MTPC2004 TRANSPORT PHENOMENA (3-0-0)

Course Objective:

1. To develop a thorough understanding of the principles of momentum, heat, and mass transfer, and their interrelation in various engineering systems.
2. To enable students to analyze and solve practical problems in fluid flow, heat transfer, and mass transfer, with applications in industrial processes, including flow measurement, packed and fluidized beds, conduction, convection, radiation, and diffusion.

Module I (6 Hrs)

Classification of fluids, ideal & real, Newtonian & Non-Newtonian, Newton's law of viscosity. Types of fluid flow – streamline & turbulent, continuity equation for incompressible and compressible fluid and its application. Concept of velocity bounds layer.; Bernoulli's equation and its application for flow measurement by venturimeter, orifice meter, pilot tube and rotameter.

Module-II (6 Hrs)

Pressure drop & friction factor in various configurations, flow in packed bed & fluidized bed, Dimensional analysis by Rayleigh's method of indices and Buckingham's π theorem. Example of analysis of pressure gradient, mass transfer co-efficient & convective heat transfer co-efficient, concept of similarly and dimensionless criteria. Dimensionless groups & their significance.

Module III (6 Hrs)

Internal & External modes of heat transfer, steady state heat conduction in monolayer and composite flat walls & cylinders. Numerical related to steady state heat conduction. Unsteady state heat conduction, thin & massive body heating & cooling. Finite difference method in solving unsteady state heat conduction.

Module IV (6 Hrs)

Natural and forced convection, concept of heat transfer co-efficient, thermal boundary layers, some examples of connective co-relations. Types of flow: Counter flow, parallel flow and cross flow with derivation. Overall Heat transfer co-efficient. Law of radiation – Steffan-Boltzmann's law, Kirchoff's law &Lambarth's law, Black & grey body concepts, view factor, Radiation from flames & gases. Radiation between simple surfaces with & without absorbing gas media. Radiation shields.

Module V (6 Hrs)

Mass Transfer: Law of diffusion and their application, concept of mass transfer coefficient & concentration boundary layer, Interfacial mass transfer, overall mass balance.

Course Outcome:

CO1: Students will understand the classification of fluids, flow types, and applications of Bernoulli's equation for flow measurement using devices like venturimeter, orifice meter, and rotameter. They will also analyze velocity boundary layers and fluid behavior in different conditions.

CO2: Students will learn to analyze pressure drops and friction factors in various configurations, including packed and fluidized beds. They will gain skills in dimensional analysis using Rayleigh's and Buckingham's π methods, along with understanding dimensionless groups and their significance.

CO3: Students will gain knowledge of steady and unsteady-state heat conduction in monolayer and composite structures and solve related numerical problems. They will also use finite difference methods for solving unsteady-state heat conduction problems

CO4: Students will understand natural and forced convection principles, thermal boundary layers, and various flow types (counter, parallel, cross). They will also study radiation laws, black and grey body concepts, radiation between surfaces, and radiation shields

CO5: Students will learn the laws of diffusion, the concept of mass transfer coefficients, and interfacial mass transfer. They will apply these principles to solve problems involving concentration boundary layers and overall mass balances in industrial processes.

Text Books:

1. Transport Phenomena by R. B. Bird, W. E. Stewart and E. N. Lightfoot, Wiley, 1960
2. Rate Processes in Metallurgy by A. K. Mohanty, PHI
3. Transport Phenomena in Metallurgy by G. H. Geiger and D. R. Poirier, Addison-Wesley, 1973.
4. Rate Phenomena in Process Metallurgy by J. Szekely and N. J. Themelis

Reference Books:

1. Rate Phenomena in Process Metallurgy by J. Szekely and N. J. Themelis
2. J. R. Welty, R. E. Wilson and C. E. Wicks, Fundamentals of Momentum Heat and Mass Transfer, Wiley, 1976