

## 28700 - Mathematics applied to engineering I

### Información del Plan Docente

Academic Year	2016/17
Academic center	175 - Escuela Universitaria Politécnica de La Almunia
Degree	423 - Bachelor's Degree in Civil Engineering
ECTS	6.0
Course	1
Period	First semester
Subject Type	Basic Education
Module	---

### 1. Basic info

#### 1.1. Recommendations to take this course

#### 1.2. Activities and key dates for the course

### 2. Initiation

#### 2.1. Learning outcomes that define the subject

#### 2.2. Introduction

### 3. Context and competences

#### 3.1. Goals

#### 3.2. Context and meaning of the subject in the degree

#### 3.3. Competences

#### 3.4. Importance of learning outcomes

### 4. Evaluation

### 5. Activities and resources

#### 5.1. General methodological presentation

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

Strong interaction between the teacher/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.

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The current subject Matemática Aplicada a la Edificación 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 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 resolves practical problems or cases for demonstrative purposes. This type of teaching complements the theory shown in the lectures with practical aspects.
- **Individual Tutorials** : Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.

### 5.2.Learning activities

**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** : The theoretical concepts of the subject are explained and illustrative examples are developed as support to the theory when necessary.
- **Practical Classes** : Problems and practical cases are carried out, complementary to the theoretical concepts studied.

#### Generic non-class activities :

- 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 trimester, in other words, 10 hours per week for 15 weeks of class.

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:

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- 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 1<sup>st</sup> semester.

There is a tutorial calendar timetable set by the teacher that can be requested by the students who want a tutorial.

### 5.3.Program

#### 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

- Riemann 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 orthogonality
- Orthogonal subspaces and sets
- Orthogonal projection and optimal approximation

##### Diagonalization

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

### 5.4.Planning and scheduling

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	Themes
1	1	Maxima - functions	First test	5%	Limits - Continuity
2	2	Limits - Continuity			
3	3	The derivative	Second test	5%	The derivative
4		Taylor			
5		Interpolation			
6	4	Integration	First written exam	40%	Infinitesimal calculus
7		Applications			
8		Numerical integration			
9	5	System of linear equations	Third test	5%	Linear systems
10		Determinants			
11		Numerical Linear Algebra			
12	6	Vector spaces	Fourth test	5%	Vector spaces
13		Optimal approximation			
14	7	Diagonalization	Second written exam	40%	Linear Algebra
15		Singular value decomposition			

### 5.5.Bibliography and recommended resources

#### Materials

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### Material

Topic theory notes  
Topic problems  
Topic theory notes  
Topic presentations  
Topic problems  
Related links  
Educational software

### Format

Paper/repository  
  
Digital/Moodle, E-mail  
  
  
Open source Maxima and Octave

### Recommended resources

- Varberg, Dale. Calculus with differential equations / Dale Varberg, Edwin J. Purcell, Steve E. Ridgon. 9th ed. : Pearson, 2006
- Larson, Ron. Calculus of a single variable / Ron Larson, Bruce H. Edwards. 9th ed. : BROOKS/COLE Cengage Learning, 2010
- Larson, Ron. Precalculus / Ron Larson, Robert Hostetler. 7th ed. : Houghton Mifflin Company, 2007
- Lay, David. Linear algebra and its applications. 4th ed. : Pearson, 2012
- Larson, Ron. Elementary linear algebra / Ron Larson, David C. Falvo. 6th ed. : Houghton Mifflin Company, 2009
- Chapra, S. Numerical methods for engineers / Steven Chapra, Raymond Canale. 6th ed.: McGraw-Hill, 2009

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- Burgos Roman, Juan de. Algebra lineal y geometría cartesiana / Juan de Burgos Román . - 2ª ed. Madrid : McGrawHill, D.L. 1999
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- Apostol, Tom M.. Calculus. Vol.2, Cálculo con funciones de varias variables y álgebra lineal, con aplicaciones a las ecuaciones diferenciales y a las probabilidades / Tom M. Apostol. - 2ª ed., 7ª reimp. Barcelona, [etc.] : Reverté, D.L. 2002
- Coquillat Blasco, Fernando. Cálculo integral : metodología y problemas / Fernando Coquillat . - Nueva ed. amp. Madrid : Tebar Flores, D.L. 1997
- Demidovich, B.P.. 5.000 problemas de análisis matemático / B.P. Demidóvich ; traducido del ruso por Emiliano Aparicio Bernardo Madrid : Paraninfo, 1976
- Galindo Soto, Félix. Guía práctica de cálculo infinitesimal en una variable real / Félix Galindo Soto, Javier Sanz Gil, Luis A. Tristán Vega . - 1ª ed. Madrid [etc.] : Thomson, D. L. 2003
- Fuertes García, Jesús. Problemas de cálculo infinitesimal / Jesús Fuertes García , Jesús Martínez Hernando . - [1a. ed. en español] Madrid [etc.] : McGraw-Hill, D.L.1997
- García Castro, Fernando. Cálculo infinitesimal-I / Fernando García Castro, Andrés Gutiérrez Gómez . - [5a. ed.] Madrid : Pirámide, D.L. 1992
- García Castro, Fernando. Cálculo infinitesimal-II / Fernando García Castro, Andrés Gutiérrez Gómez Madrid : Pirámide, 1990-1992
- Rojo, Jesús. Algebra lineal / Jesús Rojo . - 2ª ed. Madrid [etc.] : McGraw-Hill Interamericana, D. L. 2007
- Larson, Ron. Cálculo 1 : De una variable / Ron Larson, Bruce H. Edwards ; revisión técnica, Marlene Aguilar Abalo ... [et al.] ; [traducción: Joel Ibarra Escutia ... (et al.)]. - 9ª ed. México [etc.] : McGraw Hill, cop. 2010
- Larson, Ron. Cálculo 2 : De varias variables / Ron Larson, Bruce H. Edwards ; revisión técnica, Marlene Aguilar Abalo ... [et al.] ; [traducción: Joel Ibarra Escutia ... (et al.)]. - 9ª ed. México [etc.] : McGraw Hill, cop. 2010
- Chapra, Steven C. Métodos numéricos para ingenieros / Steven C. Chapra, Raymond P. Canale ; revisión técnica José Job Flores Godoy, Enrique Muñoz Díaz. 9a ed. México D. F. : McGraw-Hill/Interamericana, cop. 2015

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