Applied differential calculus

Academic Year: (2019 / 2020) **Review date: 26-04-2019**

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.
Linear Algebra.

OBJECTIVES

KNOWLEDGE (PO a - RA1.1):
- Solving linear differential equations and interpret results.
- Understand the concept of stability.
- Know how to plot slope fields.
- 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. Qualitative Technique: Slope Fields. Equilibrium and Phase line. Bifurcations.
2.- Second Order Differential Equations.
  a. Nonlinear and linear Equations.
  b. 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. Convergence of Fourier series.
  d. 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

Lectures sessions: 3.0 ECTS credits (PO:a - CGB1 - RA1).
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

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

- The continuous-assessment part consists in a written examination contributing with weight 40% to the final mark. The mid-term examination will take place, approximately, at two thirds of the semester and it will be held in regular class hours, according to the current regulations.

- The final exam (contributing with weight 60% to the final mark) will be held at the end of the semester. (PO: a.)

% 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 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.