems?

j) What is Plank's law of thermal radiation?

Section - B

(4 × 5 =

Q2) By using dimensional analysis develop a generic empirical relation betwe Nusselt number, Reynolds number and Prandtl number for forced convecti heat transfer.

Q3) Derive an expression for one dimensional heat transfer and temperature profi for straight rectangular circumferential fins.

Q4) Develop an expression for log - mean - temperature difference (LMTD) f counter flow heat exchanger.

Q5) Two slabs each 120 mm thick have thermal conductivities of 14.5 W/m and 210 W/mK. These are placed in contact but due to roughness only 30 of the area is in contact and the gap in the remaining area is 0.025 mm thic and is filled with air. If the temperature of the face of the hot surface is 220°C and the outside surface of the other slab is at 30°C. Determine

(a) Heat flow through composite system

(b) The contact resistance and temperature drop in contact. Assume that th conductivity of air is 0.032 W/mK and that half of the contact (of the contact area) is due to either metal.

Q6) Determine the heat transfer surface area required for a heat exchange constructed from O.D. tube to cool 55,000 litres/hr of a 95% methyl alcoho with from 150°C to 103°C using 50,000 lts/hr of H_2O available at 50°C Assume U as 100 W/m2K. Consider each of the following arrangements.

(a) Parallel flow shell and tube.

(b) Countercurrent flow shell and tube.

Section - C

(2 × 10 = 20)

Q7) A hollow cylinder 6 cm ID, 9 cm OD, has heat generation rate of 5 × 106 W/m³. Inner surface is maintained at 450°C and outer surface at 350°C. Thermal conductivity of the material is 3 W/mK. Determine :

(a) The location of value of maximum temperature.

(b) Temperature at the mid - thickness of the shell.

(c) The fraction of heat generated going to the inner surface.

(d) The temperature profiles.

Q8) A steam condenser, condensing at 70°C has to have a capacity of 100 kW. Water at 20°C is used and the outlet water temperature is limited to 45°C. F the overall heat transfer coefficient is 3100 W/m^2K, determine the area required. If the water inlet temperature is increased to 30°C, determine the increased flow rate to maintain the same outlet temperature.

Q9) Two parallel plates, 0.5 m × 1 m each, are spaced 0.5 m apart. Plates are at temperature of 1000°C and 500°C are their emissivities are 0.2 and 0.5 respectively. The plates are located in a large room, the walls of which are maintained at 27°C. The surfaces of the plate facing each other only exchange heat by radiation. Determine the rated of heat lost by each plate and the heat gained by the walls by radiation. Use the radiation network solution. Assume the shape factor between the parallel plates as $F_{12} = F_{21} = 0.285$.

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