UG Department: **Chemical Engineering**
Course Code: **CH202** Course Name: **Heat Transfer**
Credit: **4** L-T-P: **3-1-0**
Version: **1** Approved on:
Prerequisite Course: **Nil**

Introduction: Modes of heat transfer: conduction, convection, radiation.
Steady-State Conduction in One Dimension: Fourier's Law, thermal conductivity, steady-state conduction of heat through a composite solid, cylinder and sphere. Steady-state heat conduction in bodies with heat sources: plane wall, cylinder and sphere.
Heat Transfer Coefficient: Convective heat transfer and the concept of heat transfer coefficient, overall heat transfer coefficient, heat transfer from extended surfaces, thermal contact resistance, critical insulation thickness, optimum insulation thickness.
Forced Convection: Flow over a flat plate, thermal boundary layer, flow across a cylinder. Dimensional analysis: Buckingham Pi theorem, Dimensional groups in heat transfer. Correlations for the heat transfer coefficient: Laminar flow through a circular pipe, turbulent flow through a circular pipe, flow through a non-circular duct, flow over flat plate, flow across a cylinder, flow past a sphere, flow across a bank of tubes, heat transfer coefficient in a packed and fluidized bed.
Double-pipe heat exchanger in parallel and counter-current flow.
Free Convection: Introduction, heat transfer correlations for free convection: flat surface, cylinder, sphere, enclosure. Combined free and forced convection.
Boiling and Condensation: Boiling phenomenon, nucleate boiling, Correlations for pool boiling heat transfer: Nucleate boiling, critical heat flux, stable film boiling. Forced convection boiling, condensation phenomena, film condensation on a vertical surface, turbulent film condensation, condensation outside a horizontal tube and tube bank. Condensation inside a horizontal tube, effect of non-condensable gases. Dropwise condensation.
Radiation Heat Transfer: Basic concepts of radiation from a surface: black body radiation, Planck's Law, Wien's Displacement Law, Stefan-Boltzmann Law, Kirchoff's Law, Gray body. Radiation intensity of a black body, spectral emissive power of a black body over a hemisphere. Radiation heat exchange between surfaces – the view factor. Radiation exchange between black bodies and between diffuse gray surfaces.
Heat Exchangers: Construction of a shell-and-tube heat exchanger, fouling of a heat exchanger, LMTD, temperature distribution in multi-pass heat exchangers, individual heat transfer coefficients. Types of shell-and-tube heat exchanger.
Evaporators: Types of evaporators: Natural-circulation evaporators, forced--circulation evaporators, falling film evaporators, climbing-film evaporators, agitated thin-film evaporators and plate evaporators. Principles of evaporation and evaporators; Single and multiple effect evaporators, Capacity and economy, Boiling point rise, heat transfer coefficient enthalpy of a solution. Calculations of a single effect evaporator.

Unsteady-State Heat Conduction: Mathematical formulations and initial and boundary conditions. Analytical solution, numerical solution.

Books

1. Dutta, B. K. "Heat transfer: Principles and Applications", PHI, New Delhi, 2001.

2. Holman, J. P., "Heat Transfer", McGraw Hill, New York.
3. Chapman, A. J., "Heat Transfer", Maxwell Macmillan, 1984.
4. Kern, D. Q., "Process Heat Transfer", Tata- McGraw Hill, 1950.
5. Hewitt, G. F. Sires, G. L. and Bott, T. R. "Process heat transfer", CRC Press 1994.