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MRW–002

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 kg/s from T_i = 20°C and T_o = 80°C, with ghot oil entering at 120°C and leaving at 85°C. The overall heat transfer coefficient is U = 125 W/(m^2°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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