HEAT TRANSFER

VI Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEC29	Core	3	1	0	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Thermodynamics

I. COURSE OVERVIEW:

Heat transfer is the flow of thermal energy due to temperature difference and the subsequent temperature distribution changes commonly measured as heat flux. This course focuses on heat transfer modes such as conduction, convection and radiation, boundary conditions, one dimensional steady and unsteady state condition 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. COURSE OBJECTIVES:

The students will try to learn:

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 andwithout 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 ofBoundary 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. COURSE SYLLABUS:

MODULE-I: INTRODUCTION TO HEAT TRANSFER (12)

Modes 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 system; steady, unsteady and periodic heat transfer, initial boundary conditions.

MODULE –II: CONDUCTION HEAT TRANSFER (12)

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 (12)

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 (12)

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 (12)

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, Nusselts theory of condensation on a vertical plate Film condensation on vertical and horizontal cylinders using empirical correlations.

V.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.

VI.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.

VII.WEB REFERENCES:

1. https: //nptel.ac.in/courses/112108149/
2. https://www.wisc-online.com/learn/natural-science/earth-science/sce304/heat-transfer-conduction-convection-radiation

VIII. E-TEXT BOOKS:

1. https://www.e-booksdirectory.com/details.php?ebook=8139
2. https:// bookboon.com/en/engineering-ebooks