

# ChE-330 Fluid mechanics and transport phenomena

Cursus	Sem.	Туре
Biotechnology minor	Н	Opt.
Chemical Engineering	BA5	Obl.
HES - CGC	Н	Obl.

Sivula Kevin

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
Hours	4 weekly
Courses	2 weekly
Exercises	2 weekly
Number of	
positions	

## **Summary**

The concept of Shell balances, the Navier-Stokes equations and generalized differential balances equations for heat and mass transport are given. These relations are applied to model systems. Integral balances are introduced in the context of boundary layers and transfer coefficients.

#### 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, Shell balance, Euler and Bernoulli equations, transfer in a system with multiple variables, transfer coefficient.

#### **Learning Prerequisites**

#### Required courses

ChE 201 Introduction to Chemical Engineering

ChE 204 Introduction to transport phenomena

Basic knowledge of mass and energy balances and the three fundamental laws of transport phenomina (Fick's law, Fourier's law, and Newton's law) are needed.

## **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