



## MÉTHODES VARIATIONNELLES POUR LES EDP

### VARIATIONAL METHODS FOR PDES

Lecturers: **Martine MARION**

| Lecturers : 16.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 12.0 | Project : 0.0 | Language : FR

#### Objectives

Variational methods, also called energy methods, are a major tool in the study of partial differential equations (PDEs) for linear and nonlinear problems. They rely on estimates of the solutions in well chosen functional spaces and the use of powerful methods borrowed from the theory of functional analysis.

The aim of this course is twofold :

- to study the tools in analysis underlying these methods
- to apply them to the study of stationary PDEs (elliptic problems) as well as unsteady problems (parabolic problems).

**Keywords :** Partial differential equations, weak solutions, linear and non linear problems, variational methods

#### Programme

- Chapter 1 : Sobolev spaces
  - Introduction to the theory of distributions
  - Density and trace theorems
- Chapter 2 : Linear elliptic problems
  - Variational methods
  - Eigenvalue problems
- Chapter 3 : Nonlinear elliptic problems
  - Weak topology
  - Galerkin method

#### Learning outcomes

- To learn the analysis tools at the basis of the study of PDEs To be able to apply them to actual problems

#### Independent study

Objectifs :

Méthodes :

#### Core texts

- H. Brézis, *ANALYSE FONCTIONNELLE*, Dunod, 2005
- R. Dautray et J.L. Lions *ANALYSE MATHÉMATIQUE ET CALCUL NUMÉRIQUE*, Dunod, 1988
- R. Temam *THEORY AND NUMERICAL ANALYSIS OF THE NAVIER-STOKES EQUATIONS*, North Holland, 1979

#### Assessment

Final mark = 70% Knowledge + 30% Know-how  
Knowledge N1 = 100% final exam  
Know-how N2 = 100% continuous assessment