4^{th}Semester	RCH4C002	Heat Transfer	L-T-P 3-0-0	3 CREDITS

Module I: (10 hrs)

Introduction: Modes of heat transfer, basic laws of heat transfer, analogy between heat flow andelectrical flow.Conduction: The Fourier heat conduction equation, Steady-state onedimensional heat conduction through plane wall, cylindrical wall, spherical wall and composite structures. Heat transfer from extended surfaces, unsteady state heatconduction through a semi-infinite slab, critical insulation of thickness.

Module II: (09 hrs)

Convection: Introduction to convection: Natural and forced convection, Natural Convection:Grashoff number, natural convection from vertical and horizontal surfaces. Forcedconvection, The convective heat transfer coefficient, introduction to thermal boundarylayer,Dimensionless numbers in heat transfer and their significance, Dimensional analysis,Analogy between heat and momentum transfer,Reynold'sPrandtl and Colburn analogies.

Module III: (07 hrs)

Heat transfer to liquid metals,heat transfer for tubes in cross flow.Heat exchangers: Types of heat exchangers, log-mean temperature difference,energybalances, overall heat transfer coefficients,heat exchanger effectiveness, Fouling factors,design and description of heat transfer equipment.

Module IV: (12 hrs)

Evaporation: Types of evaporators, capacity and economy of evaporators,boiling pointelevation and Duhring's rule,material and energy balance for evaporators, methods offeeding, capacity and economy of multiple effect evaporators.Heat Transfer with phase change: Heat transfer from condensing vapours: film and dropwisecondensation, derivation and practical use of Nusselt equation, condensation ofsuperheated vapours, effect of non-condensable gases on ratio of condensation. Heattransfer to boiling liquids. Boiling of a saturated liquids. Maximum heat flux and criticaltemperature, minimum flux and film boiling, sub cooled boiling.

Module V: (07 hrs)

Heat transfer by radiation: Thermal radiation, black body radiation, Kirchhoff's law,emissivity, grey body, laws of black body radiation, geometric factor, radiation inenclosures with black surfaces and grey surfaces. Large parallel plates, concentric,cylindrical, spheres. Combined heat transfer by conduction, convection, and radiation.

Books:

- Unit Operations of Chemical Engineering, 7th ed. by W L McCabe, J C Smith, and P Harriott, McGraw-Hill.
- Process Heat Transfer by D Q Kern, McGraw-Hill.
- Heat Transfer: A Practical Approach, 2nd ed. by Y A Cengel, McGraw-Hill.
- Heat Transfer, 10th ed. by J Holman and SBhattacharyya, McGraw-Hill.