Roll No…….. **Total No. of Printed Pages: 1**

Total No. of Questions: [11]

M. Tech ME (Semester – 1st)

ADVANCED HEAT & MASS TRANSFER

Subject Code: MMEE2102

Paper ID: [191002]

Time: 03 Hours **Maximum Marks: 60**

Instruction for candidates:

1. Section A is compulsory. It carries 16 marks. It consists of 4 questions of 4 marks each.
2. Section B consist of 4 questions of 8 marks each. The student has to attempt any 3 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A **(4 marks each)**

Q1. State and discuss Fourier's Law of heat conduction?

Q2. Sketch formation of boundary layer and show laminar, transition & turbulent flow.

Q3. Distinguish between Absorptivity & Transmittivity of radiation.

Q4. What is mass diffusion velocity?

Section – B **(8 marks each)**

Q5. A furnace wall consists of three layers. The inner layer of 10 cm thickness is made of firebrick (k =1.04 W/mK). The intermediate layer of 25 cm thickness is made of masonry brick (k = 0.69 W/mK) followed by a 5 cm thick concrete wall (k = 1.37 W/mK). When the furnace is in continuous operation the inner surface of the furnace is at 800°C while the outer concrete surface is at 50°C. Calculate the rate of heat loss per unit area of the wall, the temperature at the interface of the firebrick and masonry brick and the temperature at the interface of the masonry brick and concrete.

Q6. Write down the momentum equation for a steady, two dimensional flow of an incompressible, constant property newtonian fluid in the rectangular coordinate system and mention the physical significance of each term.

Q7. Discuss how the radiation from gases differs from that of solids.

Q8. Explain Fick's first and second laws of diffusion.

Section – C **(10 marks each)**

Q9. Derive the heat conduction equation in cylindrical co-ordinates using an elemental volume for a stationary isotropic solid.

Q10. Air at 25°C flows over 1 m x 3 m (3 m long) horizontal plate maintained at 200°C at 10 m/s. Calculate the average heat transfer coefficients for both laminar and turbulent regions. Take Re (critical) = 3.5×10^5

Q11. State and prove the following laws:

a) Kirchoff’s law of radiation

b) Stefan - Boltzmann law