Mathematics Extension

Academic Year: (2023 / 2024) **Review date: 28-07-2023**

Department assigned to the subject: Mathematics Department

Coordinating teacher: ROBLES PEREZ, SALVADOR JOSE

Type: Basic Core ECTS Credits : 6.0

Year : 1 Semester : 2

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus, Linear Algebra

OBJECTIVES

Understand the language of differential equations (with ordinary and partial derivatives) and their importance in engineering and science. Understand the use of differential equations in the modelization and solution of problems in science and engineering.

SPECIFIC OBJECTIVES: (CB1,CB2)*
- Understand the basic theorems on existence and uniqueness of solutions and the notion of well-posed problem.
- Apply the notion of linear operator to solve differential equations and understand its relation to the superposition principle.
- Understand the different methods to solve specific ordinary differential equations including the Laplace transform. Interpretation of solutions.
- Distinguish and interpret physically the different types of partial differential equations: elliptic, hyperbolic and parabolic. Understand which typical initial value and boundary value problems correspond in each case. Understand some basic tecniques of resolution of these equations, including non linear problems.
- Understand how to apply the method of separation of variables and Fourier¿s method to solve initial and boundary value problems of basic equations in mathematical physics.
- Understand use of the method of characteristics to solve linear and semi-linear wave equations.

SPECIFIC ABILITIES: (CB5)*
- Understand and interpret ordinary differential equations. Detect and iterpret the existence or uniqueness of solutions. Use of a variety of techniques to solve different types of equations.
- Understand and interpret initial and boundary value problems of ordinary and partial differential equations. Use of different analytical methods to find solutions of the equations.
- Use of Laplace transform and Fourier series in the solutions of differential equations. Aplication of specific techniques like, for example, the method of separation of variables.
- Understand the role of eigenvalues and the principle of superposition to solve initial and boundary value problems in classical equations in Mathematical Physics.

GENERAL ABILITIES: (CG1)*
- Understand the necessity and importance of abstract reasoning and the value of proofs in mathematics and science.
- Scientific and mathematical communications skills and strategies to solve problems analytically and with different approximation procedures.
- Mathematical modeling of real situations and resolution of practical problems.

[* Acronyms refer to the basic and general capacities described in the degree's memory]

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction. Models and basic types of differential equations.
2. First order ordinary differential equations. Strategies for finding solutions.
3. Higher order ordinary differential equations. Solution methods and aspects of non linear equations and stability.
4. Laplace transform: solution of ordinary differential equations and systems of differential equations with constant coeficients.

5. Partial differential equations in Mathematical Physics. Wave equations, heat equations and Laplace equations. Boundary and initial value problems.
6. Methods of resolution of partial differential equations, in particular the method of separation variables. Applications of Fourier series to solve differential equations.

LEARNING ACTIVITIES AND METHODOLOGY

The lectures aim to provide the students with the abilities mentioned before. They will be structured as follows:

i) The teacher will present the main topics and techniques of the course using the necessary technical support. The necessary bibliography will be presented in order to complement the students background. During these lectures the students will

ii) Solutions of practical exercises and problems by the teacher and students (individually or in groups).

In addition, there will personal or group tutorships where the students may ask questions to complete their understanding of the lectures and of the problems proposed.

ASSESSMENT SYSTEM

According to the degree¿s documentation, the final grade will be assigned in view of the students¿ performance in two kinds of assessments: continuous evaluation (40%) - two partial exams (20%+20%) of selected topics of the course. Final exam on all topics of the course (60%).

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

BASIC BIBLIOGRAPHY

- J.R. Brannan and W.E. Boyce Differential equations : an introduction to modern methods and applications, Wiley, 2007
- R.K. Nagle, E.B. Saff and A.D. Snider Fundamentals of differential equations and boundary value problems, Pearson Education, 2012
- S.G. Krantz and G.F. Simmons Differential equations : theory, technique, and practice, 2nd ed., Boca Raton Florida etc. : CRC Press : Taylor & Francis Group, 2015

ADDITIONAL BIBLIOGRAPHY

- K. Bryan, Differential Equations: A Toolbox for Modeling the World,, Simiode, 2021
- B. Goodwine Engineering Differential Equations. Theory and Applications, Springer, 2011
- C.H. Edwards, D.E. Penney and D. Calvis Differential Equations and Boundary Value Problems: Computing and Modeling, Pearson Education, 2016
- M.S. Gockenbach Partial Differential Equations. Analytical and Numerical Methods, SIAM, 2011