Applied differential calculus

Academic Year: (2024 / 2025) **Review date: 21-02-2025**

Department assigned to the subject: Mathematics Department

Coordinating teacher: TERRAGNI , FILIPPO

Type: Basic Core ECTS Credits : 6.0

Year : 2 Semester : 2

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)

LEARNING OUTCOMES

RA1.1: Knowledge and understanding of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes.
CB1: Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CGB1: Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge of: linear algebra; differential and integral calcu- lus; numerical methods; numerical algorithms; statistics and optimisation.
CGB3: Ability to understand and master the basic concepts of discrete mathe- matics, logic, algorithmic and computational complexity, and their application to the resolution of engineering problems.

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

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	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 adquired 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 extrarodinary 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 . Curse OCW-UC3M Applied Differential Calculus: http://ocw.uc3m.es/matematicas/applied-differential-calculus