

Year & Sem: E2S2	Course Code:CH2205	Course Name: Transport Phenomena	No. of Credits: 4	L 2	T&PS 2	P 0
UNIT I: Momentum Transport: Viscosity and the Mechanism of Momentum Transport (i) Newton's Law of Viscosity, (ii) Non-Newtonian fluids. Velocity distributions in laminar flow: (i) Shell momentum balances boundary conditions (ii) Flow of a falling film, (iii) Flow through a circular tube (iv) Flow through an annulus. The Equations of change for isothermal systems: (i) The equations of continuity, motion and mechanical energy in rectangular and curvilinear coordinates, (ii) Use of the equations of change to set up steady flow problems (iii) Dimensional analysis of the equations of change. UNIT II: Momentum Transport: Velocity distributions with more than one independent variable (i) Flow near a wall suddenly set in motion. (ii) Unsteady laminar flow in a circular tube. Velocity distributions in Turbulent flow: (i) Fluctuations and time smoothed quantities, (ii) Time-smoothing of the equations of change for an incompressible fluid, (iii) Semi empirical expressions for the Reynolds stresses. Interphase transport in isothermal systems: (i) Definition of friction factors (ii) Friction factors for flow in tubes (iii) Friction factors for flow around spheres. UNIT III: Energy Transport: Thermal conductivity and the mechanism of energy transport: (i) Fourier's law of heat conduction. Temperature distributions in solids and in laminar flow: (i) Shell energy balances - boundary conditions (ii) Heat conduction with an electrical heat source (iii) Heat conduction with a viscous heat source (iv) Heat conduction through composite walls (v) Forced convection and (vi) Free convection. The equations of change for non-isothermal systems : (i) The equation of energy in rectangular and curvilinear coordinates, (ii) the equations of motion for forced and free convection in non-isothermal flow (iii) Tangential flow in an annulus with viscous heat generation. and (iv) Dimensional analysis of the equations of change. Temperature distribution with more than one independent variable : Heating of a semi-infinite slab only. UNIT IV: Energy Transport: Temperature distribution in turbulent flow: (i) Temperature fluctuations and time-smoothed temperature, (ii) Time smoothing the energy equation (iii) Semi empirical expressions for the turbulent energy flux. Interphase transport in non-isothermal systems : (i) Definition of the heat transfer coefficient (ii) Heat transfer coefficients for forced convection in tubes and around submerged objects, and (iii) Heat transfer coefficients for free convection. Mass Transport: Diffusivity and the mechanism of mass transport : (i) Definitions of concentrations, velocities, and mass fluxes (ii) Fick's law of Diffusion. Concentration distribution in solids and in laminar flow : (i) Shell mass balances - boundary conditions, (ii) Diffusion through a stagnant gas film, (iii) Diffusion with heterogeneous chemical reaction (iv) Diffusion with homogeneous chemical reaction and (v) Diffusion into a falling liquid film. UNIT V: Mass Transport: The equations of change for multicomponent systems : (i) The equations of continuity for a binary mixture (ii) The equations of continuity of A in curvilinear coordinates and (iii) Dimensional analysis of the equations of change for a binary isothermal fluid mixture. Concentration distributions in turbulent flow : (i) Concentration fluctuations and the time smoothed concentration (ii) Time-smoothing of the equation of						

continuity of A. **Interphase transport in multicomponent systems:** (i) Definition of binary mass transfer coefficients in one phase, (ii) Correlations of binary mass-transfer coefficients in one phase at low mass-transfer rates (iii) Definition of binary mass-transfer coefficients in two phases at low mass-transfer rates, and (iv) Definition of the transfer coefficients for high mass transfer rates.

References/Text Books:

1. Transport Phenomena - R Byron Bird, Warren E Steward and Edwin N Lightfoot, John Wiley & Sons, Inc. New York.
2. Transport Phenomena - Robert S Brodkey and Harry C Hershey, Mc Graw Hill Book Company, New York Tokyo-Toronto.
3. Transport Phenomena for Engineers - Louis Theodore, International Text-book Company, London.
4. Transport Phenomena - W.J. Book and K.M.K. Multzall, John Wiley & Sons Ltd, London, New York;
5. Fundamentals of Momentum, Heat and Mass Transfer - Mames R Welty, Charles E Wicks and Robert E Wilson, John Wiley & Sons Inc. New York.
6. Fluid Dynamics and Heat Transfer by James G Knudsen and Donald L. Katz, McGraw Hill Book Co. Inc., New York.

Lecture Plan: Unit-I & -II syllabus for MID-I, Unit-III & -IV syllabus for MID-II and Unit-V & -VI syllabus for MID-III examinations.

Video Lectures (Web Links):

- 1.
- 2.

Study Materials (Web Links):

- 1.
- 2.

Problems & Solutions (Web Links):

- 1.
- 2.

Assignments (Web Links):

- 1.
- 2.