No. of Printed Pages : 4 **MRW–002**

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

Term-End Examination

December, 2024

MRW–002 : HEAT TRANSFER

Time : 3 Hours *Maximum Marks : 70*

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

(ii) All questions carry equal marks.

(iii) Use of scientific calculator is permitted.

(iv) Symbols have their usual meaning.

1. (a) Describe the relationship between heat transfer and thermodynamics. What are the basic units ? How do you obtain force, pressure, energy from the basic units ? 5

   (b) How does conduction occur in a composite wall with different materials put in (i) series and (ii) parallel ? 5

2. (a) Show that the temperature profile for heat conduction through a plane of constant thermal conductivity is a straight line. 5

   (b) An aluminium plate (K = 160 W/mK, ρ = 2790 kg/m^3, C_p = 0.88 kJ/kg-K) of thickness 30 mm and at a uniform temperature of 225°C is suddenly immersed at time t = 0 in a well-stirred fluid at a constant temperature of 25°C. The convective heat transfer coefficient between the plate and the fluid is 320 W/m^{2}K. Determine the time required for the center of the plate to reach 50°C. 5

3. (a) What are the different modes of heat transfer ? Explain conduction heat transfer in solids with suitable examples and data. 5

   (b) Derive an expression for heat transfer and temperature distribution for a rectangular fin with its tip at adiabatic condition. 5

4. (a) 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

(b) Derive the energy equation and explain the significance of different terms in the final equation. 5

5. (a) What is the boundary layer thickness ? What do you mean by laminar and turbulent boundary layer ? 5

(b) What will be the relative magnitude of heat flux in case of forced convection (laminar flow) in a tube for : 5

(i) at inlet to the tube

(ii) near exit of the tube ?

6. (a) Explain the following terms : 5

(i) Radiosity

(ii) Emission

(iii) Spectral intensity

(b) What do you mean by surface property ? How does radiation vary with surface properties ? 5

7. (a) Explain how the shape factor is determined by decomposing one or both the surfaces into subdivisions. 5

(b) What do you mean by a radiation shield ? Where is it used ? 5

8. (a) What do you mean by fouling ? How does fouling affect the overall heat transfer coefficient of a heat exchanger ? 5

   (b) Define effectiveness of a heat exchanger. What is NTU ? When do you use the NTU method ? 5

9. Write short notes on any *two* of the following : 5+5

   (a) Fin effectiveness *vs*. Fin efficiency

   (b) Stephan-Boltzmann's law

   (c) Reynolds' number and Prandtl's number

   (d) Critical radius of insulation

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