1. BASIC INFORMATION

Course	Applied Mathematics
Degree program	Grado en Fundamentos de la Arquitectura
School	Architecture, Engineering, Science and Computing
Year	1st
ECTS	6 ECTS
Credit type	Basic
Language(s)	English
Delivery mode	On-site
Semester	1st semester
Academic year	2025/2026
Coordinating professor	Javier Pérez

2. PRESENTATION

The course allows the student to learn and use the necessary skills to perform adequately in subjects such as *Process Physics*, *Structural Mechanics* and in almost all the subjects of the degree where the student has to apply the acquired knowledge of Calculus and Algebra. The student must be able to understand the concepts, procedures and strategies of Algebra, differential and integral Calculus, in one and several variables, for later application in exercises and practical problems.

3. COMPETENCIES AND LEARNING OUTCOMES

Core competencies:

- **CB1**: That students have demonstrated knowledge and understanding in a field of study that is based on general secondary education, at a level which, although supported by advanced textbooks, imply some knowledge of the vanguard of their field of study.
- **CB2**: That students can apply their knowledge to their work or vocation in a professional way and have competences that can be displayed by means of elaborating and sustaining arguments and solving problems in their field of study.
- **CB5**: That students have developed the necessary learning skills to undertake further studies with a high level of autonomy.

Cross-curricular competencies:

- **CT02**: Self-confidence.
- **CT04**: Communication skills in the native language (both oral and written) and in the English language, in accordance with the principles the Universidad Europea de Madrid, any concept or specification for the development of the regulated profession of architect. This includes learning the specific vocabulary of the degree as well as the ability to manage information.
- **CT09**: Planning and time management: Ability to plan work in order to comply with delivery times and to respect the limits imposed by budgets and building codes.

Specific competencies:

- **CE11**: Applied knowledge of numerical calculus, analytic and differential geometry, and algebraic methods.

Learning outcomes:

- **LO1**: Use of applied knowledge related to numerical and infinitesimal calculus, linear algebra, analytical and differential geometry, and probabilistic techniques and methods and statistical analysis.
- **LO2**: Integration of knowledge for solving problems.
- **LO3**: Initiative to deepen the search for fundamental bibliographical sources related to mathematics.
- **LO4**: Ability to communicate and express ideas in the language of mathematics.

The following table shows the relationship between the competencies developed during the course and the learning outcomes pursued:

Competencies	Learning outcomes
CB1, CB2, CB5, CT02, CT04, CT09, CE11	**LO1**: Use of applied knowledge related to numerical and infinitesimal calculation, linear algebra, analytical and differential geometry, and probabilistic techniques and methods and statistical analysis.
CB1, CB2, CB5, CT02, CT04, CT09	**LO2:** Integration of knowledge for problem solving.
CB1, CB2, CB5, CT02, CT04, CT09, CE11	**LO3**: Initiative to deepen the search of fundamental bibliographical sources related to mathematics.
CB1, CB2, CB5, CT02, CT04, CT09, CE11	**LO4:** Ability to communicate and express ideas in the language of mathematics.

4. CONTENT

The course is organized into five learning units which are again subdivided into several items. The following are the contents:

- Unit 1. Systems of equations, matrices and determinants.
  - Item 1.1: Matrices and determinants.
  - Item 1.2: System of LE and their applications.
  - Item 1.3: Linear applications.

- Unit 2. Geometry of the plane and space.
  - Item 2.1: Geometry of the plane and space.
  - Item 2.2: Conics.

- Unit 3. Fundamentals of differential calculus in one and several variables
  - Item 3.1: Function of a real variable.
  - Item 3.2: Functions of two or more variables.
  - Item 3.3: Derivatives and concept of differentials. Optimization.
  - Item 3.4: Partial derivatives. Gradient vector. Directional derivative. Plane tangent and normal straight.

- Unit 4. Fundamentals of integral calculus in several variables.
  - Item 4.1: Integration methods.
  - Item 4.2: Integration applications.
  - Item 4.3: Calculation of multiple integrals. Coordinate systems (cartesian, cylindrical, spherical).
  - Item 4.4: Applications of multiple integrals.

- Unit 5. Elements of discrete mathematics, descriptive statistics, linear programming.
  - Item 5.1: Elements of discrete mathematics.
  - Item 5.2: Introduction to descriptive statistics.
  - Item 5.3: Optimization with linear programming.

5. TEACHING-LEARNING METHODOLOGIES

The types of teaching-learning methodologies used are indicated below:

- Theoretical class, field experiences, conferences, trips, visits to companies and institutions.
- Problem-based learning.
- Cooperative learning.

6. LEARNING ACTIVITIES

Listed below are the types of learning activities and the number of hours the student will spend on each one:

Campus-based mode:

Learning activity	Number of hours	Use of AI
EA1: Master lectures/classes.	25 h	Allowed
EA2: Directed work: Individual and/or collaborative work that consists, among others, of reading complementary topics and materials, carrying out individual application activities or participating in debates and seminars. In the case of the online modality, all these activities are carried out with the support of the *Virtual Campus* (debates via forums and online seminars).	15h	Allowed
EA3: Practical exercises and problem solving	35 h	Not Allowed
EA4: Independent study	50 h	Allowed
EA5: Tutorials, follow-up and evaluations	25 h	Not Allowed
TOTAL	**150 h**	

7. ASSESSMENT

Listed below are the assessment systems used and the weight each one carries towards the final course grade:

Campus-based mode:

Assessment system	Weight
Working Sessions	30 %
Written test (Algebra)	25 %
Written test (Calculus)	30 %
Individual presentation	5 %
Group project	10 %

When you access the course on the *Campus Virtual*, you'll find a description of the assessment activities you have to complete, as well as the delivery deadline and assessment procedure for each one.

7.1. First exam period

To pass the course in the first exam period you must:

- Obtain 5 points out of 10 in the weighted average of the evaluable activities.

Minimum requirements to calculate the weighted average:

- Obtain 5 points out of 10 in the **written Algebra test**.
- Obtain 5 points out of 10 in the **written Calculus test.**
- Obtain 5 points out of 10 in the **group project.**
- 50% of attendance to master classes.

When the minimum required to perform the weighted average of the evaluable activities is not met (the minimum is not reached in any of the previous points), the final grade will be:

- The weighted average if its value is less than or equal to 4.
- 4, if the value of the weighted average is greater than 4.

The grade in ordinary call will be considered as NP (Not Presented) when the student has not delivered any evaluable activity of those that are part of the weighted average.

A recovery of the Algebra test may be made before the end of the semester. This option is not available for the Calculus test.

7.2. Second exam period

In the extraordinary call you must repeat the modules not passed (individual activities, group project and Algebra and Calculus exams), keeping the qualification in those passed. The details of the complementary activities will be published in the *Virtual Campus* at the end of the ordinary call.

To pass the subject in the second exam period you must:

- Obtain 5 points out of 10 in the weighted average of the evaluable activities.

Requirements to calculate the weighted average:

- Obtain 5 points out of 10 in the **written Algebra test**.
- Obtain 5 points out of 10 in the **written Calculus test**.
- Obtain 5 points out of 10 in the **group project.**

When the minimum required to perform the weighted average of the evaluable activities is not met (the minimum is not reached in any of the previous points), the final grade will be:

- The weighted average if the value is below 4.
- 4 if the value of the weighted average is above 4.

The grade in the extraordinary call will be considered as NP (Not Presented) when the student has not delivered any evaluable activity of which they are part of the weighted average.

8. SCHEDULE

This table shows the delivery deadline for each assessable activity in the course:

Assessable activities	Deadline
Working Sessions	Weeks 2, 3, 5, 7 and 8 Weeks 10, 12 and 13 Week 16
Group project	Project development: Weeks 3-13 Presentation and delivery: Week 14
Written test (Algebra)	Week 9
Written test (Calculus)	Week 17
Individual presentation	Week 14

This schedule may be subject to changes for logistical reasons relating to the activities. The student will be notified of any change as and when appropriate.

9. BIBLIOGRAPHY

The main reference work for this subject is:

- HERNÁNDEZ, E. "*Álgebra y geometría*". Madrid, Pearson Addison Wesley, 1994.
- SALAS, HILLE, ETGEN. "*Calculus. Una y varias variables*". Ed. Reverté 2002.

The recommended Bibliography is:

- STEWARD, J. "*Cálculo de una variable*". Ed. Thomson 2001.
- STEWARD, J. "*Cálculo multivariable*". Ed. Thomson 2002.
- ROGAWSKI, J. "*Cálculo varias variables*". Ed. Reverté 2012.
- A. HAHN. "*Mathematical excursions to the world's great buildings*". Princeton, 2012.
- K. WILLIAMS & M. OSTWALD. Architecture & Mathematics from Antiquity to the Future (2 vols.). Birkhäuser, 2015.
- J. BURRY & M. BURRY. "*The New Mathematics of Architecture*". Thames Hudson, 2015.

10. EDUCATIONAL GUIDANCE AND DIVERSITY UNIT

From the Educational Guidance and Diversity Unit we offer support to our students throughout their university life to help them reach their academic achievements. Other main actions are the students inclusions with specific educational needs, universal accessibility on the different campuses of the university and equal opportunities.

From this unit we offer to our students:

1. Accompaniment and follow-up by means of counselling and personalized plans for students who need to improve their academic performance.
2. In terms of attention to diversity, non-significant curricular adjustments are made in terms of methodology and assessment for those students with specific educational needs, pursuing an equal opportunities for all students.
3. We offer students different extracurricular resources to develop different competences that will encourage their personal and professional development.
4. Vocational guidance through the provision of tools and counselling to students with vocational doubts or who believe they have made a mistake in their choice of degree.

Students in need of educational support can write to us at:
orientacioneducativa@universidadeuropea.es

11. ONLINE SURVEYS

Your opinion matters!

The Universidad Europea encourages you to participate in several surveys which help identify the strengths and areas we need to improve regarding professors, degree programs and the teaching-learning process.

The surveys will be made available in the “surveys” section in virtual campus or via e-mail.

Your assessment is necessary for us to improve.

Thank you very much for your participation.