Universitat Autònoma de Barcelona

**2018/2019**

# Differential equations and modelling II

Code: 100101
ECTS Credits: 6

| Degree | Type | Year | Semester |
|---|---|---|---|
| 2500149 Mathematics | OB | 3 | 2 |

## Contact

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## Use of languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

## Teachers

Francesc Mañosas Capellades

## Prerequisites

Mathematical analysis in one and several variables, Linear Algebra and a first course on Differential Equations and modeling.

## Objectives and Contextualisation

This subject is the second part of a two semesters course of introduction to ordinary differential equations (ODE). It has both theoretical and applied sides. It is aimed that the students know and are able to apply the concepts of the qualitative theory of ordinary planar differential equations and also that they have a basic knowledge of the paradigmatic partial differential equations. During this semester we will apply many of the results established and studied in the first course on ODE and at the same time we will introduce new tools for studying the mentioned differentiated equations.

## Content

This subject is structured in two parts. The first one is about the qualitative theory of ordinary differential equations, with special emphasis on planar autonomous systems. It is an introduction of which later can be studied in more depth in the course "Dynamical systems". The second is a first study of the most famous partial differential equations and also has continuity in the course "Partial differential equations".

3.1 Autonomous systems in the plane.

3.1.1. Autonomous systems in R^n. Geometric interpretation. Structure of the orbits. First integrals. Invariant surfaces. Phase portraits and conjugation.

3.1.2. Integrable systems. Phase portrait of planar integrable systems: potential systems, Hamiltonian systems, the model of Lotka-Volterra.

3.1.3. Non-integrable systems: flow box theorem, qualitative analysis of equilibrium points, limit behavior of the

orbits, Bendixson-Poincaré theorem, Lyapunov functions. Limit cycles. Criterion of Bendixon-Dulac. Models of ecology. Van der Pol system.

3.2 First order partial differential equations.

3.2.1. Introduction to partial differential equations(PDE).

3.2.2. Linear and quasi-linear PDE of first order.

3.3 Second order partial differential equations.

3.3.1. The wave equation on an infinite string. D'Alembert's formula. Boundary value problems.

3.3.2. The heat equation. The case of an infinite bar.

3.3.3. Separation of variables and Fourier series.

3.3.4. Laplace's equation.