PCE4I102 HEAT TRANSFER

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

Module II:
Convection: Introduction to convection: Natural and forced convection, Natural Convection: Grashoff number, natural convection from vertical and horizontal surfaces. Forced convection, The convective heat transfer coefficient, introduction to thermal boundary layer,Dimensionless numbers in heat transfer and their significance, Dimensional analysis, Analogy between heat and momentum transfer,Reynold'sPrandtl and Colburn analogies. Heat transfer to liquid metals,heat transfer for tubes in cross flow.

Heat exchangers: Types of heat exchangers, log-mean temperature difference,energy balances, overall heat transfer coefficients,heat exchanger effectiveness, Fouling factors, design and description of heat transfer equipment.

Module III:
Evaporation: Types of evaporators, capacity and economy of evaporators,boiling point elevation and Duhring's rule,material and energy balance for evaporators, methods of feeding, capacity and economy of multiple effect evaporators.

Heat Transfer with phase change: Heat transfer from condensing vapours: film and drop-wise condensation, derivation and practical use of Nusselt equation, condensation of superheated vapours, effect of non-condensable gases on ratio of condensation. Heat transfer to boiling liquids. Boiling of a saturated liquids. Maximum heat flux and critical temperature, minimum flux and film boiling, sub cooled boiling.

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

Text Book:

1. *Unit Operations of Chemical Engineering, 7th ed. by W L McCabe, J C Smith, and P Harriott, McGraw-Hill.*

Reference Books:

1. *Process Heat Transfer by D Q Kern, McGraw-Hill.*
2. *Heat Transfer: A Practical Approach, 2nd ed. by Y A Cengel, McGraw-Hill.*
3. *Heat Transfer, 10th ed. by J Holman and SBhattacharyya, McGraw-Hill.*

HEAT TRANSFER LAB

1. *To find the overall heat transfer coefficient in parallel and counter-current heat exchanger.*
2. *To determine the overall heat transfer coefficient of shell and tube heat exchanger.*
3. *To study and operate single effect evaporator and to find its steam economy.*
4. *To calculate the overall heat transfer coefficient in vertical and horizontal condenser.*
5. *To find the thermal conductivity of composite walls.*
6. *To find the overall heat transfer coefficient, fin effectiveness, and fin efficiency for finned tube heat exchanger.*
7. *Determination of heat transfer coefficient for film wise and drop wise condensation.*
8. *To determine the emissivity of the non–black surface and compare with the black body.*
9. *Determination of thermal conductivity of liquid.*
10. *To determine the Stefan Boltzmann's constant.*