COURSE DATA

Data Subject	
Code	34872
Name	Mathematics III
Cycle	Grade
ECTS Credits	6.0
Academic year	2021 - 2022

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
ALOY TORAS, MIGUEL ANGEL	16 - Astronomy and Astrophysics
IBAÑEZ CABANELL, JOSE M	185 - Theoretical Physics
REGLERO VELASCO, VICTOR	16 - Astronomy and Astrophysics

SUMMARY

Course name: Mathemtics III
Number of credits ECTS: 6
Time slot: 1st (Second 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.

OUTCOMES

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

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. 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.

2. Numerical methods for the resolution of linear systems: direct methods 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 and Young relaxation) stressing its usefulness in dealing with problems associated with sparse matrices.

3. 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. As variants of the above methods, and depending on the time available, we will also introduce the secant and the Regula-Falsi methods.

4. 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 methods will be introduced if time permits it.

5. Numerical methods for solving ordinary differential equations

Ordinary differential equations (ODEs) appear in the modeling a number of physical phenomena and technical processes. This technical unit will address the resolution of ODEs using numerical methods such as Euler or Runge-Kutta. We will particularly explain the concept of convergence of an approximate numerical solution to the real solution of the equation, as well as differences between methods of first order and higher-order methods.

6. Inference and Decision: Confidence Intervals

Statistical inference takes the observed values of a variable and tries to deduce the probability model that generated these data. This unit will provide students with the mathematical criteria that allow them to extract and test hypotheses based on experimental data. Basic concepts will be refreshed, such as random variable and probability distribution. The concept of confidence interval as a key element of statistical inference will also be considered.

7. Basic convex optimization

We will introduce the concept of optimization as a basic process in any engineering or management job (resources, capital, etc.). Teaching is particularized to the case of convex functions for their relevance in realistic calculations. The graphic optimization method will be first introduced to analyze problems of two variables. We will later explain shallowly the simplex method, and finally, the relevant utilities of mathematical packages to perform more complex optimization calculations.

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 evaluation of the knowledge and skills achieved by the students will be done continuously throughout the course, and consist of the following blocks of evaluation:

1. Test or tests to assess the theoretical and practical content of the course with a score of up to 60% of the total grade for the course. Individual obligatori exercices will also be posed to the students.
2. Continuous assessment of the laboratories participation, by means of on-line questionaries and the presentation of obligatory exercices. This assessment will test or practice exams. In addition the teacher may request the presentation of specific works, reports or lab notebook to complete the assessment. The aggregated scores of all assessment activities, practices will be up to 50% of the overall grade for the course.
3. Attendance at the lectures, practices and participation in the development of the subject may in the

discretion of the teacher, have a weight of up to 10% of the overall grade for the course.

The overall grade for the course is calculated from the marks obtained in the previous sections, according to percentages established by the professor, provided that the notes of paragraphs 1 and 2 exceed 40% of the maximum score for each one of the sections. It will also be indispensable to have attended more than 50% of the practical classes to pass the practical part.

The rating of the memories and/or specific work will be kept for the two calls of each academic year.

In any case, the evaluation will be regulated by the Reglamento de Evaluación y Calificación de la Universitat de València para Grados y Masters:

https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?idEdictoSeleccionado=5639

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

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

In case of a closure of the facilities due to the health situation that affects all or part of the classes of the subject, these will be replaced by non-presential sessions following the established schedules. If the closure affects a course evaluation test, it will be replaced by a test of a similar nature that will be carried out in virtual mode through the University of Valencia institutional support tools. The percentages of each assessment test will remain unchanged, as established by this guide.

If it is required by the sanitary situation, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaption to each subject, establishing the specific conditions in which it will be developed, taking into account the actual enrolment data and the space availability.

This addendum will only be activated if the health situation so requires and subject to the agreement of the Governing Council.