NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY, SCHOOL OF ENGINEERING
B Tech in Mechanical Engineering
Semester V

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Course Code	**2ME503**
Course Title	**Heat and Mass Transfer**

Course Outcomes (CO):

After successful completion of the course, student will be able to-

1. assess the principles of steady and unsteady state heat conduction,
2. interpret the principles of heat transfer by convection,
3. apply the concepts of radiation heat transfer for practical applications,
4. infer the principles of heat transfer for applications such as boiling and condensation, heat exchanger design and mass transfer.

Syllabus **Teaching Hours: 45**

UNIT I **Conduction** **10 hours**

Derivation of generalized equation in Cartesian, Cylindrical and Spherical coordinates, generalized transport equation, one-dimensional steady state heat transfer equations, heat transfer calculations in slabs, cylinders and spheres, use of electrical analogy and estimation of resistance and heat transfer, factors affecting thermal conductivities of various substances, properties of insulation and their importance, critical thickness of insulation. Transient heat conduction in solids – lumped analysis and one dimensional analysis using Heisler charts. Use of finite difference techniques for solving heat conduction problems.

UNIT II **Heat transfer through extended surfaces** **03 hours**

Types, arrangement and application, determination of fin temperature and heat transfer, fin effectiveness and fin efficiency.

UNIT III **Convection** **08 hours**

Dimensionless numbers, concept of hydrodynamics and thermal boundary layers, continuity momentum equation & energy equation, derivation of generalized equation in dimensionless groups for free & forced convection by dimensional analysis and principle of similarity, use of empirical co-relations to determine heat

transfer co-efficient in natural and forced convection for parallel, counter and cross flow arrangements.

UNIT IV	**Boiling and Condensation**: Boiling curve and modes of pool boiling, flow boiling, film and dropwise condensation.	**04 hours**
UNIT V	**Radiation** Concept of black and grey surfaces, laws of radiation, Kirchoff's, Stephan–Boltzmann's, Planck's and Wien's laws, emissivity, electrical analogy, heat exchange between black and grey surfaces and enclosed body and enclosure, radiation shield and their effects, use of electrical analogy methods.	**09 hours**
UNIT VI	**Heat Exchangers** Types and classification, fouling factors, overall heat transfer coefficient, LMTD calculation for parallel flow, counter flow and cross flow heat exchangers, effectiveness – NTU method, effectiveness and efficiency of heat exchangers, designation of shell and tube heat exchangers as per TEMA standards.	**08 hours**
UNIT VII	**Mass transfer**: Fick's law, equimolal diffusion, diffusion of vapors through a stagnant medium, applications.	**03hours**

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 10 experiments/exercise to be incorporated.

Suggested Readings:

1. Cengel Y., Ghajar A., Heat and Mass Transfer, McGraw Hill.
2. Incropera F., DeWitt D. Fundamentals of Heat and Mass Transfer, John Wiley.
3. Sukhatme S.P., Heat Transfer, Universities Press.
4. Holman J. P., Heat and Mass Transfer, McGraw Hill.
5. Kumar D. S., Heat and Mass Transfer, Kataria and Sons.
6. Nellis G.,Klein S., Heat Transfer, Cambridge University Press

L=Lecture T= Tutorial P=Practical, C=Credit