GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 1

Mechanical Engineering (Cryogenic Engineering)

Subject Name ADVANCED HEAT & MASS TRANSFER

Sr.No	Course content
1.	Conduction: Factors affecting thermal conductivity of solids, liquids & gases. General three dimensional heat conduction equation in Cartesian, cylindrical & spherical coordinates. Initial condition and various boundary conditions. Heat sources systems, Critical thickness of insulation. Different types of fins & their analysis. Two dimensional steady state conduction. Transient heat conduction.
2.	Convection: Free & forced convection, Similarity & simulation of convection heat transfer, Boundary layer theory, Turbulent flow heat transfer. Analogy between momentum & heat transfer. Heat transfer with liquid metals. Recent developments in the theory of turbulent heat transfer. Natural convection under different situations. Empirical relations in convection heat transfer.
3.	Two phase flow & heat transfer: Boiling- Introduction to boiling heat transfer, regimes of boiling heat transfer, pool boiling, flow boiling. Condensation- Heat transfer in condensation, Drop wise & film wise condensation. Empirical equations.
4.	Radiation: Laws of thermal radiation. Shape factors. Radiation heat transfer between black, diffuse & gray surface.
5.	Design of Heat Exchanger: LMTD Methods, importance of fouling factor, Overall heat transfer co-efficient, NTU- effectiveness method, Analysis of compact heat exchanger—plate-fin heat exchangers, regenerative type heat exchanger. Optimization & simulation of heat exchangers.
6.	Basic aspects of heat transfer in porous media.
7.	Mass Transfer: Modes of mass transfer, comparison between heat & mass transfer, Frick's law of diffusion, general mass diffusion equation, diffusion through stagnant gas, convective mass transfer, dimensionless parameters & dimensional analysis of convective mass transfer, Evaporation of water in air.

List of Experiments:

1. Thermal conductivity of metallic rod
2. Thermal conductivity of insulating powder
3. Thermal conductivity of composite wall
4. Natural convection experiment
5. Forced convection
6. Heat transfer in pin-fin
7. Stefan Boltzmann's constant
8. Measurement of emissivity of test surface
9. Effectiveness of heat exchanger

10. Critical heat flux
11. Heat pipe
12. Calibration of thermo couple with the help of the test rig
13. To find the diffusivity of volatile liquid
14. Comparison of filmwise and dropwise condensation.

Reference Books:

1. 1. J.P. Holman, “Heat Transfer”, McGraw Hill Book Co. 9th edition, 2008.
2. Roshenow, W. Hartnell, J. Ganic, “Hand Book of Heat Transfer”, Vol. 1 & 2, Mcgraw Hill, 2005.
3. Incropera & Hewitt, “Fundanentals of Heat & Mass Transfer”, John Willey, 2005.
4. Engineering heat & mass transfer by **Mahesh M. Rathore**.
5. S.P.Sukhatme “Heat Transfer “ University Press
6. Eckert and Drake. Heat and Mass transfer. McGraw Hill
7. Collier, J.B. and Thome, J.R., *Convective boiling and condensation*, Oxford Science Publications, 1994.
8. L S Tong and Y S Tang. *Boiling Heat Transfer and Two-Phase Flow*. Taylor and Francis, 1997.
9. P.B Whalley. *Boiling, Condensation and Gas-Liquid Flow.* Oxford University Press, 1987.
10. Louis C Burmeister, *Convective Heat Transfer*, John Wiley and Sons, 1993.
11. Adrian Bejan, *Convective Heat Transfer*, John Wiley and Sons, 1995.