

MASTER PHYSIQUE

## PARCOURS PHYSIQUE OCÉAN ET CLIMAT

### semestre 8 Physique POC

# Mathématiques appliquées 2

## Présentation

This course aims at introducing exact and approximate solutions of partial differential equations to the students. In particular, parabolic (diffusion) equations, hyperbolic (wave and transport) equations and elliptic (Poisson and Laplace) equations are introduced, and are solved in finite or in infinite domains. Functional transforms (Fourier and Laplace) are introduced and are used to solve these equations. A link with domains of physics in which these equations are used is made. A connection with numerics is also given at the end of the course, to relate the theoretical results with numerical results.

This course is taught in English.

### 3 crédits ECTS

Volume horaire

Travaux Dirigés : 19h

Cours Magistral : 14h

## Objectifs

This is an essential course for all fluid dynamics courses (GFD, fluid-solid interactions) and more generally for all of physics (electromagnetism for instance). Partial differential equations govern the evolution of physical phenomena in many fields (subatomic physics, microscopic physics, physics of solids and of fluids, electromagnetism...)

## Pré-requis nécessaires

- > mathematical analysis : ODEs, real functions of several variables, geometry of curves and surfaces, vector analysis ;
- > physics : classical mechanics, electromagnetism.

## Compétences visées

- > ability to validate numerical results with theoretical results
- > problem solving in fluids
- > global approach (holistic approach) to problem solving
- > building numerical algorithms for professional purposes

## Descriptif

Introduction/ description of PDEs, basic theory

### Part I / Parabolic equations

- > solution in a finite domain
- > solution in a semi infinite or an infinite domain

### Part II / Hyperbolic equations

#### A) second order wave equations

- > solution in a finite domain
- > solution in a semi infinite or an infinite domain

#### B) first order transport equations

- > linear equations
- > nonlinear equations / shocks
- > systems of equations

### Part III / Elliptic equations

- > Laplace equation
- > Poisson equation

Complement : first integrals, nonlinear diffusion equations, Korteweg-DeVries equation

## Bibliographie

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Partial differential equations for scientists and engineers (available on the web)

## Modalités de contrôle des connaissances

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### Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit - devoir surveillé	150	2/3	
	CC	Autre nature		1/3	

### Session 2 : Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Oral	30	100%	