CH351: PROCESS HEAT TRANSFER

CREDITS = 6 (L = 4, T=0, P = 2)

1.	**FUNDAMENTALS OF HEAT TRANSFER**: Steady and unsteady state conductions in one and two dimensions	3 Hours
2.	**Heat transfer by conduction:** Conduction through a plane wall, thermal resistances in series, conduction through a thick-walled tube, conduction through a spherical shell and to a particle, unsteady state conduction, conduction with internal heat source	3 Hours
3.	**CONVECTION**: Application of dimensional analysis to convection, Natural and forced convection, laminar and turbulent flow heat transfer without phase change. Overall heat transfer coefficient. forced convection in tubes, forced convection outside tubes, flow in non-circular sections, convection to spherical particles, natural convection, heat transfer in coils, jackets & agitated vessels.	5 Hours
4.	**HEAT TRANSFER BY RADIATION**: Radiation from a black body, Radiation from real surfaces, radiation transfer between black surfaces, radiation transfer between grey surfaces, radiation from gases.	4 Hours
5.	**HEAT TRANSFER WITH PHASE CHANGE:** Heat transfer in the condensation of vapours , film coefficients for vertical and inclined surfaces, condensation on vertical and horizontal tubes, dropwise condensation, condensation of mixed vapours, Boiling liquids, conditions for boiling, types of boiling, heat transfer coefficients and heat flux, analysis based on bubble characteristics, sub-cooled boiling, design considerations.	5 Hours
6.	**DESIGN PRINCIPLES & SPECIFICATIONS OF HEAT EXCHANGERS**: Types of heat exchangers and their selection, Design Standards. Double Pipe, Shell & Tube heat exchangers, finned tube heat exchangers, Fabrication and testing of heat exchangers,	5 Hours
7.	**FURNACES & FIRED HEATERS**: Basic construction, design, heat transfer, stack design, thermal efficiency	3 Hours
8.	**EVAPORATION:** Factors affecting evaporations, Duhring's plot, Types, Selection & design of evaporators, Heat economy in evaporation, single & multiple effect evaporation	5 Hours
9.	**HEAT INSULATION:** Insulating materials and their selection, Principles & practical aspects of industrial insulation. Heat losses through lagging, Economic thickness of lagging,critical thickness of lagging	5 Hours

10. **HEAT TRANSFER MEDIA.** 2 Hours

REFERENCE BOOKS

Title: Process Heat Transfer
Author: D.Q.Kern
Publisher: Tata McGraw Hill

Title: Unit Operation in Chemical Engineering
Author: McCabe & Smith
Publisher: Tata McGraw Hill

Title: Chemical Engineering Vol – 1
Author: Coulson & Richardson
Publisher: Asian Books Pvt. Ltd.

Title: Heat Transfer
Author: B K Dutta
Publisher: Printice Hall of India

LIST OF EXPERIMENTS

1. To determine the Overall Thermal Conductivity of Composite Wall & to check that the Thermal Resistances in Composite Wall are connected in series.

2. To determine the thermal conductivity of insulating material in powder form.

3. To determine the overall heat transfer coefficient making the use of logarithmic mean temperature difference. From overall heat transfer coefficient determine the individual film heat transfer coefficient and verify the relation between Nusselt number and Reynolds & Prandtl number for laminar flow.

4. To determine the overall heat transfer coefficient making the use of logarithmic mean temperature difference. From overall heat transfer coefficient determine the individual film heat transfer coefficient and verify the Dittus-Boelter equation for turbulent flow heat transfer.

5. To determine the overall heat transfer coefficient making the use of logarithmic mean temperature difference. Find out the effect of fluid velocity through tubes for a fixed flow rate of cooling water through the shell of the heat exchanger.

6. To determine the efficiency of given longitudinal/transverse fin and compare it with the theoretical value for the given fin.

7. To determine the surface heat transfer coefficient for heated vertical cylinder in Natural Convection.

8. To study the heat transfer characteristic of a mechanically agitated vessel provided with a agitator, jacket and the coil. To find out the overall and individual film coefficient for unsteady state cooling of the liquid in the vessel.

9. To calculate Stefan Boltzmann constant (σ_b).

10. To determine the specific heat of water.

11. To determine the fin efficiency of heat exchanger**.**