

27009 - Ordinary Differential Equations

Información del Plan Docente

Academic Year	2017/18
Faculty / School	100 - Facultad de Ciencias
Degree	453 - Degree in Mathematics
ECTS	9.0
Year	2
Semester	Annual
Subject Type	Compulsory
Module	---

1.General information

1.1.Introduction

1.2.Recommendations to take this course

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

2.Learning goals

2.1.Learning goals

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The course contains theoretical classes, including examples, and exercise sessions in small groups. Interaction between the teacher and the student is encouraged. Exercises proposed to the students will be presented to the group. Students will be attended by the teacher at office hours. Students will be required to form a group and to study a concrete problem and prepare a written report, to be discussed in the classroom.

5.2. Learning tasks

During the lectures the teacher will provide explanations about the theory and abundant examples. Exercises will be solved by the student and presented to the group.

5.3. Syllabus

I.- Linear systems: constant coefficients

1. Linear differential equations with constant coefficients

First-order homogeneous equation
First-order nonhomogeneous equation
Second order equations

2. Homogeneous linear systems: obtaining solutions

Eigenvectors and eigensolutions
Generalized eigenvectors
Generalized eigensolutions

3. Exponential Matrix

Convergence
Exponential matrix definition and first properties
Exponential matrix via generalized eigensolutions
Differential of the exponential matrix

4. Linear systems

Solution of homogeneous system
Solution of a nonhomogeneous system
Higher-order differential equations

5. Qualitative theory

Notion of stability
Stability and spectrum
Phase portrait. Classification of 2-d systems.

6. Laplace transform

Laplace transform defined
Calculus of Laplace transform
Calculus of inverse Laplace transform
Solution of initial value problems
Stability

II.- Linear systems: general case

7. Linear equations

Homogeneous equations
Nonhomogeneous equations
Grönwall inequality

8. Linear systems

Existence and uniqueness of solutions (homogeneous system)
Superposition principle. Resolvent matrix
Nonhomogeneous equations
Higher-order equations
Stability*

9. Periodic systems*

Periodic solutions
Structure of the solution
Stability and resonance

III.- Nonlinear systems

10. Autonomous equations

Some examples and properties
Existence and uniqueness. Asymptotes
Qualitative analysis

11. Nonautonomous equations

Exact equations
Integrating factors
Other methods (separable, homogeneous,...)

12. Existence and uniqueness

27009 - Ordinary Differential Equations

Lipchitz functions
Existence and uniqueness: Picard theorem
Maximal solution

13. Numerical methods

Euler methods and Taylor method
Convergence
Runge-Kutta method
Multistep methods*

14. Regularity of the general solution

Continuous dependence
Smooth dependence.
The variational equation
Trivialization*

15. Qualitative theory

Autonomous systems
Stability of equilibria: linearization method
Stability of equilibria: Lyapunov functions
Phase diagram

5.4.Course planning and calendar

Two weekly lectures plus a weekly exercise session. See the web of the Faculty of Science.

5.5.Bibliography and recommended resources

- Simmons, George F.. Ecuaciones diferenciales : con aplicaciones y notas históricas / George F. Simmons ; con un capítulo sobre métodos numéricos de John S. Robertson ; traducción Lorenzo Abellanas Rapun . - 2a ed. Madrid [etc.] : McGraw-Hill, D.L. 2000
- Boyce, William E.. Ecuaciones diferenciales y problemas con valores en la frontera / William E. Boyce, Richard C. DiPrima ; colaboración en la traducción Hugo Villagómez Velázquez . - 4a ed. México [etc.] : Limusa, cop.1998
- Braun, Martin. Ecuaciones diferenciales y sus aplicaciones / M. Braun ; Traductor Ignacio Barradas Bribiesca . - [1a ed.] México : Grupo Editorial Iberoamérica, 1990
- Hirsch, Morris W.. Ecuaciones diferenciales, sistemas dinámicos y álgebra lineal / Morris W. Hirsch, Stephen Smale ; versión española, Carlos Fernández Pérez Madrid : Alianza, 1983
- Guzmán, Miguel de. Ecuaciones diferenciales ordinarias : teoría de estabilidad y control / M. de Guzmán . - [1a. ed., reimp.] Madrid : Alhambra, 1987
- Calvo Pinilla, M.. Curso de ecuaciones diferenciales ordinarias / Manuel Calvo Pinilla y Jesús Carnicer Álvarez Zaragoza : Prensas Universitarias de Zaragoza, 2010

27009 - Ordinary Differential Equations

- Zill, Dennis G.. Ecuaciones diferenciales con aplicaciones de modelado / Dennis G. Zill . - 6a ed. México [etc.] : International Thomson Editores, cop. 1997
- Marcellan, Francisco. Ecuaciones diferenciales : problemas lineales y aplicaciones / Francisco Marcellan, Luis Casaus, Alejandro Zarzo . - 1ª ed. en español, [reimp.] Madrid [etc.] : McGraw-Hill, D. L. 1991