Course Type	Course Code	Name of Course	L	T	P	Credit
DC	MEC 208	Heat and Mass Transfer	3	0	0	9

Course Objective

The objective of the course is to develop the fundamental concepts and principles for various modes of heat and mass transfer processes with derivations and applications of rate equations under various operating condition.

Learning Outcomes

Upon successful completion of this course, students will:

- have a broad understanding of different rate equations related to various modes of heat transfer
- be able to determine heat and mass transfer rates under various operating conditions.
- have the concept to solve heat and transfer equations both analytically and numerically.
- be able to model systems involving heat and mass transfer
- be able to design and optimize the thermal systems to maximize or minimize heat transfer.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Introduction:** Definitions, Mechanisms and rate equations of conduction, convection and radiation, conservation of energy for a control volume	4	Understanding mechanism for different modes of heat transfer and the basic rate equations.
2	**Conduction:**General heat conduction equation in different coordinate systems, one-dimensional steady state heat conduction for plane wall, cylindrical and spherical systems with and without heat generation – temperature distribution, thermal resistance, composite systems, Critical thickness of insulation. Heat transfer through extended surface with uniform cross-sectional area, fin performance; Transient heat conduction: lumped capacitance method, Spatial effects, plane wall with convection – exact and approximate solutions, Heisler and Grober charts.	10	Derivation of general heat conduction equation and its applications. Determination of 1-D heat transfer for different types of systems Use of boundary conditions, Estimations of enhancement of heat transfer through extended surfaces Methods of finding heat transfer rate when heat flow is dependent on time.
3	**Convection**: Basic concept, natural and forced convection, hydrodynamic and thermal boundary layers, Mass, Momentum and energy equations in forced convection, dimensionless numbers, Solution of laminar flow over a flat plate; momentum and energy equations for natural convection, empirical correlations, and introduction to boiling and condensation heat transfer	10	Basic concepts of heat transfer by forced and natural convection, determination of heat transfer rate over a flat plate. Heat transfer phenomena during phase change of a substance and the corresponding rate equations
4	**Radiation:** Fundamental concepts, Radiation properties and laws of black body radiation, Kirchhoff's law, radiation heat exchange between black and non-black surfaces, radiation shield.	7	Basic concepts of radiation mode of heat transfer, Understanding blackbody radiation and radiation heat exchange between two bodies
5	**Heat Exchanger:** Classification of heat exchanger, recuperative and regenerative heat exchangers, parallel, counter and cross flow heat exchangers, shell and tube heat exchangers, performance of heat exchangers, effectiveness, Number of Transfer unit and capacity ratio	6	Understanding the methodology of designing heat exchangers To determine the heat transfer and performance of heat exchangers

6	**Mass Transfer:** Basic concept, Fick's law of diffusion, Introduction to diffusive and convective mass transfer, different dimensionless numbers and empirical correlations	5	Basic understanding of mass transfer processes and determination of mass transfer rates

Text book

1. Fundamentals of Heat and Mass Transfer-Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. Dewitt, Wiley publication, 8th Edition, 2018

Other References

1. Heat transfer- J.P. Holman Bhattacharya, McGraw Hill, 10th edition, 2011
2. Heat and Mass Transfer: Fundamentals and Applications By YunusCengel and AfshinGhajar ,McGraw Hill, 6th edition, 2019
3. Heat Transfer – A F Mills and V Ganesan, Pearson Education, 2nd edition, 2009