Applied differential calculus

Academic Year: (2020 / 2021) **Review date: 09/07/2020 00:57:07**

Department assigned to the subject: Mathematics Department

Coordinating teacher: CARRETERO CERRAJERO, MANUEL

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.
Linear Algebra.

OBJECTIVES

- GENERAL COMPETENCES (PO: a) (CGB1): Ability to resolve the mathematical problems that may arise in engineering.
Ability to apply knowledge about: linear algebra; differential and integral calculus; differential equations and partial differential equations; numerical methods and numerical algorithmic.

- SPECIFIC COMPETENCES: The objective of the course is to provide the student with the necessary tools to understanding the scientific and mathematical principles of Computer Engineering.
The LEARNING RESULTS that are acquired in Applied Differential Calculus are of type RA1 (knowledge and understanding). In particular, next section is included
(RA1.1.) "Knowledge and understanding of the scientific and mathematical principles of Computer Engineering"
The specific competences of the subject have been divided into three sections:

KNOWLEDGE (PO a - RA1.1):
- Know how to solve linear and nonlinear ordinary differential equations of first order and interpret results.
- Know how to solve linear ordinary differential equations of second order.
- Know how to calculate Laplace transforms and how to use them to solve differential equations.
- Know how to solve systems of linear differential equations of first order.
- Understand the concept of Fourier series and using them to solve differential equations.
- Know how to use numerical methods to compute approximate solutions of first order non-linear systems of differential equations.

SPECIFIC ABILITIES (PO a - RA1.1):
- Increase the level of abstraction.
- To be able to solve practical problems using differential equations.

GENERAL ABILITIES (PO a - RA1.1):
- Ability to communicate orally and in writing correctly using signs and the language of mathematics.
- Ability to model a real situation described in words by differential equations.
- Ability to interpret the mathematical solution of a problem, their reliability and limitations.

DESCRIPTION OF CONTENTS: PROGRAMME

1.- First order differential equations:
  a. Linear equations.
  b. Separable equations.
  c. Exact equations.
  d. Homogeneous equations.
  e. Qualitative analysis of equations.

2.- Second order differential equations.
  a. Nonlinear and linear equations.
  b. Homogeneous and non-homogeneous Linear Equations.
  c. Reduction of Order.
  d. Euler-Cauchy Equations.
3.- Laplace transformations:
  a. Definition.
  b. Application to differential equations.
  c. Convolution.
4.- Systems of differential equations:
  a. Linear and Nonlinear Systems.
  b. Vector 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 to differential equations.
6.- Numerical methods:
  a. Euler method.
  b. Runge-Kutta method.
  c. Solution of boundary value problems.

LEARNING ACTIVITIES AND METHODOLOGY

The subject is bimodal 50% :

1.- Synchronous online teaching in big or aggregate groups. Lectures sessions: 3.0 ECTS credits (PO:a - CGB1 - RA1).
2.- Face-to-face teaching in small groups. Problem sessions: 3.0 ECTS credits (PO:a - CGB1 - RA1).)

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/test:	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. (PO: a.)

- In both the mid-term and final exams, competence CBG1 will be evaluated.

- 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 2nd ed., 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