

(CH206) PROCESS HEAT TRANSFER

Objective of the Course:

Practically all the operations that are carried out by the chemical engineer involve the production or absorption of energy in the form of heat. The laws governing the transfer of heat and types of apparatus that have for their main object the control of heat flow are therefore of great importance for a prospective chemical engineer.

UNIT - I

Heat Transfer and Its Applications: Nature of heat flow, Conduction, Convection, Radiation Heat Transfer by Conduction. Fourier's law of conduction, Thermal conductivity, Steady state conduction, Compound resistances in series, Heat flow through cylinder, Unsteady state conduction, Semi-infinite solid. Principles of heat flow in fluids: Heat exchange equipment, Counter current & parallel current flows, Energy balances, Rate of heat transfer, LMTD, Individual heat transfer coefficients, Overall heat transfer coefficient, Fouling factors, Unsteady state heat transfer.

UNIT - II

Heat Transfer to Fluids Without Phase Change: Regimes of heat transfer, Thermal boundary layer, Heat transfer by forced convection in laminar flow, Heat transfer by forced convection in turbulent flow, Analogy between transfer of heat and momentum, Reynolds analogy, Colburn analogy, Heat transfer in transition region, Transfer to liquid metals, Interpretation of dimensionless groups. Natural Convection: Dimensional analysis, Natural convection to vertical shapes and horizontal planes.

UNIT - III

Heat Transfer to Fluids With Phase Change: Drop wise and film type condensation, Coefficients for film type condensation, Practical use of nusselt equations, Condensation of super heated vapors, Effect of non condensable gases on rate of condensation, Heat transfer to boiling liquids, Pool boiling of saturated liquid, Maximum Flux and critical temperature drop, Minimum flux and film boiling.

UNIT - IV

Radiation Heat Transfer: Fundamental facts concerning radiation, Emission of radiation, Black body radiation, Laws of black body radiation, Absorption of radiation by opaque solids, Radiation between surfaces, Non black surfaces, Radiation to semitransparent materials, Combined heat transfer by conduction-convection and radiation.

UNIT - V

Heat Exchange Equipment: General design of heat exchange equipment, Heat exchangers, Condensers, Boilers, Calandrias, Extended surface equipment.

Evaporation: Liquid characteristics, Types of evaporators, Performance of tubular evaporators, Enthalpy balances for single effect evaporator, Multiple effect evaporators.

TEXT BOOKS:

1. W.L.McCabe, J.C.Smith & P.Harriott, "Unit Operations of Chemical Engineering", 6th ed., McGraw-Hill, Inc., 2001.
2. D.Q.Kern, "Process Heat Transfer", 1st ed., Tata McGraw Hill, 2002.

REFERENCE BOOKS:

1. J.P.Holman, "Heat Transfer", 8th ed., McGraw Hill, New York, 1997.
2. Y.V.C.Rao, "Heat Transfer", 1st ed., University Press, 2001.
3. Donald Pitts, Leighton E, Sissom, "Schaum's Outline of Heat Transfer", 2nd ed., McGraw Hill publications, 1998.
4. J.M. Coulson. J.F.Richardson, "Chemical Engineering", Vol-1, Oxford, Pergamon Press, 1968.
5. Christie J Geankoplis, "Transport Processes and Unit Operations", 3rd ed., PHI Pvt Ltd, 1993.