

**MASTER OF SCIENCE
(RENEWABLE ENERGY AND
ENVIRONMENT) (MSCRWEE)**

Term-End Examination

June, 2026

MRW-002 : HEAT TRANSFER

Time : 3 Hours

Maximum Marks : 70

Note : (i) *Attempt any **seven** questions.*

(ii) *All questions carry equal marks.*

(iii) *Use of scientific calculator is permitted.*

1. A wall of furnace consists of 120 mm thick refractory bricks and 150 mm thick insulating fire bricks separated by an air gap. A 15 mm thick plaster covers the outer

surface wall. The inner surface of the wall is at 1200°C and the ambient temperature is 25°C . The heat transfer coefficient on the outside wall to the air is $27 \text{ W/m}^2\text{K}$, and the resistance to heat flow of the air gap is 0.14 K/W . The thermal conductivities of refractory brick, insulating firebrick and plasters are 2.6, 0.8 and 0.44 W/m.K , respectively. Calculate :

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- (a) The rate of heat loss per unit area of the wall.
 - (b) The interface temperatures throughout the wall.
2. (a) Show that the temperature profile for heat conduction through a plane wall of constant thermal conductivity is a straight line.
- 5
- (b) How does conduction occur in a composite wall with different materials put (i) in series (ii) in parallel ?
- 5

3. (a) Define the fin efficiency and fin effectiveness. 5
- (b) What is the physical significance of Prandtl number ? 5
4. (a) What do you mean by laminar and turbulent boundary layer ? 5
- (b) How do you calculate the average heat transfer coefficient ? 5
5. (a) Explain the following terms : 6
- (i) radiosity
- (ii) emission
- (iii) spectral intensity
- (b) Explain Kirchhoff's law. Discuss the significance of the statement "A perfect absorber of radiant energy is also a perfect emitter". 4
6. (a) Explain how the shape factor is determined by decomposing one or both the surfaces into sub-divisions. 5

- (b) Draw the equivalent electrical network for radiative flux between four walls of a black body. 5
7. (a) How does fouling affect the overall heat transfer coefficient of a heat exchanger ? 5
- (b) What is LMTD ? When do you use LMTD method ? 5
8. (a) What is NTU ? When do you use NTU method ? 5
- (b) What are the different regimes of pool boiling ? 5
9. Write short notes on any *two* of the following : 5+5
- (a) Fire Tube Boilers
- (b) Fins
- (c) Film-wise condensation
- (d) Fourier's law of heat conduction

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