IV CHE484 Transport Phenomena

Course Outlines

- **Title:** Transport Phenomenon
- **Code Number:** CHE484
- **Semester:** 8^{th}
- **Credit hours:** 3
- **Pre-requisites course requirements/ skills:** CHE232, CHE353
- **Learning Outcomes:**

  Upon successful completion of the course, the students will be able to:
  1. Acquire skills for modelling of velocity, temperature and concentration distribution for various industrial processes.
  2. Solve the problems requiring velocity, temperature and concentration distributions involved in a wide range of industrial operations.
  3. Evaluate the processes defined for mass, energy and momentum transport.

- **Contents**

  Unit I: Viscosity and the Mechanism of Momentum Transport

  1.1 Newton's law of viscosity
  1.2 Various interpretations of the Newton's law of viscosity
  1.3 Vector notation of Newton's law of viscosity
  1.4 Pressure and Temperature dependence of viscosity
  1.5 Molecular theory of viscosity of gases at low density
  1.6 Molecular theory of viscosity of liquids
  1.7 Non Newtonian fluids and their mathematical models

  Unit II: Shell Momentum Balance and Velocity Distributions

  2.1 Concept of Shell Momentum Balance
  2.2 Concept of boundary conditions
  2.3 Velocity distribution in a flow of falling film
  2.4 Flow through an annulus
  2.5 Flow of two adjacent immiscible fluids

  Unit III: Thermal Conductivity and the Mechanism of Energy Transport

  3.1 Fourier's law of heat conduction
  3.2 Temperature and pressure dependence of heat conductivity

3.3 Theory of thermal conductivity of gases at low density
3.4 Theory of thermal conductivity of liquids
3.5 Theory of thermal conductivity of solids
3.6 Thermal conductivity of composite solids

Unit IV: Shell Energy Balance and Temperature Distributions in Solids

4.1 Concept of shell energy balance
4.2 Concept of boundary conditions
4.3 Heat conduction with an electrical heat source
4.4 Heat conduction with a nuclear heat source
4.5 Heat conduction with a viscous heat source
4.6 Heat conduction with a chemical heat source

Unit V: Diffusivity and the Mechanism of Mass Transport

5.1 Fick's law of binary diffusion (Molecular mass transport)
5.2 Temperature and pressure dependence of diffusivities
5.3 Theory of diffusion of gases at low density
5.4 Theory of diffusion in binary liquids
5.5 Theory of diffusion in colloidal suspensions
5.6 Theory of diffusion in polymers
5.7 Mass and molar transport by convection
5.8 Exercises and numerical problems

Unit VI: Concentration Distributions in Solids and Laminar Flow

6.1 Concept of shell mass balance
6.2 Concept of boundary conditions
6.3 Diffusion through a stagnant gas film
6.4 Diffusion with a heterogeneous chemical reactions
6.5 Diffusion with a homogeneous chemical reactions
6.6 Diffusion into a falling liquid film

- **Teaching-learning Strategies**

  The teaching and learning strategy has been designed on the understanding of concepts and the ability to critically analyze and apply the learned content through lectures, discussion, activities, case studies using computer, multi-media and writing board instructional aids.
  Lectures: 3 hours per week

- **Assignments- Types and Number with calendar**

A minimum of two assignments to be submitted before the written exam of final term

- **Assessment and Examinations**

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written examination at the mid-point of the semester.
2.	Formative Assessment	25%	It includes: classroom participation, attendance and assignments.
3.	Final Assessment	50%	Written examination at the end of semester.

- **Textbooks and reference readings**

1. Bird R. B., Stewart W. E., Lightfoot E. N. (2006). “Transport Phenomena”. 2nd Edition, Wiley & Sons.
2. Bird R. B., Stewart W. E. , Lightfoot E. N., Klingenberg D. J. (2015). “Introductory Transport Phenomena”, Wiley.
3. Christie J. G., Hersel, A. A., Lepek, D. H. (2018). “Transport Processes and Separation Process Principles”. 5th Edition, Pearson.
4. Tosun, I. (2007). Modeling in Transport Phenomena: A Conceptual Approach, 2nd Edition, Elsevier.