Applied differential calculus

Academic Year: (2021 / 2022)   **Review date: 26-06-2021**

Department assigned to the subject: Mathematics Department

Coordinating teacher: CARRETERO CERRAJERO, MANUEL

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)

OBJECTIVES

  The specific competences of the subject have been divided into three sections:

  KNOWLEDGE:
  - 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 the Laplace transform and how to use it to solve differential equations.
  - Know how to solve systems of linear differential equations of first order.
  - Understand the concept of Fourier series and using it to solve differential equations.
  - Know how to use numerical methods to compute approximate solutions of non-linear differential equations.

  SPECIFIC ABILITIES:
  - Increase the level of abstraction.
  - To be able to solve practical problems using differential equations.

  GENERAL ABILITIES:
  - 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. Introduction.
    b. Linear equations.
    c. Separable 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 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

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.

- 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.

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

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