Hall Ticket No | | | | | | | | | | |

Question Paper Code: AITC01

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech V SEMESTER END EXAMINATIONS (REGULAR/ SUPPLEMENTARY) - FEBRUARY 2024
Regulation: UG20
HEAT AND MASS TRANSFER
Time: 3 Hours **(AERONAUTICAL ENGINEERING)** **Max Marks: 70**

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Explain how the fins enhance heat transfer from a surface. Also, explain how the addition of fins may actually decrease heat transfer from a surface. [BL: Understand| CO: 4|Marks: 7]

   (b) A wire of 6 mm diameter with 2 mm thick insulation (K = 0.11 W/m-K). If the convective heat transfer co-efficient between the insulating surface and air is 25 W/m2-K, find the critical thickness of insulation. And also find the percentage of change in the heat transfer rate if the critical radius is used. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) Elaborate on hydrodynamic and Thermal boundary layer with neat sketch. [BL: Understand| CO: 2|Marks: 7]

   (b) Air at 20^0 at atmospheric pressure flows over a flat plate at a velocity of 3 m/s. if the plate is 1 m wide and 80^0, calculate the following at x = 300 mm. i) Hydrodynamic boundary layer thickness, ii) Thermal boundary layer thickness and iii) Heat transfer. [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Explain the concept of film boiling and discuss the various parameters involved in convection and radiation heat transfer coefficients of film boiling. [BL: Understand| CO: 3|Marks: 7]

   (b) Water is to boiled at atmospheric pressure in a polished copper pan by means of an electric heater. The diameter of the pan is 0.38 m and is kept at 115^0. Calculate the power required to boil the water, rate of evaporation and heat flux. [BL: Apply| CO: 3|Marks: 7]

4. (a) Classify and explain heat exchangers with its applications. Mention the causes and effects of fouling in heat exchangers. [BL: Understand| CO: 4|Marks: 7]

   (b) In a refrigerating plant water is cooled from $20^0$to 7^0 by brine solution entering at 2^0 and leaving at 3^0. The design heat load is 5500 W and the overall heat transfer coefficient is 800 W/m^2-K. What area required when using a shell and tube heat exchanger with the water making one shell pass and the brine making two tube passes. [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Discuss the radiation heat transfer between non-black bodies. Distinguish thermal radiation from other types of radiation. [BL: Understand| CO: 5|Marks: 7]

   (b) A large spherical furnace inside surface temperature is 1000 K. If there is a hole of diameter 0.5 cm determine the rate of emission of radiation through the opening.
   [BL: Apply| CO: 5|Marks: 7].

6. (a) Explain the radiation exchange with transmitting, reflecting and absorbing media
   [BL: Understand| CO: 5|Marks: 7]

   (b) Find the reduction in radiation heat transfer between two parallel plates when three and two shields are placed between them, with all emissivities assumed to be equal.
   [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Discuss about the dimensionless parameters used in the mass transfer.
   [BL: Understand| CO: 6|Marks: 7]

   (b) Oxygen at 25^0 and pressure of 2 bar is flowing through a rubber pipe of inside diameter 25 mm and wall thickness 2.5 mm. The diffusivity of O2 through rubber is $0.21 \times 10^{-9} m^2/s$ and the solubility of O_2 in rubber is $3.12 \times 10^{-3} kgmole/m^3$- bar. Find the loss of O2 by diffusion per metre length of pipe. [BL: Apply| CO: 6|Marks: 7]

8. (a) Summarize about the modes of mass transfer. and analogy between heat & mass transfer.
   [BL: Understand| CO: 6|Marks: 7]

   (b) An open pan 210 mm in diameter and 75 mm deep contains water at $25^0 C$ and is exposed to dry atmospheric air. Calculate the diffusion coefficient of water in air. Take the rate of diffusion of water vapour is $8.52 \times 10^{-4} kg/h$. [BL: Apply| CO: 6|Marks: 7]

– ○ ○ ◯ ○ ○ –