

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

Term-End Examination

December, 2025

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.*

(iv) *Symbols have their usual meanings.*

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1. Derive an expression for critical thickness of insulation of a cylindrical tube and state its significance. 10

2. Derive the general conduction equation for : 10
- (a) Cartesian co-ordinate
 - (b) The system being with uniform heat generation and unsteady state
3. (a) What do you mean by a semi-infinite solid ? What is its speciality ? 5
- (b) Derive an expression for heat transfer and temperature distribution for a rectangular fin with its tip at adiabatic conditions. 5
4. (a) What is the difference between free and forced convection ? 5
- (b) Explain with the help of a diagram the concept of hydrodynamic and thermal boundary layer for a laminar flow over a thin flat plate. 5
5. Describe the construction of a water tube boiler with a neat sketch. 10
6. (a) What is a black body ? What are the characteristics of a black body ? 5

- (b) Derive Wien's Displacement law from Planck's equation. 5
7. (a) Explain the electrical analogy for radioactive heat transfer in a black enclosure. 5
- (b) What do you mean by a radiation shield ? Where is it used ? 5
8. (a) What are the major differences between a recuperator and a regenerator ? 5
- (b) A counter flow shell-and-tube heat exchanger is used to heat water at a rate of $m = 0.8 \text{ kg/s}$ from $T_i = 20^\circ\text{C}$ and $T_o = 80^\circ\text{C}$, with ghot oil entering at 120°C and leaving at 85°C . The overall heat transfer coefficient is $U = 125 \text{ W/(m}^2\text{C)}$. Calculate the heat transfer area required. 5

9. Write short notes on any *two* of the following : 2×5=10

- (a) Pool boiling
- (b) Biot number
- (c) Kirchhoff's law
- (d) Effectiveness of a Heat Exchanger

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