HEAT TRANSFER

VI Semester: ME								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AMEB21	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

I. COURSE OVERVIEW:

Heat transfer is the flow of thermal energy due to temperature gradient and the subsequent distribution changes commonly measured as heat flux. This course focuses on heat transfer modes viz. Conduction, convection and radiation with different boundary conditions under steady and transient conditions, and heat exchangers applied to modern electric and electronic plants require efficient dissipation of thermal losses. Thus there is great relevance for this course in modeling heat exchangers, heat treatment of fins and complex mechanical systems.

II. OBJECTIVES:

The course should enable the students to:

I	The governing equations and performance relations of various modes of heat transfer using the three types of coordinate systems.
II	The concepts for validating heat transfer parameters during internal and external flows based on non-dimensional numbers and convective mode heat transfer.
III	The performance and analysis of heat exchangers for real-time applications using logarithmic mean temperature difference and number of transfer unit methods.
IV	The design methodologies for enhancing heat transfer among a wide variety of practical engineering problems.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Recall** the basic concepts of heat transfer mechanisms and general heat conduction equation in Cartesian, Cylindrical and Spherical Coordinate System for various measures of heat transfer rate.	Remember
CO 2	**Solve** problems involving steady state heat conduction with and without heat generation in simple geometries.	Apply
CO 3	**Make use of** the concept of Boundary layer theory for the derivation of empirical relations related to the characteristics of Boundary layer.	Apply
CO 4	**Utilize** the principles associated with convective heat transfer to formulate and solve the heat transfer coefficients for various cross section areas	Apply
CO 5	**Explain** the physical mechanisms involved in radiation heat transfer, boiling and condensation to give various correlations applied to heat exchangers, boilers, heat engines, etc.	Understand
CO 6	**Analyze** LMTD and NTU techniques for tackling real time problems with thermal analysis, simulation (mathematical model) and cost optimization of heat exchangers.	Analyze

IV. SYLLABUS:

MODULE-I	INTRODUCTION TO HEAT TRANSFER	Classes : 09
Modes and mechanisms of heat transfer, basic laws of heat transfer, applications of heat transfer; conduction heat transfer: Fourier rate equation, general three dimensional heat conduction equations in cartesian, cylindrical and spherical coordinates; Simplification and forms of the field equation, steady and unsteady and periodic heat transfer, initial and boundary conditions.		

MODULE-II	CONDUCTION HEAT TRANSFER	Classes : 09

One dimensional steady state conduction heat transfer: Homogeneous slabs, hollow cylinders and spheres, overall heat transfer coefficient, electrical analogy, Critical radius of insulation; one dimensional steady state conduction; heat transfer: with variable thermal conductivity, extended surfaces (Fins) long, short and insulated tips; significance of Biot and Fourier numbers, chart solutions of transient conduction systems.

MODULE-III	CONVECTIVE HEAT TRANSFER	Classes: 09

Buckingham Pi Theorem and method, application for developing semi, empirical non-dimensional correlation for convection heat transfer, significance of non-dimension numbers, concepts of continuity, momentum and energy equations; free convection: Development of hydrodynamic and thermal boundary layer along a vertical plate, use of empirical relations for vertical plates and pipes.

Forced convection: external flows: Concepts of 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 flows based on this, use of empirical correlations for horizontal pipe flow and annulus flow.

MODULE-IV	RADIATION HEAT TRANSFER	Classes: 09

Emission characteristics, 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.

MODULE-V	HEAT EXCHANGERS AND PHASE CHANGE	Classes : 09

Classification of heat exchangers, overall heat transfer Coefficient and fouling factor, Concepts of LMTD and NTU methods, Problems using LMTD and NTU methods. Boiling: Pool boiling-regimes Calculations on Nucleate boiling, Critical heat flux, 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.

Text Books:

1. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw hill Education (P) Ltd, New Delhi, India. 4th Edition, 2012.
2. R. C. Sachdeva, "Fundamentals of Engineering, Heat and Mass Transfer", New Age, New Delhi, India, 3rd Edition, 2012.

Reference Books:

1. Holman, "Heat Transfer", Tata McGraw-Hill Education, 10th Edition, 2011.
2. P. S. Ghoshdastidar, "Heat Transfer", Oxford University Press, 2nd Edition, 2012.
3. D. S. Kumar, "Heat and Mass Transfer", S.K. Kataria & sons, 9th Edition 2015.

Web References:

1. https://nptel.ac.in/courses/112101097/

E-Text Book:

1. https://b-ok.cc/book/539558/504c7c
2. https://b-ok.cc/book/454490/e8f467