

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

**B.Tech III Year I Semester Regular & Supplementary Examinations February-2024**

**HEAT AND MASS TRANSFER**

(Mechanical Engineering)

**Time: 3 Hours**

**Max. Marks: 60**

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

**UNIT-I**

- |          |  |            |           |           |
|----------|--|------------|-----------|-----------|
| <b>1</b> | <b>a</b> List the basic laws which govern the heat transfer.         | <b>CO1</b> | <b>L1</b> | <b>6M</b> |
|          | <b>b</b> What is Fourier's law of conduction? State the assumptions. | <b>CO1</b> | <b>L2</b> | <b>6M</b> |

**OR**

- |          |  |            |           |           |
|----------|--|------------|-----------|-----------|
| <b>2</b> | <b>a</b> What is conduction heat transfer? Explain.  | <b>CO1</b> | <b>L2</b> | <b>6M</b> |
|          | <b>b</b> A 150 mm thick plane wall having cross sectional area of 5 m <sup>2</sup> . If its conductivity is 9 W/m °C and its surface temperature are steady at 150°C and 45°C, determine i).Heat transfer across the plane wall, ii).Temperature gradient in the flow direction. | <b>CO1</b> | <b>L3</b> | <b>6M</b> |

**UNIT-II**

- |          |  |            |           |           |
|----------|--|------------|-----------|-----------|
| <b>3</b> | <b>a</b> Derive an expression for heat conduction through a composite wall.  | <b>CO2</b> | <b>L3</b> | <b>6M</b> |
|          | <b>b</b> A spherical shaped vessel of 1.5 m diameter is 70 mm thick. Find the rate of heat leakage, if the temperature difference between the inner and outer surface is 200°C. Thermal conductivity of the material of the sphere is 0.080 W/m °C | <b>CO2</b> | <b>L3</b> | <b>6M</b> |

**OR**

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|----------|---|------------|-----------|-----------|
| <b>4</b> | <b>a</b> Write short note on transient heat conduction.   | <b>CO2</b> | <b>L1</b> | <b>6M</b> |
|          | <b>b</b> A steel ingot (large in size) heated uniformly to 745 °C is hardened by quenching it in an oil bath maintained at 20 °C. Determine the time required for the temperature to reach 595 °C at a depth of 12 mm. The ingot may be approximated as a flat plate. For steel ingot take the thermal diffusivity as 1.2x10 <sup>-5</sup> m <sup>2</sup> /s. | <b>CO2</b> | <b>L3</b> | <b>6M</b> |

**UNIT-III**

- |          |   |            |           |            |
|----------|---|------------|-----------|------------|
| <b>5</b> | Explain hydrodynamic and thermal boundary layer with reference to flow over flat plate. | <b>CO3</b> | <b>L2</b> | <b>12M</b> |
|----------|---|------------|-----------|------------|

**OR**

- |          |  |            |           |            |
|----------|--|------------|-----------|------------|
| <b>6</b> | In a straight tube of 60 mm diameter, water is flowing at a velocity of 12 m/s. The tube surface temperature is maintained at 70 °C and the following water is heated from the inlet temperature 15 °C to an outlet temperature of 45 °C. taking the physical properties of water at its mean bulk temperature, Calculate the following: | <b>CO3</b> | <b>L4</b> | <b>12M</b> |
|          | i. The heat transfer coefficient from the tube surface to the water  |            |           |            |
|          | ii. The heat transferred iii. The length of the tube   |            |           |            |

**UNIT-IV**

- |          |   |            |           |           |
|----------|---|------------|-----------|-----------|
| <b>7</b> | <b>a</b> Deduce the correlation in boiling with proper expression.                                | <b>CO4</b> | <b>L4</b> | <b>6M</b> |
|          | <b>b</b> Discuss the different types of processes for condensation of vapours on a solid surface. | <b>CO4</b> | <b>L1</b> | <b>6M</b> |

**OR**

- 8 a Define Radiation heat transfer. C04 L1 6M  
b Define the term absorptivity, reflectivity and transmittivity of radiation. C04 L2 6M

**UNIT-V**

- 9 Which of the arrangement of heat exchangers is better, C05 L2 12M  
(i) parallel flow,(ii)Counter flow. Explain with neat sketches.

**OR**

- 10 a Discuss about the modes of Mass transfer. C06 L2 6M  
b What is Mass transfer coefficient? Explain it briefly. C06 L2 6M

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