

Differential Equations

Academic Year: (2023 / 2024)

Review date: 19/12/2023 13:15:29

Department assigned to the subject: Mathematics Department

Coordinating teacher: ROMERA COLMENAREJO, ELENA

Type: Basic Core ECTS Credits : 6.0

Year : 2 Semester : 1

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus I, Calculus II and Linear Algebra

LEARNING OUTCOMES

RA1: Acquire knowledge and understanding of the basic general fundamentals of engineering and biomedical sciences.

RA2: Be able to solve basic engineering and biomedical science problems through a process of analysis, identifying the problem, establishing different methods of resolution, selecting the most appropriate one and its correct implementation.

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.

CB2: Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.

CG1: Adequate knowledge and skills to analyse and synthesise basic problems related to engineering and biomedical sciences, solve them and communicate them efficiently.

CG3: Knowledge of basic scientific and technical subjects that enables them to learn new methods and technologies, as well as providing them with great versatility to adapt to new situations.

CG4: Ability to solve problems with initiative, decision-making, creativity, and to communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the biomedical engineer's activity. Capacity for leadership, innovation and entrepreneurial spirit.

CG8: Ability to solve mathematical, physical, chemical and biochemical problems that may arise in biomedical engineering.

CG12: Ability to solve mathematically formulated problems applied to biology, physics and chemistry, using numerical algorithms and computational techniques.

ECRT1: Ability to solve mathematical problems that may arise in engineering and biomedicine. Ability to apply knowledge of: linear algebra; geometry; differential and integral calculus; differential and partial derivative equations; numerical methods; numerical algorithms; statistics and optimisation.

CT1: Ability to communicate knowledge orally and in writing to both specialised and non-specialised audiences.

OBJECTIVES

SPECIFIC LEARNING GOALS (PO a):

- To understand the fundamental theorems of existence and uniqueness in differential equations, paying particular attention to the concept of well-posed model.
- To understand the importance of differential equations in the field of biomedical engineering.
- To understand the concept of linear operators and their relation with the superposition principle for solving differential equations.
- To solve elementary differential equations by standard methods.
- To know the basic differential equations of mathematical engineering and physics as well as the initial and contour problems they lead to.
- To solve partial differential equations by separation of variables and Fourier analysis.

GENERAL ABILITIES (PO a, g, k):

- To understand the necessity of abstract thinking and formal mathematical proofs.
- To acquire communicative skills in mathematics.
- To acquire the ability to model real-world situations mathematically, with the aim of solving practical problems.
- To improve problem-solving skills.

DESCRIPTION OF CONTENTS: PROGRAMME

I) DIFFERENTIAL EQUATIONS OF FIRST ORDER

- 1.1 Introduction
- 1.2 Elementary methods of resolution
- 1.3 Other kinds of equations
- 1.4 Applications

II) HIGHER ORDER DIFFERENTIAL EQUATIONS

- 2.1 Introduction
- 2.2 Equations with constant coefficients
- 2.3 Equations with variable coefficients
- 2.4 Systems
- 2.5 Applications

III) LAPLACE TRANSFORM

- 3.1 Definition and Basic Properties
- 3.2 Resolution of equations and linear systems
- 3.3 Advanced properties

IV) METHOD OF SEPARATION OF VARIABLES

- 4.1 Introduction to Partial Differential Equations
- 4.2 Method of separation of variables
- 4.3 Fourier series
- 4.4 More examples of separation of variables
- 5.5 Advanced properties of partial differential equations

V) STURM-LIOUVILLE EIGENVALUE PROBLEMS

- 5.1 Introduction
- 5.2 Generalized Fourier series
- 5.3 Rayleigh Quotient and Minimization Principle
- 6.5 Bessel equation

LEARNING ACTIVITIES AND METHODOLOGY

- 1.- Master classes.
- 2.- Problem classes.
- 3.- Partial controls.
- 4.- Final exam.
- 5.- Tutorials.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	60
% of continuous assessment (assignments, laboratory, practicals...):	40
Two mid-term tests, 2 x 20%	
Final exam, 60%	

BASIC BIBLIOGRAPHY

- HABERMAN, R. Elementary Applied Partial Differential Equations, with Fourier Series and Boundary Problems 3rd. Ed., Prentice Hall, 1998
- SIMMONS, G. F. ; KRANTZ, S. G. Differential Equations, Theory, Technique and Practice, McGraw-Hill, 2007

ADDITIONAL BIBLIOGRAPHY

- BRANNAN, J. R., BOYCE, W. E. Differential Equations with Boundary Value Problems: An Introduction to Modern Methods & Applications, Wiley., 2010
- EDWARDS, C. H., PENNEY, D. E. Differential Equations and Boundary Value Problems, Pearson Education, 2014
- NAGLE, R. K., SAFF, E. B., SNIDER, A. D. Fundamentals of Differential Equations , Pearson Addison-Wesley, 2008, 7th ed.
- SIMMONS, G. F. Differential Equations with Applications and Historical Notes 2017, 3rd edition, CRC Press Textbooks in mathematics,, 2017, 3rd edition