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

II B. Tech II Semester Supplementary Examinations, November - 2018
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 Newton's law of cooling.
   b) What is critical thickness of insulation? Explain.
   c) Write a short not on black body and gray body.
   d) Explain about Nusselt number and discuss about its physical significance.
   e) Write a short note on boundary layer thickness and displacement thickness.
   f) Explain about mass average velocity.

PART -B

2. a) Derive expression for temperature distribution, under one dimensional steady state heat conduction for a plane wall.
   b) Explain the mechanism of conduction, convection and radiation.
3. a) What is critical thickness of insulation? Explain its importance and derive the expression to calculate critical thickness of insulation for a cylinder.
   b) A cold storage room has walls made of 23 cm of brick on the outside, 8 cm of plastic foam and finally 1.5 cm of wood on the inside. The outside and inside air temperatures are 22°C and -2°C respectively. The inside and outside heat transfer coefficients are respectively 29 and 12 W/m^2.K. The thermal conductivities of brick, foam and wood are 0.98, 0.02 and 0.12 W/m.K respectively. If the total wall area is 90 m^2, determine the rate of heat removal by refrigeration and the temperature of the inside surface of the brick.

4. a) Derive a general expression for shape factor in case of radiation between two surfaces of same area.
   b) Two parallel black plates 0.5 by 1.0m are separated by 0.5m distance. One plate is at 1100^{0}C and the other at 600^{0}C. What is the net radiant heat exchange between the two plates?
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5. a) Explain about dimensional analysis applied to free convection heat transfer.
   b) Calculate the average co-efficient of heat transfer for natural convection for a vertical plate 30.48 cm high at 51.67^0C. The surrounding air is at 25^0C. Also calculate the boundary layer thickness at the trailing edge of plate.

6. a) Derive an expression for logarithmic mean temperature difference in case of parallel flow heat exchanger.
   b) Two horizontal plates separated by a distance of 25.4 mm contain air at atmospheric pressure. The temperatures of lower and upper panels are 60^0C and 15.6^0C respectively. Calculate the free convection heat transfer per m^2 of panel surface.

7. a) Explain various modes of mass transfer and enumerate its applications.
   b) Vessel contains a binary mixture of oxygen and nitrogen with partial pressures in the ratio 0.21 and 0.79 at 15^0C. The total pressure of the mixture is 1.1 bar. Determine i) molar concentration, ii) Mass densities, iii) Mass fractions, iv) Molar fractions of each species.