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SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)

B.Tech II Year I Semester Regular & Supplementary Examinations March-2023
HEAT & MASS TRANSFER
(Agricultural Engineering)

Time: 3 hours

Max. Marks: 60

(Answer all Five Units 5 x 12 = 60 Marks)

UNIT-I

1 Derive the general heat conduction equation in Cylindrical coordinate System. CO1 L3 12M

OR

- 2 a Define the following Terms. CO1 L1 6M
i). Heat ii).Heat Transfer
- b Enumerate the some important areas which are covered under the discipline of heat transfer. CO1 L1 6M

UNIT-II

- 3 a Derive an expression for heat conduction through a plane wall. CO2 L1 6M
- b Calculate the critical radius of insulation for asbestos ($k = 0.172 \text{ W/mK}$) surrounding a pipe and exposed to room air at 300K with $h = 2.8 \text{ W/mK}$. Calculate the heat loss from a 475K, 60 mm diameter pipe when covered with the critical radius of insulation and without insulation. CO2 L4 6M

OR

- 4 a Write short note on transient heat conduction. CO2 L1 6M
- b A steel ingot (large in size) heated uniformly to 7450C is hardened by quenching it in an oil bath maintained at 200C. Determine the length of time required for the temperature to reach 5950C at a depth of 12 mm. The ingot may be approximated as a flat plate. For steel ingot take α (thermal diffusivity) = $1.2 \times 10^{-5} \text{ m}^2/\text{s}$. CO2 L4 6M

UNIT-III

5 Explain hydrodynamic and thermal boundary layer with reference to flow over flat plate. CO3 L1 12M

OR

- 6 a Define Nusselt number, Prandtl number and their significance. CO3 L1 6M
- b Air stream at 24°C is flowing at 0.4 m/s across a 100 W bulb at 130°C. If the bulb is approximately by a 65 mm diameter sphere. Calculate CO3 L4 6M
i) The heat transfer rate ii) The percentage of power lost due to convection

UNIT-IV

7 Explain briefly the various regimes of saturated pool boiling with diagram. CO4 L3 12M

OR

- 8 a Explain the concept of black body CO4 L3 6M
- b Explain the surface emissive properties CO4 L4 6M

UNIT-V

9 The flow rate of hot and cold water streams running through a parallel flow heat exchanger are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperatures on the hot and cold sides are 750C and 200C respectively. The exit temperature of hot water is 450C. If the individual heat transfer coefficients on the both sides are 650 W/m²0C, calculate the area of heat exchanger. CO5 L4 12M

OR

- 10 a Explain correlation for Mass Transfer. CO6 L2 8M
- b List out the application of Mass Transfer. CO6 L2 4M

*** END ***

Max. Marks: 60

Time: 3 hours

(Answer all Five Units & 12 = 60 Marks)

UNIT-I

1. Define the terms: a) Thermal conductivity of a material b) Thermal conductive system

OR

2. a) Define the following terms: i) Heat flux ii) Heat transfer

b) Explain the term: important areas which are covered under the discipline of heat transfer.

UNIT-II

3. a) Derive an expression for heat conduction through a pipe wall.

b) Calculate the critical radius of insulation for asbestos ($k = 0.173 \text{ W/mK}$)

retrofitting a pipe and exposed to mean air at 200K with $h = 24 \text{ W/m}^2\text{K}$.

Calculate the heat loss from a 1.75K , 60 mm diameter pipe when covered with

the critical radius of insulation and without insulation.

OR

4. a) Write short note on transient heat conduction.

b) A steel ingot (diameter is 200 mm) heated uniformly to 7450K is hardened by quenching

it in a water bath maintained at 300K . Determine the length of time required for

the temperature to reach 300K at a depth of 15 mm . The ingot may be

approximated as a flat plate for each side take a thermal diffusivity $\alpha = 1.2 \times 10^{-5} \text{ m}^2/\text{s}$.

UNIT-III

5. Explain boundary layer and thermal boundary layer with reference to flow over flat plate.

OR

6. a) Define Prandtl number, Fourier number and their significance.

b) Air at 20C is flowing at 0.4 m/s over a 100 W bulb at 100C . If the

bulb diameter is 60 mm and thermal conductivity is 0.03 W/mK . Calculate

i) The heat transfer rate ii) The percentage of power lost due to convection.

UNIT-IV

7. Explain briefly the various regimes of natural convection over a vertical plate.

OR

8. a) Explain the concept of heat body.

b) Explain the various emissive properties.

UNIT-V

9. The interface of hot and cold water streams passing through a vertical flow heat

exchanger is 0.2 m long. The hot water is at 100C and the cold water is at 20C .

Calculate the overall heat transfer coefficient on the hot side and $0.02 \text{ W/m}^2\text{K}$.

OR

10. a) Explain the concept of heat transfer.

b) List out the application of heat transfer.