

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

**Term-End Examination**

**June, 2022**

**MRW-002 : HEAT TRANSFER**

*Time : 3 hours*

*Maximum Marks : 70*

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**Note :** Answer any **seven** questions. All questions carry equal marks. Use of calculator is permitted.

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1. (a) What are the various modes of heat transfer ? Explain their differences. 5  
(b) State Fourier's law of heat conduction. 5
  
2. (a) Air at 40°C flows over a hot plate (50 cm × 75 cm) maintained at 200°C with the help of an electric heater. The convection coefficient is 20 W/m<sup>2</sup>. Calculate the heat transfer. 5  
(b) The quantity of radiation received by the Earth from the Sun is 1.4 kW/m<sup>2</sup> (solar constant). Assuming that the Sun is an ideal radiator, calculate the surface temperature of the Sun. The ratio of the radius of the Earth's orbit to the radius of the Sun is 216. 5

3. Show how Fourier's law and Ohm's law are similar. Derive the expression for thermal resistance of a composite wall with three layers of thickness  $L_1$ ,  $L_2$  and  $L_3$  having thermal conductivity  $K_1$ ,  $K_2$  and  $K_3$ , respectively when the layers are in (i) series, and (ii) parallel. The area of cross-section for all walls is 'A'. 10
4. One end of a long rod is inserted into a furnace while the other projects into ambient air. Under steady state, temperature of the rod is measured at two points 75 mm apart and found to be  $125^\circ\text{C}$  and  $88.5^\circ\text{C}$  respectively, while the ambient temperature is  $20^\circ\text{C}$ . If the rod is 25 mm minimum diameter and  $h = 23.26 \text{ W/m}^2 \text{ K}$ , find the thermal conductivity of the rod material. 10
5. Discuss in detail the boundary layer growth for flow over a flat plate. 10
6. (a) What is the difference between free and forced convection ? 3
- (b) Define Reynolds number and give its significance. 3
- (c) What is viscosity ? Give its unit in SI system. 4
7. (a) What is a black body ? What are the characteristics of a black body ? 4
- (b) What is meant by radiation intensity ? 3
- (c) State Wein's displacement law. 3

8. (a) What is view factor ? 3
- (b) What is shape factor with respect to itself if the surface is concave, convex or flat ? 3
- (c) What is a radiation shield and where is it used ? 4
9. Write short notes on any **two** of the following : 5+5=10
- (a) Tubular Heat Exchanger
- (b) Plate Heat Exchanger
- (c) Regenerative Heat Exchanger
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