ME-466 Instabili	ty					
Gallaire F	rançois					
Cursus		Sem.	Туре	Language of	English	
Computational science and Engineering Mechanical engineering minor Mechanical engineering		MA1, MA3	Opt.teachingOpt.CreditsOpt.SessionOpt.Semester	teaching	English	
		Н		3 Minter		
		MA1, MA3		Semester	Fall	
Mechanics			Opt.	Exam Workload Weeks Hours Lecture Exercises Number of positions	Written 90h 14 <b>3 weekly</b> 2 weekly 1 weekly	

# Summary

This course focuses on the physical mechanisms at the origin of the transition of a flow from laminar to turbulent using the hydrodynamic instability theory.

## Content

Learn to understand the complex phenomena originating in the destabilization of laminar flows, and their transition to turbulence. Know how to linearize the fluid equations and to formulate the question of stability of a flow in terms of an eigenvalue problem and a dispersion relation. Identify the physical mechanisms resulting in classical instabilities as Kelvin-Helmholtz instability. Spatial instability in open flows. Understanding the different types of bifurcations. Reading scientific literature.

## Keywords

Instability, linearization, bifurcation

## **Learning Prerequisites**

Recommended courses hydrodynamics

## Important concepts to start the course

- concept of linear operator and eigenvalues
- be able to solve a linear differential system at constant coefficients
- Fourier analysis
- Taylor expansions
- Navier-Stokes equations
- Use a work methodology appropriate to the task.
- Use both general and domain specific IT resources and tools
- Make an oral presentation.
- Write a literature review which assesses the state of the art.
- Summarize an article or a technical report.

## **Learning Outcomes**

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

• Describe the physical differences between laminar and turbulent flows, AH4

• Implement the basics of computer programming; develop a (simple) structures software using a programming language / environment such as C, Fortran or Matlab, AH40

- Describe the physical differences between laminar and turbulent flows, AH4
- Integrate the basics of computer programming; develop a (simple) structures software using a programming language
- / environment such as C, Fortran or Matlab, AH25

## **Transversal skills**

- Use both general and domain specific IT resources and tools
- Write a literature review which assesses the state of the art.
- Use a work methodology appropriate to the task.
- Summarize an article or a technical report.

## **Teaching methods**

Lectures, exercices and homework

### **Expected student activities**

The students should follow the lectures and practise at home both the resolution of application exercises and the reading of scientific articles.

#### **Assessment methods**

Written exam.

### Supervision

Office hours	Yes
Assistants	Yes
Forum	No

## Resources

### Bibliography

Instabilités hyrodynamiques, F. Charru, CNRS Editions, 2007 [in FRENCH] Hydrodynamic instabilities, F. Charru, Cambrdige Univ. Press, 2011 [in ENGLISH] Introduction to Hydrodynamic Stability, P.G. Drazin, Cambridge Univ. Press, 2002

## Ressources en bibliothèque

- Hydrodynamic instabilities, F. Charru
- Instabilités hydrodynamiques, F. Charru
- Introduction to Hydrodynamic Stability, P.G. Drazin

## Websites

https://slsp-epfl.primo.exlibrisgroup.com/permalink/41SLSP\_EPF/1g1fbol/alma99116705266405516

#### Moodle Link

https://go.epfl.ch/ME-466