28700 - Mathematics applied to engineering I

Información del Plan Docente

Academic Year	2018/19
Subject	28700 - Mathematics applied to engineering I
Faculty / School	175 - Escuela Universitaria Politécnica de La Almunia
Degree	423 - Bachelor's Degree in Civil Engineering
ECTS	6.0
Year	1
Semester	First semester
Subject Type	Basic Education
Module	

1.General information

1.1.Aims of the course

1.2.Context and importance of this course in the degree

1.3.Recommendations to take this course

2.Learning goals

2.1.Competences

2.2.Learning goals

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The learning process designed for this subject is based on the following:

Strong interaction between the teacher and the student. This interaction is brought into being through a division of work and responsibilities between the students and the teacher. Nevertheless, it must be taken into account that, to a certain degree, students can set their learning pace based on their own needs and availability, following the guidelines set by the teacher.

The current subject "Matemática Aplicada a la Ingeniería I" is conceived as a stand-alone combination of contents, yet organized into two fundamental and complementary forms, which are: the theoretical concepts of each teaching unit and

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the solving of problems or resolution of questions, at the same time supported by other activities.

The organization of teaching will be carried out using the following steps:

- **Theory Classes**: Theoretical activities carried out mainly through exposition by the teacher, where the theoretical supports of the subject are displayed, highlighting the fundamental, structuring them in topics and or sections, interrelating them.
- **Practical Classes**: The teacher solves practical problems or cases for demonstrative purposes. This type of teaching complements the theory shown in the lectures with practical aspects. Here, students are expected to participate actively in the class throughout the semester.
- **Individual Tutorials**: Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.

Regarding to the slides, proposed exercise photocopies, laboratory session guides and other materials used in class, all of them are going to be available on the Moodle platforma of this subject.

Material	Format
Topic theory notes	Paper/repositry
Topic problems	
Topic theory notes	Digital/Moodle, E-mail
Topic presentations	
Topic problems	
Related links	
Educational software	Open source Maxima and Octave

4.2.Learning tasks

The programme offered to the student to help them achieve their target results is made up of the following activities:

Involves the active participation of the student, in a way that the results achieved in the learning process are developed, not taking away from those already set out; the activities are the following:

Face-to-face generic activities:

- **Theory Classes**: (2 ECTS: 20 h) The theoretical concepts of the subject are explained and illustrative examples are developed as support to the theory when necessary.
- **Practical Classes**: (1.77 ECTS: 17.7 h) Problems and practical cases are carried out, complementary to the theoretical concepts studied.

Generic non-class activities: (1.5 ECTS: 15 h)

- Study and understanding of the theory taught in the lectures.
- Understanding and assimilation of the problems and practical cases solved in the practical classes.
- Preparation of seminars, solutions to proposed problems, etc.
- Preparation of the written tests for continuous assessment and final exams.

The subject has 6 ECTS credits, which represents 150 hours of student work in the subject during the semester, in other words, 10 hours per week for 15 weeks of class.

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A summary of a weekly timetable guide can be seen in the following table. These figures are obtained from the subject file in the Accreditation Report of the degree, taking into account the level of experimentation considered for the said subject is moderate.

Activity	Weekly school hour
Lectures	6
Other activities	3

Nevertheless, the previous table can be shown into greater detail, taking into account the following overall distribution:

- 52 hours of lectures, with 50% theoretical demonstration and 50% solving type problems.
- 8 hours of written assessment tests, one hour per test.
- 90 hours of personal study, divided up over the 15 weeks of the 1st semester.

There is a tutorial calendar timetable set by the teacher that can be requested by those students who are interested in tutorials.

4.3.Syllabus

Introduction to the open-source software Maxima and revision of real functions of real variables

Limits and Continuity of functions
- Limits, indeterminate forms, equivalence functions
- Continuity and discontinuity of functions
- Classical theorems
- Bisection method

The derivative

- The derivative, the tangent (straight) line, properties and rules
- The chain rule
- Implicit differentiation, inverse function and parametric functions
- Newton's Method
- Classical theorems: Rolle, Mean value and L'Hôpital
- Taylor polynomials and approximations
- Interpolation and numerical differentiation
- Monotonic function, increasing and decreasing functions, concavity and convexity of functions

Integration

- Riemmann Integral and its basic properties
- Antiderivatives and indefinite integration
- Fundamental theorems of Calculus
- Improper integrals
- Geometric applications
- Numerical integration

System of linear equations

- Groups, rings and fields
- System of linear equations: elementary operations

- Gaussian elimination and rank of a matrix
- Theorems of characterization (Rouché-Frobenius)
- Determinants
- Numerical Gaussian elimination, condition number
- Decompositions: LU, QR and Cholesky
- Iterative methods

Vector spaces with inner products

- Linearly independent sets, dimension and basis
- Subspaces of vector spaces
- Inner product
- Length, angles and orhtogonality
- Orthogonal subspaces and sets
- Orthogonal projection and optimal approximation

Diagonalization

- Eigenvalues and eigenvectors
- Spectral decomposition and polynomials of matrices
- Normal matrices
- Numerical methods for approximating eigenvalues
- Compatible matrices
- Singular value decomposition (SVD)

4.4.Course planning and calendar

The dates of the final exams will be those that are officially published at Distribución de exámenes.

The written assessment tests will be related to the following topics:

- **Test 1**: Limits and continuity.
- **Test 2**: The derivative.
- **Test 3**: Infinitesimal calculus.
- **Test 4**: System of linear equations.
- **Test 5**: Vector spaces.
- **Test 6**: Linear Algebra.

Week	Topic	Contents	Test	Weight
1	1	Maxima - functions	First test	5%
2	2	Limits - Continuity		
3	3	The derivative	Second test	5%
4		Taylor		
5		Interpolation		
6	4	Integration	First written exam	40%
7		Applications		
8		Numerical integration		
9	5	System of linear equations	Third test	5%
10		Determinants		
11		Numerical Linear Algebra		
12	6	Vector spaces	Fourth test	5%
13		Optimal approximation		

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14 15	7	Diagonalization Singular value decomposition	Second written exam	40%

4.5.Bibliography and recommended resources