Ref. No. EX/PG/ME/T/116H/2018

M.E. MECHANICAL ENGINEERING FIRST YEAR FIRST SEMESTER EXAM 2018

Subject: Heat and Mass Transfer

Time: 3 hours | Full Marks: **100**

50 Marks for each Part

Use separate Answer Script for each Part

Part – I

Answer any two questions

1	What is enthalpy flux? Develop a general heat conduction equation for the temperature field in Cartesian coordinates, which may be applicable to any heat conduction analysis.	25
2	Consider a rectangular plate of length L and width b. The thickness of the plate t is assumed to be a very small. The thermal conductivity of the plate material is k which is constant. The plate is immersed in a fluid of a constant temperature T_∞. The energy exchange between the plate and the surrounding fluid is due to convection with a constant convective heat transfer coefficient h. The energy interaction occurs through all the surfaces except one thickness surface where a constant temperature is exhibited. Draw a schematic diagram of the above problem and show the coordinate system taken for the mathematical formulation. If there is no heat generated inside the plate, determine the steady state temperature distribution in the plate. Also determine the heat transfer rate.	25
3 (a)	What is modified Bessel equation? How to solve this equation with a practical problem in heat transfer applications.	15
(b)	Demonstrate to determine radiation heat exchange in an enclosure.	10

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M.E. MECHANICAL ENGINEERING FIRST YEAR FIRST SEMESTER EXAM 2018

M.E. CHEMICAL ENGINEERING FIRST YEAR FIRST SEMESTER EXAM 2018

MASTER OF NUCLEAR ENGINEERING FIRST YEAR FIRST SEMESTER EXAM 2018

M.TECH. LASER SCIENCE AND TECHNOLOGY FIRST YEAR FIRST SEMESTER EXAM 2018

HEAT AND MASS TRANSFER

Time: Three hours **Full Marks 100**

Part – II (FULL MARKS 50)

Use separate answer script for each part

Answer question number 1 and any 2 from the rest.
All parts of the same question must be answered together.

Q:1 Answer any **three** parts 3X6

(a) Write down 2-D steady state momentum equation in Cartesian Co-ordinate and non-dimensionalize it. Identify the non-dimensional parameters.

(b) What do you mean by viscous dissipation function? Write down the terms of viscous dissipation in Cartesian coordinate in terms of velocity gradients.

(c) Why axial diffusion terms are neglected in momentum and energy equation in boundary layer analysis?

(d) Relate Nusselt number with non-dimensional temperature gradient for convective heat transfer. Explain the physical significance of Eckert number.

Q:2 Consider the boundary layer type of flow over a flat plate. Write down the energy equation and boundary conditions. With an appropriate similarity transformation technique develop the following equations along with the boundary conditions:

$$\theta'' + \frac{Pr}{2} F\theta' = 0$$

16

Q: 3 Consider the natural convection over a vertical flat plate with constant wall temperature condition. Write down the continuity, momentum and energy equation along with the boundary conditions. Derive for Pr>1, the expression for Nusselt number using a scale analysis. 16

Q:4 Derive the individual continuity equation for *n*-th species and bulk continuity equation for the mixture. Define the bulk average velocity and species mass flux.

16