HEAT TRANSFER

B.Tech. III Year II Semester

Course Code	Category	Hours/ Week			Credits	Maximum Marks		
		L	T	P		CIA	SEE	TOTAL
ME3202PC	Core	3	1	0	4	25	75	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Thermodynamics

I. COURSE OVERVIEW:

This course will provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications.

II. COURSE OBJECTIVES:

To provide knowledge about application of conduction, convection and radiationheat transfer concepts to different practical applications.

III. COURSE OUTCOMES:

At the end of this course, student will be able to

- Understand the basic modes of heat transfer
- Compute one dimensional steady state heat transfer with and without heat generation
- Understand and analyze heat transfer through extended surfaces
- Understand one dimensional transient conduction heat transfer
- Understand concepts of continuity, momentum and energy equations
- Interpret and analyze forced and free convective heat transfer
- Understand the principles of boiling, condensation and radiation heat transfer.
- Design of heat exchangers using LMTD and NTU methods.

Note: Heat Transfer Data Book is permitted.

IV. COURSE SYLLABUS:

UNIT – I:

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer -General discussion about applications of heat transfer.

Conduction Heat Transfer: Fourier rate equation - General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates - simplification and forms of the field equation - steady, unsteady,and periodic heat transfer - Initial and boundary conditions.

One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders, and spheres- Composite systems- overall heat transfer coefficient - Electrical analogy - Critical radius of insulation.

UNIT – II:

One Dimensional Steady State Conduction Heat Transfer: Variable Thermal conductivity - systems with heat sources or Heat Generation-Extended surface (fins) Heat Transfer - Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature.

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance - Significance of Biot and Fourier Numbers -Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi-infinite body.

UNIT – III:

Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow - Dimensional analysis as a tool for experimental investigation - Buckingham n Theorem and method, application for developing semi - empirical non- dimensional Correlation for convection heat transfer - Significance of non-dimensional numbers - Concepts of Continuity, Momentum and Energy Equations - Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

UNIT – IV:

Internal Flows: Concepts about Hydrodynamic and Thermal Entry Lengths - Division of internal flow based on this -Use of empirical relations for Horizontal Pipe Flow and annulus flow.

Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.

Heat Exchangers: Classification of heat exchangers - overall heat transfer Coefficient and fouling factor - Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT – V:

Heat Transfer with Phase Change:

Boiling: - Pool boiling - Regimes - Calculations on Nucleate boiling, Critical Heat flux and Film boiling.

Condensation: Film wise and drop wise condensation -Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

Radiation Heat Transfer: Emission characteristics and laws of black-body radiation - Irradiation - total and monochromatic quantities - laws of Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann- heat exchange between two black bodies - concepts of shape factor - Emissivity - heat exchange between grey bodies - radiation shields - electrical analogy for radiation networks.

TEXT BOOKS:

1. Heat and Mass Transfer - Dixit /Mc Graw Hill
2. Heat and Mass Transfer / Altamush Siddiqui/ Cengage

REFERENCE BOOKS:

1. Essential Heat Transfer - Christopher A Long / Pearson
2. Heat Transfer -Ghoshdastidar / Oxford