ME387: HEAT TRANSFER
CREDITS = 5 (L=3, T=0, P=2)

Course Objective:

To introduce the basic principles of heat transfer and to develop methodologies which facilitate the application of the subject to practical problems.

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				
L	T	P	C	Theory		Practical		Total Marks
				ESE	CE	ESE	CE	
3	0	2	5	70	30	30	20	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Fundamental:** Modes of heat transfer, effect of temperature on thermal conductivity of different solids, liquids and gases, derivation of generalized equation in Cartesian, cylindrical and spherical coordinates and its reduction to specific cases, General laws of heat transfer.	03
2	**Conduction:** Fourier's law, One dimensional steady state conduction, heat conduction through plane and composite walls, cylinders and spheres, electrical analogy, critical radius of insulation for cylinder and sphere, overall heat transfer coefficient. **Transient heat conduction**: lumped heat capacity analysis, time constant, transient heat conduction in solids with finite conduction and convective resistances **Heat transfer from extended surface:** Types of fin, heat flow through rectangular fin, infinitely long fin, fin insulated at the tip and fin losing heat at the tip, efficiency and effectiveness of fin, Biot number, Estimation of error in temperature measurement in a thermometer well.	10
3	**Convection:** Newton's law of cooling, Dimensional analysis applied to forced and free convection, dimensionless numbers and their physical significance, empirical correlations for free and forced convection Continuity, momentum and energy equations, thermal and hydrodynamic boundary layer, Blasius solution for laminar boundary layer, General solution of Von-Karman integral momentum equation.	09
4	**Radiation:** Absorptivity, reflectivity and transmissivity, black, white and grey body, emissive power and emissivity, laws of radiation – Planck, Stefan-Boltzmann, Wein's displacement, Kirchhoff's law, intensity of radiation and solid angle, Lambert's cosine law Radiation heat exchange between black bodies, shape factor, heat exchange between non-black bodies- infinite parallel planes and infinite long concentric cylinders, radiation shield, heat exchange between two grey surfaces, electrical analogy	09

Unit No.	Topics	Teaching Hours
5	**Heat exchanger:**	
	Classification, heat exchanger analysis, LMTD for parallel and counter flow exchanger, condenser and evaporator, overall heat transfer coefficient, fouling factor, correction factors for multi pass arrangement, effectiveness and number of transfer unit for parallel and counter flow heat exchanger, introduction of heat pipe and compact heat exchanger.	07
6	**Two-phase heat transfer:**	
	Boiling of liquids, Pool boiling curve, different types of pool boiling, condensation of vapor. Film wise & drop wise condensation.	04
	TOTAL	**42**

List of References:

1. P.K. Nag, "Heat & Mass Transfer", McGraw-Hill Education.
2. Yunus Cengel, "Heat and Mass Transfer: Fundamentals and Application", McGraw Hill.
3. Incropera and Dewitt, " Fundamental of Heat and Mass Transfer ", Wiley Publication
4. J P Holman, "Heat Transfer", McGraw Hill
5. R K Rajput," Heat and Mass Transfer", S.Chand Publication

Course Outcomes (COs):

At the end of this course students will be able to …

1. Understand basic concept of conduction, convection and radiation heat transfer.
2. Analyze basic calculations involving conduction heat transfer.
3. Deduce governing equations of convection heat transfer applying physical concepts and laws and apply in practical cases.
4. Deduce governing equations of radiation heat transfer applying physical concepts and laws and apply in practical cases.
5. Analyze and thermal design of heat transfer equipment's.
6. Investigate two phase heat transfer.