

Roll No.

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.

$$T_s = 37.7^\circ\text{C} \quad \text{hfg (at 0.065 bar)} = 2412 \times 10^3 \text{J/kg.}$$

Properties of water at mean temp. are:

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

- 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 $0.15 \text{ kcal/m-hr}^{\circ}\text{C}$ and heat transfer coefficient on the surface of bare wire as well as on insulated wire is $10 \text{ kcal/m}^2\text{-hr}^{\circ}\text{C}$. 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

$(2 \times 10 = 20)$

- 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 $6 \times 10^5 \text{ W/m}^3$ 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 $3 \text{ kJ/kg } ^{\circ}\text{K}$ from 100°C to 30°C by water initially at 20°C . The quantity of water feed is 1300 kg/hr. Calculate water outlet temp. and heat transfer area for overall heat transfer coefficient of $4000 \text{ kJ/hr-m}^2\text{K}$. 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.