HEAT TRANSFER

Course Code	19ME3601	Year	III	Semester	II
Course Category	Program Core	Branch	ME	Course Type	Theory
Credits	4	L – T – P	3 – 1 – 0	Prerequisites	Nil
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes		Levels
Upon successful completion of the course, the student will be able to		
CO1	Describe modes of heat transfer	L1
CO2	Formulate one dimensional steady and transient conduction heat transfer problems and explain concept of fins	L2
CO3	Explain concepts on forced convective heat transfer, significance of non-dimensional numbers and free convection heat transfer	L2
CO4	Solve problems based on boiling, condensation, LMTD and NTU methods.	L3
CO5	Describe basic concepts of radiation heat transfer including both black body radiation and gray body radiation.	L2

	Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3				1							1	1
CO2	2	3				2							3	3
CO3	2	3				2							3	3
CO4	2	3				2							3	3
CO5	2	3				2							3	3

Syllabus		
Unit No	**Contents**	**Mapped COs**
I	**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.	CO1
II	**ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER-**Steady, unsteady and periodic heat transfer – Initial and boundary conditions. Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – Critical radius of insulation - Variable Thermal conductivity – systems with and without 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 Chart solutions of transient conduction systems.	CO2

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 Pi 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. FREE CONVECTION: Development of Hydrodynamic and thermal boundary layer along a vertical plate – Use of empirical relations for Vertical plates.	CO3
IV	**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. **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.	CO4
V	**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.	CO5

Learning Recourse(s)

Text Book(s)

1. Heat and Mass Transfer by Y.A Cengel, A J Ghajar, Mc Graw Hill education,2011.
2. Heat transfer, by J.P.Holman, TMH publications, 2008 .
3. Heat and Mass Transfer, by Sachdeva, New age International.

Reference Book(s)

1. Engineering Heat & Mass transfer by Mahesh.M.Rathor ,University science press ,2006
2. Heat Transfer -A Basic Approach, by N.Ozisik , MC Grawhill,1985
3. Heat transfer, by S.P.Sukhatme , Orient longman Pvt. Ltd. 2005
4. Introduction to Heat Transfer, by lncropera and Dewitt, Wiley Publishers,2001
5. Heat Transfer, by D.S. Kumar, SK. Kataria & sons,2009.

e-Resources & other digital material

1. https://nptel.ac.in/courses/112/108/112108149/
2. https://nptel.ac.in/courses/112/105/112105271/
3. .https://nptel.ac.in/courses/103/103/103103031/#

Data book to be allowed in examination:

C.P.Kothandaraman & S. Subramanyam, Heat and Mass Transfer Data Book, New Age International Publishers – Sixth edition.