2. HEAT TRANSFER

Module I (13 Hours)

Introduction: The three modes of heat transfer, basic law of heat transfer. Analogy between heat flow & electrical flow.

Conduction: The Fourier heat conduction equation, Steady state one dimensional heat conduction through plane wall, cylindrical wall, spherical wall, and composite structure. Heat transfer from extended surfaces. Unsteady state heat conduction through semi-infinite stab, cylindrical & sphere. Critical insulation thickness.

Module II (13 Hours)

Convection: The convective heat transfer coefficient, introduction to thermal boundary layer. Dimensionless numbers in heat transfer and their significance. Forced convection: Heat transfer by forced convection inside tubes and ducts in laminar, transition and turbulent flow. Natural Convection: Grashoff number, Natural Convection from vertical and horizontal surfaces.

Module III (10 Hours)

Radiation: Thermal transition, black body radiation, Kirchhoff's law, emissivity, grey body laws of black body radiation, geometric factor

Heat exchangers: Types of heat exchangers, log mean temperature difference energy balances. Overall heat transfer coefficients. Heat exchanges effectiveness, Fouling factors,

Module IV (12 Hours)

Heat transfer with phase change: Heat transfer from condensing vapours, film and dropwise condensation. Derivation and practical use on Nusselt equation. Condensation of superheated vapours. Effect of non-condensable gases on ratio of condensation. Heat transfer to boiling liquids. Boiling of saturated liquids. Maximum heat flux and critical temperature, minimum flux and film boiling, sub cooled boiling.

Evaporation: Types of evaporators, capacity and economy of evaporators, boiling point elevation and Duhring's rule material and Energy evaporators. Methods of feeding capacity and economy of multiple effect evaporators.

Text and Reference Books:

1. J.P. Holman, Heat Transfer, McGraw-Hill
2. Mc Cabe W.L & Smith J.C. & Harriot P. Unit Operation of Chemical Engineering (5^{th} Edition) Mc Craw Hill
3. M. Necati Ozisik, Heat Transfer: A Basic Approach, McGraw-Hill Education
4. P.K. Nag, Heat Transfer, Tata Mcgraw-Hill
5. S.P. Sukhatme, Heat Transfer, Universities Press
6. W.H. Mc Adams, Heat Transmission, Krieger Pub. Co.

7. Y. Cengel and A. Ghajar, Heat and Mass Transfer: Fundamentals and Applications, McGraw-Hill
8. D.G. Kern, Process Heat Transfer, Tata McGraw-Hill