

Transport Phenomena

- 1.1 Course Number: CH401
- 1.2 Contact Hours: 2-0-0 Credits: 6
- 1.3 Semester-offered: 3rd Year-Even
- 1.4 Prerequisite: Thermodynamics, Fluid Mechanics, Heat and Mass Transfer.
- 1.5 Syllabus Committee Member: : Dr. K. G. Biswas & Dr. Shweta

2. **Objective:**

- To understand the similarity in the mathematical formulations of momentum, heat and mass transfer phenomena and nature of convective and diffusive transport in all the three cases.
- To be able to apply the governing equations and obtain analytical solutions of simple problems in transport phenomena.
- To be able to carry out non-dimensionalization for a given problem and understand the physical origin and implications of various dimensionless numbers when simultaneous transport of any two or more of heat, mass, or momentum occurs, and be able to analyze the problem based on the values of these dimensionless numbers.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Introduction to Transport Processes	Fundamental concepts of Momentum, Energy and Mass transport, Dimensional analysis, Physical interpretation of dimensional group, Diffusion (Continuum Description), Mechanism of Diffusion	7
2	Transport in Cartesian co-ordinates	Unidirectional transport in Cartesian co-ordinates, Similarity solutions, Separation of variables, Momentum source in the flow, Heat and Mass source, Equivalence of heat, mass and momentum transport for unsteady one-dimensional diffusion	7
3	Transport in Cylindrical Coordinates	Unidirectional Transport Cylindrical Coordinates – Conservation Equations, Similarity solutions, Separation of variables, Steady flow in pipe, Separation of variables, Steady and unsteady transfer to a cylinder - balances in cylindrical co-ordinates. Effect of pressure in fluid flow	7
4	Mass and Energy Conservation Equation	Mass and energy conservation equations for Cartesian and Cylindrical co-ordinates (Combination of convection, diffusion), Heat Conduction in Cube	7
		Total	28

4. Readings

4.1 Textbook:

1. R.B. Bird, W.E. Stewart and E. W. Lightfoot, "Transport Phenomena", John Wiley & Sons.

4.2 Reference books:

1. Brodkey, R. S. and Hershey, H. C., "Transport Phenomena", McGraw-Hill 3.
2. Pritchard Philip J., Fox and McDonald's "Introduction to Fluid Mechanics", 7th Edition, John Wiley & Sons Inc.
3. Welty, J.R., Wicks, C.W., Wilson, R.E. and Rorrer, G., "Fundamentals of Momentum Heat and Mass Transfer", John Wiley & Sons.

5 Outcome of the Course:

Students are able to:

- Give physical meanings to different kinds of mathematical terms appearing in a transport equation.
- Non-dimensionalize a given problem and identify the dimensionless numbers.
- Solve problems where various transport processes including those of mass, heat, and momentum may occur.
- Propose a mathematical model by themselves given a problem involving the transport processes.