B.E Semester: 5 Mechanical Engineering
Subject Name: Heat and Mass Transfer (MA502-N)

A. Course Objective

The course should enable the student to

- Know about concept and application of conduction.
- Understand the concept and application of convection
- Learn the concept and application of radiation
- Understand the principle of heat transfer and heat exchangers.
- Understand the principle of mass transfer

B. Teaching / Examination Scheme:

Teaching Scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
4	0	2	6	5	3	70	30	20	30	150

C. Detailed Syllabus:

Unit No.	Details
1	**Conduction** Fourier's law of heat conduction, derivation of generalized equation in the Cartesian, cylindrical and spherical co-ordinates, one dimensional steady state conduction. Thermal conductivity of metals, refractory and building materials, liquids & gases. Temperature distribution and heat flow in steady state through plane, cylindrical and spherical walls wi th constant and variable thermal conductivity, composite walls, electrical analogy, transient heat conduction, critical thickness of insulation
2	**Convection** Newton – Rikhman law, dimensional analysis applied to forced and free convection, Dimensionless numbers & their physical significance, empirical correlations for free and forced convection. Hydrodynamic boundary layer, continuity and momentum equations, Blasius solution for laminar boundary layer, Von – Karman integral momentum equation, thermal boundary layer, energy equation for thermal boundary layer, use of Pohlh'ausen solution for energy equation, integral energy equation.
3	**Radiation** Concept of radiation, absorptivity, reflectivity & transmissivity, black, white and grey surfaces, emissive power & emissivity. Laws of radiation – Planck, Stefan – Boltzman , Wein's displacement, Kirchoff. Intensity of radiation & solid angle, Lambert's cosine law, shape factor. Radiation exchange between non black bodies, radiation shield, heat exchange between two grey surfaces, electrical analogy
4	**Heat transfer from extended surface** Heat flow through rectangular fin, Heat dissipation from an infinitely long fin, fin insulated at 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.
5	**Heat Exchangers** Types, Heat exchanger analysis, LMTD for parallel & counter flow heat exchanger, overall heat transfer

	coefficient, fouling, correction factor for multi-pass arrangement, effectiveness and number of transfer unit for parallel and counter flow heat exchanger
6	**Mass Transfer** Modes of mass transfer, concentrations, velocities and fluxes, Fick's law, general equation of mass diffusion in stationary media, equimolal diffusion, diffusion of water vapour through air, mass transfer coefficient, convective mass transfer.
7	**Boiling & Condensation** General aspects of boiling, boiling regimes, bubble growth, nucleate boiling, film boiling, boiling correlations, film wise & drop wise condensation, Laminar film condensation on vertical plate, turbulent film condensation, film condensation on tubes.

Total hours (Theory):64
Total hours (Practical):32
Total hours:96

D. Lesson Planning:

Sr. No.	Date/Week	Unit	Weight age	Topic No
1	1^{st} ,2^{nd} ,3^{rd}	Unit 1	20%	1
2	4^{th} .5^{th} ,6^{th}	Unit 2	20%	2
3	7^{th} , 8^{th} ,9^{th}	Unit 3	20%	3,4
4	10^{th} .11^{th} . 12^{th}	Unit 4	20%	5,6
5	13^{th} , 14^{th} ,$15^{th,}$,16^{th}	Unit 5	20%	7

E. Instructional Method & Pedagogy

1	At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
2	Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal Weight age should be given to all topics while teaching and conduction of all examinations.
3	Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
4	One/Two internal exams may be conducted and total/average/best of the same may be converted toequivalent of 30 marks as a part of internal theory evaluation.
5	Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
6	Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overallinternal evaluation.
7	The course includes a laboratory, where students have an opportunity to build an appreciation for theconcept being taught in lectures. Suggested list of experiment is given below

F. List of Practical:

1	Performance of conduction heat transfer in composite wall.
2	Performance of conduction heat transfer in metal rod.
3	Performance of conduction heat transfer through insulating powder.
4	Performance of conduction heat transfer from a Pin Fin.
5	Performance of convection heat transfer in forced convection.
6	To Performance unsteady state heat transfer by the lumped capacitance.

7	Performance of heat transfer phenomena in parallel/ counter flow arrangement.
8	To Performance of heat transfer in the process of condensation.
9	To demonstrate the super thermal conduction heat pipe and to compare its working with that of the best conductor i.e. cu pipe..
10	To determine the value of Stefan-Boltzmann constant for radiation heat transfer.
11	To measure the emissivity of test plate.
12	To Performance the pool boiling phenomena and measure the critical heat flux.

G. Students Learning Outcomes:

1	The student can identify different areas of Heat and Mass Transfer.
2	Can find the applications of all the areas in day to day life.

H. Text Books & Reference Books:

1	Heat & Mass Transfer by D. S. Kumar, S.K.Kataria& Sons
2	Heat & Mass Transfer by R. K. Rajput, S.Chand& Co.
3	Heat & Mass Transfer by Arora &Domkundwar, Dhanpatrai& co
4	Engineering Heat & Mass Transfer by M.M.Rathore, LaxmiPrakashan
5	Fundamentals of Heat & Mass Transfer by Incropera& Dewitt, John Wiley& Sons
6	Heat Transfer by Holman, Tata Mc Graw Hill
7	Heat Transfer –A Practical Approach by YunusCengel, Tata Mc Graw Hill