VNIVERSITAT DE VALÈNCIA

COURSE DATA

Data Subject	
Code	34872
Name	Mathematics III
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1403 - Degree in Telematics Engineering	School of Engineering	2	First term

Subject-matter

Degree	Subject-matter	Character
1403 - Degree in Telematics Engineering	1 - Mathematics	Basic Training

Coordination

Name	Department
STEFANON -, MAURO	16 - Astronomy and Astrophysics

SUMMARY

Course name: Mathemtics III
Number of credits ECTS: 6
Time slot: 2nd (First Quartal)
Subject: Mathematics
Character: Basic Education
Degree: Degree in Electronic Engineering in Telecommunications
Cicle: Grade / Bachelor
Departament: Astronomy and Astrophysics

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Contents of the course Mathematics I.

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

1403 - Degree in Telematics Engineering

- G3 - Acquisition of the knowledge of the basic and technological subjects that allows students to learn new methods and theories and endows them with the versatility to adapt to new situations.
- G4 - Ability to solve problems with initiative, decision-making and creativity, and to communicate and transmit knowledge, abilities and skills, understanding the ethical and professional responsibility of the activity of a telecommunications technical engineer.
- B1 - Ability to solve any mathematical problems that may arise in engineering. Ability to apply knowledge of: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial derivatives, numerical methods, numerical algorithms, statistics and optimization.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

Learning Outcomes (G3, G4, B1)

At the end of the semester and as a result of the learning process of the course, students should be able to:

- Understand and have a good graps of basic concepts in mathematics.
- Solve problems using mathematical concepts of advanced engineering.
- Understand the mathematical formalisms that may arise in engineering.
- Arrange the solution of engineering problems in mathematical form.
- Model physical phenomena using mathematical tools.
- Interpret the mathematical results applied to the physical world

Skills to be acquired (G3, G4, B1)

The student should be able to:

- Understand the concept of a root or zero of a function, and the basic operation of simple methods for calculating approximate roots. Recognize situations that require a numerical method for calculating roots.
- Know how to complete the data in a table associated with an unknown function through polynomial interpolation.
- Understand the need and appreciate the convenience of using numerical methods for solving large

systems of linear equations.
- Understand and use the relationship between the definite integral of a positive function and the associated area. Understand the need and desirability of using numerical techniques for calculating definite integrals.
- Understand the process of discretization associated with the calculation of the numerical solution of ordinary differential equations. Understand the concept of order of the numerical method.
- Understand simple processes of making decisions based on statistical concepts.
- Pose basic convex optimization problems and solve them using appropriate mathematical tools.
- Know how to calculate the regression line associated with a set of discrete data.
- Discover and understand connections with other disciplines of interest to the student.

To complement the above results, this subject also to acquire the following skills and social skills:

- Correct and understandable oral and written presentation of mathematical questions related to engeneering.
- Skills associated with the ability to work as a team.

DESCRIPTION OF CONTENTS

1. Numerical systems and sources of error

The concept of encoding / representation of numbers in computers will be introduced describing the basic fixed point and floating point codings. We will show the fact that the discrete representation of the numerical non-integer values has an associated error that must be known and controlled. It will also be explained how the discrete algebra, necessary to operate in a system of representation with a finite number of values, leads to a series of errors that must be taken into account when designing numerical algorithms for solving engineering problems.

2. Probability, inference and confidence intervals

We will introduce the fundamental concepts related to probability (average, variance, etc.). Statistical inference takes the observed values of a variable and tries to deduce the probabilistic model that has generated these data. This unit will equip students with the mathematical criteria that allow you to extract and test hypotheses from experimental data. The concept of confidence interval as a key element in statistical inference will also be considered. It will show how to take decisions on the basis of statistical hypothesis testing nature.

3. Numerical methods for the resolution of linear systems: direct and iterative methods.

Direct methods for solving systems of linear equations will be presented, with particular emphasis on the usefulness of the LU decomposition for this purpouse, as well as for the calculation of both determinants and inverse matrices. Likewise, we will introduce some basic iterative numerical methods (Jacobi, Gauss-Seidel) stressing its usefulness in dealing with problems associated with sparse matrices.

4. Numerical methods for the resolution of nonlinear equations

We will introduce the methods of bisection and of Newton-Raphson to find the roots of nonlinear functions. Special emphasis will be put on showing under which conditions the application of each method is more favorable.

5. Polynomial interpolation and numerical integration

Polynomial interpolation is introduced from the methods of Lagrange and Newton, emphasizing its utility for estimating the errors in the process and the usefulness of these methods to numerically estimate the value of definite integrals.
Definite integrals will be evaluated numerically using the basic and compound rules of the rectangle, of the trapezoid, of the midpoint, and of Simpson. We will emphasize the differences in the order of each of these methods and their numerical cost. Gauss and Monte Carlo-based methods will be introduced as time will allow.

6. Integration of Ordinary Differential Equations

The Ordinary Differential Equations (ODE) appear in the modeling of a large number of physical processes. Here we will learn how to solve ODEs through numerical methods such as those of Euler and Runge-Kutta. Emphasis will be devoted to understanding the concept of convergence of a numerical solution that approximates the true solution of the ODE.

7. Regression.

Least squares method to fit statistical or previously decided analytical models. In particular, we will consider regression lines or analytic functions that can be reduced to the evaluation of regression lines.

8. Basic optimization

We will introduce the concept of optimization, as a fundamental process in engineering. We will start from discussing the graphical optimization, enabling to solve 2-variable problems. Successively, we will introduce the Simplex method, and depending on time availability, we will show how to use numerical programming environments to implement more complex optimization procedures.

WORKLOAD

ACTIVITY	Hours	% To be attended
Laboratory practices	30,00	100
Theory classes	15,00	100
Classroom practices	15,00	100
Development of group work	2,00	0
Development of individual work	9,00	0
Study and independent work	9,00	0
Preparation of evaluation activities	25,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	20,00	0
Resolution of online questionnaires	10,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

- During the theory lectures, the profesor will introduce the concepts of each subject, and their use in solving specific problems. (G3, G4, B1)
- In the practical lectures, we will make exercices about the theoretical contents, individually and in groups, to promote the learning of theoretical concepts. (G3, G4, B1)
- Work on practical classes in the computer lab, is aimed at solving specific problems for the student. For this, we will use a computing environment that facilitates structured programming. (G3, G4, B1)
- Promote teamwork through the development of jobs that can be presented to the profesor and to the rest of the class. (G3, G4, B1)

EVALUATION

The course assessment will be performed in the following way:

1. Continuous evaluation: the student's continuous progress will be assessed through active participation in class, or by delivering problems indicated by the teacher, or by performing periodic partial exams. If for some reason, the continuous evaluation of a student was not completed, or if it was beneficial for the student, the weight of the continuous evaluation will decrease proportionally, increasing the weight of the exam. The weight of this part will be in the range 25-50%.

2. Final exam, with a weight of 50-75% on the final grade.

Nevertheless, the evaluation of the student will be performed in accordance with the Regulation of evaluation and qualification of the Universitat de València for the degree and master's degrees approved by the Government Council of May 30, 2017 (ACGUV 108/2017)

REFERENCES

Basic

- Análisis Numérico. Burden y Faires. Thomson Learning.
- Curs dEstadística. Colomer Mª Àngels. Ed. Universitat de Lleida, 1997
- Convex Optimization. S. Boyd y L. Vandenberghe. Cambridge Univ. Press 2009.
- Aproximació Numèrica. S. Amat, F. Aràndiga, J.V. Arnau, R. Donat, P. Mulet, R.Peris. P.U.V.

Additional

- Cálculo científico con MATLAB y Octave. A. Quarterioni. Springer ,2010
- Mètodes Numèrics per a l'àlgebra lineal. F. Aràndiga, R. Donat, P. Mulet. P.U.V
- Càlcul Numèric. F. Aràndiga, P. Mulet. P.U.V.
- Linear and Nonlinear Programming, 2009. David G. Luenberger, Yinvu Ye.
- Estadística Aplicada Básica. Moore David S.Ed. Antoni Bosch, 1998.
- Métodos Numéricos: Introducción, Aplicaciones y Programación. A. Huerta, J. Sarrate, A. Rodriguez-Ferrer. Edicions UPC