ADVANCED HEAT AND MASS TRANSFER

CourseCode		Year		Semester	
Course Category	HONORS	Branch	ME	Course Type	Theory
Credits	3	L – T – P	3 – 0 – 0	Prerequisites	Thermodynamics, Fluid Mechanics, Differential Calculus
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes: Upon successful completion of the course, the student will be able to

	Statement	Skill	BTL	Units
CO1	Understand the basic concepts of Heat and Mass Transfer	Understand	L2	1,2,3,4,5
CO2	Apply the various numerical approaches in solving convection heat transfer problems	Apply	L3	2,3
CO3	Analyze the systems with various numerical approaches to solve Conduction and Radiation problems	Analyze	L4	1,4

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	3	3	2	1	1							1	3	1
CO2	3	3	2	1	1							1	3	1
CO3	3	3	2	1	1							1	3	1

Syllabus

UNIT	Contents	Mapped COs
I	**Modes of Heat Transfer, Steady State Conduction:** Analytical Solution- Method of separation of variables, Numerical Solution- FDM **Unsteady Conduction:** Lumped Heat Capacity System, Transient heat conduction in infinite plates, long cylinders and spheres, Heisler charts for Transient heat flow and semi-infinite solids, numerical solution for transient heat flow, explicit approach, Implicit approach.	CO1
II	**Forced Convection:** Mechanism of convective heat transfer, Dimensionless expression of heat transfer coefficient. Laminar Boundary Layer: solution of boundary layer equation for flow over flat plate (Blasius solution), wall shear stress and boundary layer thickness, solution of momentum integral equation (Karman Pohihausen method), Boundary layer Analogies, Use of empirical correlations for flow over a flat plate, flow across cylinders and spheres, tube banks – inline and staggered arrangement.	CO1, CO2
III	**Free-Convection:** Mechanism of Natural convective heat transfer, Laminar free convection on a vertical surface, approximate solution by the integral method, Use of empirical correlations for vertical plates, horizontal plates, cylinders, spheres and enclosed spaces, Combined free and forced convection.	CO1, CO2

IV	**Radiation Heat Exchange**: Radiation heat exchange between black and non-black surfaces separated by non-participating media. **Gas Radiation:** Radiation transfer in enclosures containing absorbing and emitting media - interaction of radiation with conduction and Convection.	**CO1, CO3**
V	**Diffusion Mass Transfer:** Physical Origins and Rate Equations: Fick's law of Diffusion; initial and boundary conditions, mass transfer in non-stationary media, the stationary media approximation, conservation of species for a stationary medium.	**CO1, CO3**

Learning Resources
Text books
1.Introduction to Heat Transfer – S.K. Som, PHI. 2.Principles of Heat and Mass Transfer – Frank P Incropera, David P. Dewitt, Theodore L Bergman and Adrienne S Lavine, Wiley. 3.Heat and Mass transfer - P.K. Nag, TMH.
Reference books
1.Heat Transfer - A Basic Approach - Ozisik M.N., McGraw-Hill. 2.Convective heat and mass transfer - Kays, W.M. and Crawford, M.E., McGraw Hill. 3.Heat and mass transfer - D.S. Kumar, Kataria & sons.
E- Resources & other digital material
1.http://nptel.ac.in/courses/112101097/ 2.http://nptel.ac.in/courses/Webcourse contents/IIScBANG/Heat%20and%20Mass%20Transfer/New_index1.html 3.http://textofvideo.nptel.iitm.ac.in/112101097/lec1.pdf 4.http://www.nptelvideos.in/2012/11/heat-transfer.htm

Data Books

1. Heat and Mass Transfer Data Book by Kothandaraman and Subramanian (or) Domkundwar to be allowed in Examination