ChE-301

Transport phenomena I

Sivula Kevin

Cursus	Sem.	Type
Biotechnology minor	H	Opt.
Chemical Engineering	BA5	Obl.
HES - CGC	H	Obl.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	During the semester
Workload	90h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

- Derivation of differential balances equations for momentum, heat and mass. In this context, the derivation of the Navier-Stokes equation is applied for the calculation of velocity profiles in some systems. - Recognize and apply the analogies between the three types of transfer.

Content

- Equations for molecular flow: material (Fick's law); heat (Fourier's law); momentum (Newton's law).
- Analogy between the three types of transfer (linked by their diffusivities).
- Non-Newtonian fluids (Bingham and Ostwald models, thixotropic and rheopectic fluids).
- Differential and integral mass balance.
- Derivation and application of the continuity equation.
- Integral and differential momentum balance.
- The Navier-Stokes equation (analytical solution for simple systems).
- The perfect fluid: Euler and Bernoulli equations, validity domain.
- Pressure drop in a complex flow circuit. Use of the Moody diagram.
- Momentum, heat and mass transfer in multiple variables systems (solving partial differential equations).

Keywords

Transport phenomena, Continuity equation, Navier-Stokes equation, Euler and Bernoulli; equations; transfer in a system with multiple variables.

Learning Prerequisites

Required courses

Introduction to Chemical Engineering

Learning Outcomes

By the end of the course, the student must be able to:

- Analyze engineering problems involving transfer phenomena.
- Realize sustainable models for the three types of transfer
- Deduce the initial and boundary conditions for an analytical solution of differential equations
- Explore the similarities between the three types of transfer

- Deduce pressure drop in a complex flow path. Use the Moody diagram.
- Investigate the transfer of momentum, heat and mass in a system with multiple variables (solving partial differential equations)
- Realize the identical mathematical formalism of the three types of transfer

Teaching methods

Lectures with exercises

Expected student activities

Solution of exercices

Assessment methods

Continuous control
Two written tests during the semester

Resources

Bibliography

Transport Phenomena (second Edition); R. B. Bird; W.E. Stewart; E.N. Lightfoot. John Wiley and Sons, Inc (2002)

Ressources en bibliothèque

- Transport Phenomena / Bird