

Academic Year: ( 2024 / 2025 )

Review date: 24-05-2024

Department assigned to the subject: Mathematics Department

Coordinating teacher: TERRAGNI , FILIPPO

Type: Basic Core ECTS Credits : 6.0

Year : 2 Semester :

Branch of knowledge: Engineering and Architecture

**REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)**

Calculus (Course 1 - Semester 1)

Linear Algebra (Course 1 - Semester 1)

**SKILLS AND LEARNING OUTCOMES**

- ¿ Solve linear and non-linear first-order ordinary differential equations and second-order linear ordinary differential equations and interpret the results
- ¿ Understand the concept of Fourier series and Laplace transform and apply them to the solution of differential equations.
- ¿ Solve systems of first order linear differential equations.
- ¿ Use numerical methods to calculate approximate solutions of non-linear differential equations.

**OBJECTIVES**

The objective of the course is to provide the student with the necessary tools to understand the scientific and mathematical principles of computer engineering.

**DESCRIPTION OF CONTENTS: PROGRAMME**

- 1.- First order differential equations:
  - a. Introduction.
  - b. Separable equations.
  - c. Linear equations.
  - d. Exact equations.
  - e. Homogeneous equations.
- 2.- Second order differential equations.
  - a. Linear and nonlinear equations.
  - b. Homogeneous and non-homogeneous linear Equations.
  - c. Reduction of order.
  - d. Euler-Cauchy equations.
- 3.- The Laplace Transform:
  - a. Definition. Properties.
  - b. Application to differential equations.
- 4.- Systems of differential equations:
  - a. Linear and nonlinear systems.
  - b. Vectorial representation.
  - c. Eigenvalues and linearization.
5. Fourier series and separation of variables:
  - a. Basic results.
  - b. Fourier Sine and Cosine Series.
  - c. Applications of Fourier series and separation of variables to partial differential equations.

- 6.- Numerical methods:
  - a. Euler method.
  - b. Runge-Kutta method.
  - c. Boundary value problems.

## LEARNING ACTIVITIES AND METHODOLOGY

- 1.- Teaching in big or aggregate groups. Lectures sessions (3 ECTS).
- 2.- Face-to-face teaching in small groups. Problem sessions with individual and group work (3 ECTS).

Office hours: Each teacher offers a number of office hours according to the regulations of the Carlos III University. In particular, a minimum of one hour per group with the time schedule compatible with the students.

## ASSESSMENT SYSTEM

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|---|----|
| <b>% end-of-term-examination:</b>   | 60 |
| <b>% of continuous assessment (assignments, laboratory, practicals...):</b> | 40 |

We follow a continuous-assessment system (40%) plus a final exam (60%) :

- The continuous-assessment part consists in two mid-term exams that will be held in regular class hours, according to the current regulations and will contribute a weight of 40% to the final mark. These mid-term tests allow the students to modify their own learning strategies, if necessary.
- The final exam (contributing with weight 60% to the final mark) will be held at the end of the semester, and allows to assess globally the knowledge of the course topics, skills, and capabilities acquired by the students.
- There is an extraordinary final exam in June for those students who did not obtain the required end-of-semester mark. This extrarodinay final exam has a maximum mark of 10, and the June final mark is given by  $\max(EE, 0.6 EE + 0.4 CA)$ , where EE (resp. CA) is the extrarodinay final-exam (resp. continuous-assessment) mark.

## BASIC BIBLIOGRAPHY

- Boyce, William E. Elementary differential equations and boundary value problems , John Wiley & Sons,.
- Simmons, George Finlay Differential equations with applications and historical notes., McGraw-Hill.
- Zill, Dennis G. Ecuaciones diferenciales con aplicaciones de modelado , International Thomson.

## ADDITIONAL BIBLIOGRAPHY

- Haberman, Richard Elementary applied partial differential equations with Fourier series and boundary value problems 3rd ed, Prentice Hall.
- Gockenbach, Mark S. Partial differential equations : analytical and numerical methods, SIAM.
- Kiseliov, Aleksandr I. Problemas de ecuaciones diferenciales ordinarias , Mir.
- Weinberger, Hans F. A first course in partial differential equations with complex variables and transform methods, Dover.

## BASIC ELECTRONIC RESOURCES

- Manuel Carretero, Luis L. Bonilla, Filippo Terragni, Segei Iakunin, Rocío Vega . Course OCW-UC3M Applied Differential Calculus: <http://ocw.uc3m.es/matematicas/applied-differential-calculus>