HEAT TRANSFER

Course code	23ME3601	Year	III	Semester	II
Course category	Engineering Science Course	Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Basic Thermodynamics
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

CO	Statement	Skill	Blooms	Units
CO1	Find heat transfer rate for 1D, steady state composite systems with heat generation and performance of pins.	Understand	L2	1,2,3,4,5
CO2	Understand the concepts transient heat conduction and basic laws involved in the convection heat transfer.	Apply	L3	1,2
CO3	Apply the empirical equations for forced convection and free convection problems	Apply	L3	3
CO4	Examine the rate of heat transfer with phase change and in the heat exchangers.	Analyse	L3	4, 5
CO5	Illustrate the concepts of radiation heat transfer	Apply	L3	5

		Contribution of Course Outcomes towards the achievement of Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	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 CO
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	CO1, CO2

	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. 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.	
II	**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. **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.	**CO1, CO2**
III	**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. **Free Convection:** Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.	**CO1, CO3**
IV	**Heat Transfer with Phase Change:** **Boiling**: – Pool boiling – Regimes – Calculations on Nucleate boiling, CriticalHeat 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	**CO1, CO4**

	using LMTD and NTU methods.	
V	**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.	**CO1, CO5**

Note: Heat transfer data book by C P Kothandaraman and Subrahmanyan **is allowed.**

Learning Resource
Text books:
1. Heat Transfer by HOLMAN, Tata McGraw-Hill 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, New Age. 3. Heat& Mass Transfer by Amit Pal – Pearson Publishers 4. Heat Transfer by Ghoshadastidar, Oxford University press. 5. Heat Transfer by a Practical Approach, YunusCengel, Boles, TMH