CH224	PROCESS HEAT TRANSFER	L	T	P	C	Int	Ext
		2	1	-	3.0	30	70

Semester IV [Second Year]

COURSE OBJECTIVES:

1. To describe formulae for steady rate of heat transfer by conduction problems in simple geometries
2. To teach how to estimate the heat transfer coefficients for different flow geometries
3. To impart knowledge on the phenomenon of Heat transfer to fluids with phase change and radiation
4. To explain the working and design of double pipe, shell and tube heat exchangers and evaporators

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Solve steady state heat conduction problems in simple geometries
2. Determine heat transfer coefficients in laminar and turbulent flow conditions and in forced natural convection
3. Estimate heat transfer involving phase change & radiation
4. Design heat exchange equipment such as double pipe & shell and tube heat exchangers used in chemical industry and estimate the performance of a given single/multiple effect evaporators

UNIT I [CO:1] **(12)**

Introduction: Modes of heat transfer, basic laws of heat transfer. Heat Transfer by Conduction, Fourier law of heat conduction, thermal conductivitySteady state conduction in plane, compound resistances in series, Heat flow through a cylinder & spheres, electrical analogy, critical radius of insulation

UNIT II [CO:2] **(12)**

Heat flow in Fluids - Typical heat exchange equipment, energy balances, Heat flux and heat transfer coefficients, LMTD, Individual Heat Transfer Coefficient, Calculation of overall coefficient from individual coefficient, Resistance from overall coefficient, Fouling Factors

Heat transfer to fluids without phase change: Boundary layer - Regimes of heat transfer in fluids, Thermal boundary layer, Heat transfer by forced convection in turbulent flow â€“ Empirical Equations, Effect of Roughness, Effect of High Velocities, The Reynolds analogy, The Colubrun analogy

UNIT III [CO:3] **(12)**

Heat transfer to fluids with phase change: Heat transfer from condensing vapors â€“ Drop wise and Film wise condensation, Heat transfer to boiling liquids â€“ Pool boiling of Saturated liquids, Maximum flux, Minimum flux

Radiation: Introduction, Emission of radiation, Emissive power, black body radiation, emissivity, emissivity of solids, laws of block body radiation, absorption of radiation by opaque solids, Kirchhoffâ€™s law, Radiation between surfaces

UNIT IV [CO:4] **(12)**

Heat-Exchange Equipment: General design of heat exchange equipment, Heat Exchangers - Shell and Tube Heat Exchangers (1-1, 1-2 and 2-4), Heat Exchanger Effectiveness (NTU method), Plate-type exchangers, Extended surface equipment, Heat pipes, Scrapped surface exchangers

Evaporators: Types of evaporators, Performance of Tubular evaporators (capacity and economy), Enthalpy balance for single effective evaporator, Multiple effect evaporators, methods of feeding

LEARNING RESOURCES:

TEXT BOOK:

Unit Operations of Chemical Engineering, Warren L.McCabe, Julian C.Smith, Peter Harriot, 7th edition, McGraw Hill, New Delhi (2008)

REFERENCE BOOK(s):

1. Heat Transmission by H. William and Mc Adams, McGraw Hill (1954)
2. Process Heat Transfer by Donald, Q.Kern, McGraw Hill (2001)
3. Process Heat Transferâ€“Principles and Applications by Robert W Serth, 7th edition, Elsevier Science & Technology Books (2007)