**Transport Phenomena**

1.1 Course Number: CH401

1.2 Contact Hours: 2-0-0 Credits: 06

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 and Dr Karan Malik

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.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

| Unit | Topics | Sub-topic | Lectures |
|---|---|---|---|
| 1 | Introduction to Transport Processes | Introduction to Transport Phenomena, Concept of unified approach to Momentum, Heat and Mass Transport, Similarity of Mass, Momentum and Energy transfer, thermal conductivity and diffusivity, fluxes. | 5 |
| 2 | Transport in Cartesian co-ordinates/Cylindrical Coordinates | Limitations of unit operations approach. Molecular mechanism of transport of momentum, energy, and mass. Cartesian and cylindrical coordinate systems for analytical treatment of transport problems. Conservation equations of mass, momentum and thermal energy. | 6 |
| 3 | Shell Balances | Shell momentum, energy, and mass balance equations and distribution of velocity, temperature, and concentration (Flow through a falling film, Flow through a circular tube, Flow of fluid through annulus, Flow of two adjacent immiscible fluids, Creeping flow around a sphere, Shell energy balance and boundary conditions – Heat conduction with electrical, nuclear, viscous and chemical heat source, Heat conduction through composite walls, Heat conduction in fins). | 10 |

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|---|---|---|---|
| 5 | Unsteady Transport | Unsteady-state momentum, heat and mass transport, formulation of basic equations and similarity transform method. | 7 |
| | | **Total** | **28** |

4. **Readings**

4.1 Textbook:

1. R.B. Bird, W.E. Stewart and E. W. Lightfoot, “Transport Phenomena”, John Wiley & Sons.
2. Deen, W.M., “Analysis of Transport Phenomena”, Oxford University Press 1998.
3. L. G. Leal, Laminar Flow and Convective Transport Processes, Butterworth-Heineman, 1992.

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.
4. R. Aris, “Vectors, Tensors, and the Basic Equations of Fluid Mechanics”, Dover Publications 1989.
5. Coulson, J.M. and Richardson, J.F.,” Coulson and Richardson’s Chemical Engineering Vol. 1, Fluid Flow, Heat Transfer and Mass Transfer”, Butterworth-Heinemann 2004.

5. **Outcome of the Course:**

Students are able to:

- Give physical meanings to different kinds of mathematical terms appearing in a transport equation.
- 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.