UCH402 HEAT TRANSFER

L	T	P	Cr
3	1	2	4.5

Prerequisite(s): None

Heat Transfer: Introduction, Applications, Relation between heat transfer and thermodynamics, and transport properties.

Conduction: Fourier's law of conduction, thermal conductivity. Heat conduction equation in rectangular, cylindrical and spherical coordinates, composite wall structure, thick walled tube, sphere, insulation and optimum thickness of insulation, extended surfaces. Unsteady state conduction.

Convection: (a) Natural convection. Heat transfer in laminar and turbulent flows inside tubes. Dimensional analysis, boundary layer, Colburn analogy. Heat transfer by external flows across cylinders, tube bank and spheres. (b) Convection with Phase Change: Condensation, boiling and heat pipes.

Radiation: Basic equations, emissivity, absorption, black and gray body, thermal radiation between two surfaces.

Heat Exchangers: Classification, introduction to LMTD and ε-NTU methods. Design of heat exchangers such as double pipe heat exchanger, shell-and-tube exchanger, Plate heat exchangers, compact heat exchangers, fouling.

Evaporators: Classification, single and multiple effect evaporators, enthalpy balance, performance of evaporators such as capacity and economy, methods of feeding.

Laboratory work

Thermal conductivity of a metal rod, Thermal conductivity of insulating power, Emissivity measurement, Parallel flow/counter flow heat exchanger, Heat transfer through composite wall, Drop wise & film wise condensation, Heat transfer through a pin-fin, Heat transfer in natural convection, Heat transfer in forced convection, Critical heat flux, Stefen-Boltzman's law of radiation, Heat flow through lagged pipe, Shell-and-tube heat exchanger.

Text Books

1. *McCabe, W.L., Smith J.C. and Harriott, P., Unit Operations of Chemical Engineering, McGraw-Hill (2005) 7tyh ed.*
2. *Holman, J.P., Heat Transfer, McGraw Hill (2004) 9th ed.*

Reference Books

1. *Kern, D.Q., Process Heat Transfer, International Student Edition, Tata McGraw Hill (2002).*
2. *Incropera, Frank P., Dewitt, David P., Bergman, Theodore L. and Lavine, Adreienne S., Fundamentals of Heat and Mass Transfer, John Wiley (2007) 6th ed.*
3. *Foust, A.S., Wenzel, L.A, Clump, C.W., Maus, L. and Anderson, L.B., Principles of Unit Operations, John Wiley (2008) 2nd ed.*