HEAT AND MASS TRANSFER

Subject Code : 06ME65 IA Marks : 25

No. of Lecture Hrs./ Week : 04 Exam Hours : 03

Total No. of Lecture Hrs. : 52 Exam Marks : 100

PART - A

UNIT - 1

INTRODUCTORY CONCEPTS AND DEFINITIONS: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer ; combined heat transfer mechanism. Boundry conditions of 1
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CONDUCTION: Derivation of general three dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation). One dimensional conduction equations in rectangular, cylindrical and spherical coordinates for plane and composite walls. Overall heat transfer coefficient. Thermal contact resistance.

7 Hours

UNIT - 2

VARIABLE THERMAL CONDUCTIVITY: Derivation for heat flow and temperature distribution in plane wall. Critical thickness of insulation without heat generation, Thermal resistance concept & its importance. Heat transfer in extended surfaces of uniform cross-section without heat generation, Long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and effectiveness. Numerical problems.

6 Hours

UNIT - 3

ONE-DIMENSIONAL TRANSIENT CONDUCTION: Conduction in

solids with negligible internal temperature gradient (Lumped system a nalysis), Use of Transient temperature charts (Heisler's charts) for transient charts for transient conduction in semi-infinite solids. Numerical Problems.

6 Hours

UNIT - 4

CONCEPTS AND BASIC RELATIONS IN BOUNDARY LAYERS:

Flow over a body velocity boundary layer; critical Reynolds number; general expressions for drag coefficient and drag force; thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer Coefficient; Nusselt number. Flow inside a duct-velocity boundary layer, hydrodynamic entrance length and hydro dynamically developed flow; flow through tubes (internal flow)(discussion only). Numericals based on empirical relation given in data handbook.

FREE OR NATURAL CONVECTION: Application of dimensional analysis for free convection- physical significance of Grashoff number; use of correlations of free convection in vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres, Numerical problems.

7 Hours

PART - B

UNIT - 5

FORCED CONVECTIONS: Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro dynamically and thermally developed flows inside a duct, use of correlations for flow over a flat plate, over a cylinder and sphere. Numerical problems.

6 Hours

UNIT - 6

HEAT EXCHANGERS: Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD, Effectiveness-NTU methods of analysis of heat exchangers. Numerical problems.

6 Hours

UNIT - 7

CONDENSATION AND BOILING: Types of condensation (discussion only) Nusselt's theory for laminar condensation on a vertical flat surface; use of correlations for condensation on vertical flat surfaces, horizontal tube and horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling, pool boiling correlations. Numerical problems. Mass transfer definition and terms used in mass transfer analysis, Ficks First law of diffusion (no numericals).

7 Hours

UNIT - 8

RADIATION HEAT TRANSFER: Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surfaces, between

two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation andsolid angle; Lambert's law; radiation heat exchange between two finite surfaces-configuration factor or view factor. Numerical problems.

7 Hours

TEXT BOOKS:

1. Heat & Mass transfer, Tirumaleshwar, Pearson education 2006

2. Heat transfer-A basic approach, Ozisik, Tata Mc Graw Hill 2002

REFERENCE BOOKS:

1. Heat transfer, a practical approach, Yunus A- Cengel Tata Mc

Graw Hill

2. Principles of heat transfer, Kreith Thomas Learning 2001

3. Fundamentals of heat and mass transfer, Frenk P. Incropera and

David P. Dewitt, John Wiley and son's.

4. Heat transfer, P.K. Nag, Tata Mc Graw Hill 2002.