



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF MECHANICAL ENGINEERING

III Year - II Semester		L	T	P	C
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HEAT TRANSFER					

Course Objective: To understand different modes of heat transfer and apply these basics in the design of thermal systems

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 Π 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.

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

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.

UNIT – IV:

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, Kirchoff, 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 Transfer by HOLMAN, Tata McgrawHill



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2. Heat Transfer by P.K.Nag, TMH

REFERENCE BOOKS:

1. Fundamentals of Heat Transfer by Incropera & Dewitt, John wiley
2. Fundamentals of Engineering, Heat & Mass Transfer by R.C.Sachdeva, NewAge.
3. Heat & Mass Transfer by Amit Pal – Pearson Publishers
4. Heat Transfer by Ghosh dastidar, Oxford University press.
5. Heat Transfer by a Practical Approach, YunusCengel, Boles, TMH
6. Engineering Heat and Mass Transfer by Sarit K. Das, DhanpatRai Pub

Note: Heat and Mass transfer Data Book by C P Kothandaraman and Subrahmanyam is used to design and analyze various thermal processes and thermal equipment.

Course Outcomes: At the end of the course, the student should be able to

CO1: Compute rate of heat transfer for 1D, steady state composite systems without heat generation.

CO2: Analyze the system with heat generation, variable thermal conductivity, fins and 1D transient conduction heat transfer problems.

CO3: Develop the empirical equations for forced convection problems by using Buckingham's pi theorem.

CO4: Compute the rate of heat transfer for natural convection systems and design and analysis of heat exchangers.

CO5: Solve the heat transfer systems with phase change and radiation.