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Total No. of Questions : 09] [Total No. of Pages : 02

Paper ID [A0815]

(Please fill this Paper ID in OMR Sheet)

B.Tech. (Sem. - 5th)

HEAT TRANSFER (ME - 303)

Time : 03 Hours **Maximum Marks : 60**

Instruction 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

Q1) *(10 × 2 = 20)*

a) What are three modes of heat transfer, explain with suitable examples.

b) Define Fourier's law of heat conduction & equation governing this law.

c) Discuss log mean Area of cylinder used in heat transfer.

d) Discuss the Efficiency of Fin. Why it is used in IC engines.

e) What factors effects the thermal conductivity of insulating materials. How?

f) Define critical thickness of Insulation?

g) Differentiate between free and forced convection. What type of convection is used in radiators.

h) Discuss over all coefficient of Heat Transfer.

i) Define (a) Emissivity, (b) Absorptivity.

j) Discuss Stefan Boltzman's Law.

Section - B

(4 × 5 = 20)

Q2) Steam at 0.065 bar condenses on a vertical plate 0.6 m square. If the surface temp. of the plate is maintained at 15°C. Estimate the rate of condensation.

$T_s = 37.7°C$ hfg (at 0.065 bar) = 2412×10^3 J/kg.

Properties of water at mean temp. are:

$\rho = 1000$ kg/m^3, $\mu = 864 \times 10^{-6}$ kg/ms $K = 0.913$ W/m°K.

Q3) Define the terms:

(a) Black body (b) Emissive power (c) Grey body

Q4) A electric cable of 10 mm diameter carrying certain power is insulated for keeping the cable as cool as possible. The surface temp. of 60°C was noted when the cable was directly exposed to atmosphere. Assume conductivity of insulating material is 0.15 kcal/m–hr°C and heat transfer coefficient on the surface of bare wire as well as on insulated wire is 10 kcal/m^2–hr°C. Find the surface temp. of the wire when it is insulated. Take surrounding air temp. 20°C.

Q5) Drive an Expression for heat transfer through Fin of rectangular section if fin is infinite long.

Q6) Drive an expression for steady state unidirectional heat flow through hollow sphere with uniform conductivity without heat generation.

Section - C

(2 × 10 = 20)

Q7) A chemical reaction takes place in a packed bed between two co-axial cylinders with radii 01 cm and 3 cm. The inner is at 300°C and is insulated. Assuming reaction rate of 6 x 10^5 W/m^3 in the reactor volume, find the temperature at the outer surface of reactor.

K (Packed material) = 0.5 W/m-K.

Q8) A counter flow heat exchanger cools 1400 kg/hr of oil having heat capacity of 3kJ/kg °K from 100°C to 30°C by water initially at 20°C. The quantity of water feel is 1300 kg/hr. Calculate water outlet temp. and heat transfer area for overall heat transfer coefficient of 4000 kJ/hr-m^2°K. Also drive a relationship between oil and water temp. at any section of heat exchanger.

Q9) Discuss the followings:

(a) log mean temp. difference.

(b) Reynold's number.

(c) Critical radius of insulation.

(d) Lambert's Cosine law

(e) Irradiation and radiosity.