Roll No. | | | | | | | | | | | | | **Total No. of Pages : 02**

Total No. of Questions : 09

B.Tech. (Agriculture Engg.) (Sem.–6)

HEAT AND MASS TRANSFER

Subject Code : BTAG601-19

M.Code : 91599

Date of Examination : 02-07-22

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Write briefly :

a) Define Thermal Diffusivity and explain its physical significance.

b) What's the difference between Thermodynamics and Heat transfer?

c) Define Grashof number, and explain its importance in free convection heat transfer.

d) What is the ratio of the hydrodynamic boundary layer to thermal boundary layer in the case of laminar flow over a plate?

e) What do you understand by a gray and blackbody?

f) Sketch the temperature variations in parallel flow and counter flow heat exchangers.

g) Distinguish between fin efficiency and effectiveness.

h) What is Greenhouse effect, why it's a matter of great concern for Atmosphere scientists?

i) State Wien's displacement law and Kirchoffs law.

j) Define molar concentration and mass fraction.

SECTION-B

2. The wall of an oven consists of 3 layers of brick. Inside one is built of 20 cm of fire bricks surrounded by 10 cm of insulating brick and outside layer is binding bricks of 12 cm thick. The oven operates at 900°C, such that the outside surface of the oven is maintained at 60°C. Calculate,

   (a) The heat loss per m^2 in surface,

   (b) The interfacial temperature. Given the thermal conductivity of fire brick, insulting brick and binding are 1.2, 0.26 and 0.68, respectively in W/m °C.

3. Define Reynold's, Nusselt and Prandtl numbers.

4. Derive an expression for LMTD.

5. An open pan of 20 cm diameter and 8 cm, depth contains water at 25°C and is exposed to dry atmospheric air. Assuming the rate of diffusion of water as 8.54×10^{-4} kg/h, find the diffusion coefficient.

6. Define Kirchhoff's law and use of Radiation Shields.

SECTION-C

7. Derive the General Heat conduction equation in cylindrical coordinates for a homogeneous material. Derive there from an expression for unidirectional steady state system.

8. It is desired to use a shell and tube heat exchanger to heat 68 kg/min of water from 35°C to 75°C by using oil having a specific heat of 1.9 kJ/ kgK. The oil enters at a temperature of 110°C and flows at the rate of 170 kg/min. The water makes shell pass and the oil makes two tube passes. Calculate the area required for the heat exchangers assuming the overall heat transfer coefficient to be 300 W/m^2K and specific heat of water to be 4.18 kJ/kgK.

9. The cylinder of a 2-stroke SI engine is constructed of aluminium alloy (k = 186 W/m). The height and outside diameter of the cylinder are respectively 15 cm and 5 cm. Under steady operating conditions, the outer surface of the cylinder is at 500 K and is exposed to the ambient air at 300 K, with a convection heat transfer coefficient of 50 W/m^2K. Equally spaced annular fins are attached with the cylinder to increase the heat transfer. There are five such fins with a uniform thickness, t = 6 mm and length, L = 20 mm. Calculate the increase in heat transfer due to the addition of fins.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.