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

Required courses
Incompressible fluid mechanics

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, exercice 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
Assistant No
Forum No

Resources
Bibliography
Instabilités hyrodynamiques, F. Charru, CNRS Editions, 2007

Ressources en bibliothèque
• Introduction to hydrodynamic stability
• Instabilités hydrodynamiques - papier
• Instabilités hydrodynamiques - ebook

Moodle Link
• http://moodle.epfl.ch/course/view.php?id=4471