Course Code TEE-815	Credit Hours (Th-Pr) 3-0	**Advanced Heat and Mass Transfer (Elective)**	Contact Hrs/Week (Th-Pr) 3-0	Total Contact Hrs (Th-Pr) 45-0

Course Outline:

i. Conduction

One dimensional and two dimensional, steady state conduction. One dimensional and two dimensional transient conduction.

ii. Convection

Convection boundary layers. Laminar and turbulent flow. External flow. Internal flow. Free convection. Boiling and condensation. Pool boiling, forced convection boiling. Laminar and turbulent film condensation.

iii. Heat Exchangers

Heat exchangers types, log mean temperature. The Effectiveness - NTU Method.

iv. Radiation

Radiation intensity, emission, irradiation, radiosity. Surface absorption, reflection and transmission. Kirchaws law. Radiation exchange between surfaces. Diffusion Mass Transfer (5%) Fick´s law of diffusion. Conservation of species. Evaporation.

v. Numerical methods in heat transfer

Eligibility Criteria:

B.E in Mech., Elect (Power), Chemical, Industrial, Process

B.S (4-years) Or M.Sc. degrees in Physics

Recommended Books:

S.	Title	Author(s)	Assigned	Remarks

No.			Code	
1.	Heat and Mass Transfer A practical approach	Yunus A. Çengel	YA	Text Book
2.	Advanced Heat and Mass Transfer	Amir Faghri, Yuwen Zhang, John Howell	AF	Reference
3.	Computational Methods for Heat and Mass Transfer	Pradip Majumdar, Pradip Majumdar	PM	Reference
4.	Heat Exchangers: Selection, Rating, and Thermal Design,	Sadik Kakaç, Hongtan Liu	SK	Reference
5.	Engineering Heat Transfer	William S. Janna	WS	Reference
6.	Transient Heat Transfer	Annaratone, Donatello	AD	Reference

Course Objectives:

The goals of this course are:

- To Develop a strong physical and conceptual understanding of heat and mass transfer processes; and
- Learn about their application to thermal energy systems and other technologies.

Learning outcome:

This course is designed to introduce the students with phenomena of heat and mass transfer, to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems and processes. A knowledge-based design problem requiring the formulations of solid conduction and fluid convection and the technique of numerical computation progressively elucidated in different chapters will be assigned and studied in detail.

Topics Covered:

No.	Topics	Book	Contact Hours
1.	**Conduction Heat transfer** • Differential equations for heat conduction in solid materials. • Solutions for different special cases. Fin efficiency for different fin designs • Two and three-dimensional cases at stationary conditions. • Laplace equation. The form factor. Numerical solution methods and analogy methods. Numerical solutions of unsteady conduction and steady conduction • Non-stationary cases. Solutions for flat surfaces and cylinders • The "Lumped heat capacity" method. • Unsteady state conduction in solids with infinite thermal conductivity, infinite thick-solids, periodic variation	YA,AF & AD	12
2.	**Convection heat transfer** • Forced convection inside tubes and ducts • Forced convection over exterior surfaces • Heat transfer at natural (free) convection, Grashof's number. Boundary layer equations in integral form with solutions for natural convection for vertical plates • Empirical relationships for laminar and turbulent boundary layers at vertical and horizontal plates, cylinders and slots • Transitional Flow in tubes	YA,AF & AD	10
3	**Radiation Heat Transfer** • Heat transfer at radiation • The "black body" concept. Emission and absorption numbers. Radiant efficiency, angular factor. • Heat transfer at irradiated surfaces	YA& AF	7

	• Heat transfer at condensation • Nusselt's theory, condensation on and in horizontal pipes • Heat transfer at boiling and various types of boiling, the boiling curve		
4.	**Heat exchangers** • Different types of heat exchangers, Fouling Factor, logarithmic mean temperature difference, temperature effectiveness, NTU, Selection Techniques of the heat exchangers.	YA; SK & AF	8
5.	**Mass Transfer** • Introduction, Fick's law, General equation of mass diffusion steady state, diffusion through a plain membrane, diffusion of water vapor through air, Mass transfer coefficient, convective mass transfer	YA& AF	8