Code No: RT22351 **R13** SET - 1

II B. Tech II Semester Supplementary Examinations, November-2017
HEAT AND MASS TRANSFER
(Agricultural Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1. a) Explain Stefan Boltzmann law for heat transfer by radiation.
   b) Discuss about the importance of insulating material in heat transfer.
   c) Write a short note on radiation from gases, vapours and flames.
   d) Explain about Grashoff number and discuss about its physical significance.
   e) How are heat exchangers classified? Write the applications of heat exchangers.
   f) Differentiate between heat transfer and mass transfer.

PART -B

2. a) Derive the general heat conduction equation in cylindrical coordinates.
   b) Explain Fourier's law of heat transport and Newton's law of heat convection.

3. a) Derive the expression for calculating overall heat transfer coefficient when heat transfers through a plane wall.
   b) A wall of a furnace is made up of inside layer of silica brick 120mm thick covered with a layer of magnesite brick 240 mm thick. The temperature at the inside surface of silica brick wall and outside surface of magnesite brick wall are 725^0C and 110^0C respectively. The contact thermal resistance between the two walls at the interface is 0.0035^0C/W per unit wall area. If the thermal conductivities of silica and magnesite bricks are 1.7 W/m^{0}C and 5.8 W/m^{0}C, calculate
   i) The rate of heat loss per unit area of wall
   ii) The temperature drop at the interface.

4. a) What is a black body? Derive the expression for radiation heat exchange between two black surfaces.
   b) Two opposed, parallel infinite planes are maintained at 400^0C and 460^0C respectively. Calculate the net radiant heat flux between these planes if one has an emissivity of 0.6 and the other an emissivity of 0.4.
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5. a) Derive an expression for the maximum velocity in the free convection boundary layer on a vertical plate. At what position in the boundary layer does this maximum velocity occur?

   b) Explain the following dimensionless numbers and their physical significance.
   i) Reynolds number, ii) Prandtl number, iii) Nusselt number.

6. a) Calculate the overall coefficient of heat transfer between water and oil if the water flows through a copper tube of 186mm inside diameter and 15mm thick while the oil flows through the annulus formed by this pipe and an outer concentric pipe. The thermal conductivity of the tube wall is 350 W/m K and the fouling factors on the oil and water side are 0.00086 m^2K / W and 0.000344 m^2K / W respectively. The oil and water side heat transfer coefficients can be taken as 1280 and 4650 W/m^2K respectively.

   b) Derive an expression for the maximum velocity in the free convection boundary layer on a vertical plate. At what position in the boundary layer does this maximum velocity occur?

7. a) Explain about Fick's law of diffusion.

   b) Vessel contains a binary mixture of oxygen and nitrogen with partial pressures in the ratio 0.21 and 0.79 at 27^0C. The total pressure of the mixture is 1 bar.
   Determine i) molar concentration, ii) Mass densities, iii) Mass fractions, iv) Molar fractions of each species.