

**Algebra**

Code: 103801  
 ECTS Credits: 6

Degree	Type	Year	Semester
2502441 Computer Engineering	FB	1	1

**Contact**

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**Use of Languages**

Principal working language: catalan (cat)

Some groups entirely in English: No

Some groups entirely in Catalan: Yes

Some groups entirely in Spanish: No

**Teachers**

Jaume Moncasi Solsona

Laia Saumell Ariño

Francesc Perera Domènech

Joan Claramunt Caros

**Prerequisites**

Basic concepts on rational and real numbers.

Basic concepts on the method of solution of systems of linear equations.

**Objectives and Contextualisation**

The course is an introduction to linear algebra, emphasizing the most functional and instrumental aspects of linear techniques.

The basic objective is to achieve a rapid and efficient transition between the three following levels of knowledge:

- Ability to express written reasoning.
- Abstract knowledge of mathematical notions related to linear phenomena.
- To gain insight into mathematical notions by way of hands-on manipulation.

**Competences**

- Acquire thinking habits.
- Have the capacity to resolve the mathematical problems that can arise in engineering. Have the aptitude to apply knowledge about: linear algebra, differential and integral calculus, numerical methods, numerical algorithms, statistics and optimisation.
- Know the basic materials and technologies to enable the learning and development of new methods and technologies, as well as those that provide large-scale versatility to adapt to new situations.

## **Learning Outcomes**

1. Develop scientific thought .
2. Know and apply the mathematical methods of deduction and demonstration.
3. Show capacity to deal with matrices, calculation of determinants, and resolution of systems of equations.

## **Content**

### Block I: Complex numbers

Vector representation and polar form of complex numbers. De Moivre's Formula. Calculation of nth roots. Roots of polynomials and polynomial factorization.

### Block II: Matrices

Operations with matrices. Invertible matrices. Elemental transformations and row-reduction of matrices. Systems of linear equations. Rank of a matrix. Theorem of Rouché. Rank and linear dependence of rows and columns of matrices. Determinants.

### Block III: Vector spaces and linear maps

Vector spaces. Linear combinations. Linear independence of vectors. Bases, dimension and coordinates. Subspaces. Linear maps. Kernel and range of a linear map. Isomorphisms.

### Block IV: Diagonalization of matrices

Characteristic polynomial, eigenvalues and eigenvectors of a square matrix. Diagonalization of matrices. Computation of powers of a matrix.

## **Methodology**

The central part of the learning process is based on the work by the student. The lecturer's mission is to help the student in this task by providing information or pointing to sources where such information can be obtained, and tutoring their steps so that the learning process can be carried out effectively.

In line with these ideas, and in accordance with the objectives of the subject, the development of the course will be based on the following activities:

**Lectures:** The scientific and technical knowledge of the subject will be presented in the form of master classes. In them, the basic concepts set out in the syllabus will be shown to the student and indications will be given on how to complete and gain insight into these notions.

**Tutorials:** In those, attention will be paid to the scientific and technical knowledge exposed in the lectures to complete the students' understanding. In these classes the basic techniques of the course will also be practiced, by means of the resolution of practical exercises.

**Workshops:** In the workshops, students will be proposed the development of an activity, whose resolution will allow to measure the assimilation of the material developed both in the lectures, tutorials, and seminars. These workshops will be assessed on fixed dates that will be announced in due course (on the Virtual Campus).

**Seminars:** Seminar sessions will be devoted to discuss the material to be dealt with at the workshops.

**Transversal Competences:**

T01.03 - Development of scientific thinking: Theoretical classes reinforce the cross-sectional competence regarding the development of scientific thinking, providing logical arguments. In tutorials, seminars and workshops, the different tasks are combined with the contents exposed in the lectures, carrying out algorithms and problem solving skills. Obviously, scientific thinking is present in all activities in a certain proportion with the arguments of all the theoretical and practical contents of the subject. In particular, during lectures, tutorials and workshops time will be devoted to discuss proofs, a fundamental basis for the development of scientific thinking.

This will be done through proofs, and exercises of argumentation and reflection.

## Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	55	2.2	2, 3, 1
Type: Supervised			
Seminars	5	0.2	2, 3
Tutorials	50	2	2, 3, 1
Type: Autonomous			
Workshops	16	0.64	2, 3, 1

## Assessment

The evaluation is based on continuous assessment. There will be two individual written theoretical-practical tests:

- The first test will be carried out during the semester and will have a weight of 20% on the final grade.
- The second test will be carried out within the weeks reserved for exams, and will have a weight of 40% on the final grade.

The remaining 40% of the final grade, will be obtained by means of the three tutored workshops, at a rate of 14% (for the first workshop) and 13% (the second and third workshops).

There will be a resit exam corresponding to the two previous theoretical and practical tests, corresponding to 60% of the final grade. There is no resit exam corresponding to the three workshops of the course. This method of assessment will be the same for all the students enrolled, regardless of the number of times they have enrolled in the subject. In order to pass the course, it is necessary that the evaluation of each of the parts exceeds the minimum required and that the total evaluation is bigger than or equal to 5 points out of 10: this refers to the grade obtained from the workshop note and the two theoretical-practical tests, or the grade from the workshops and the resit exam corresponding to the two theoretical-practical tests.

At least, each student must turnout at two of the three assessed workshops, and have a minimum mark (overall of the workshops) of 2 points out of 10 to be able to pass the subject. Attendance to partial exams or the resit exam is mandatory in order to pass the subject. The "non-evaluable" qualification will be awarded only to students who do not turnout at the second theoretical-practical test nor at the resit exam and who have not committed any irregularity that may lead to a variation of the qualification of an instance of evaluation. In the case of not passing the subject, the numerical grade will be the lowest value between 4.5 and the weighted average of the grades of the different tests. Notwithstanding other disciplinary measures that may be deemed appropriate, and in accordance with the current academic regulations, the irregularities committed by the

student that can lead to a variation of the qualification of an instance of evaluation will result in obtaining zero marks for the corresponding instance. Therefore, copying or letting someone else copy during an exam/workshop or any other situation where assessment is being carried will entail failing the said activity, without the chance of being recovered during the same academic year. If this activity has a minimum associated mark, then the student will fail the subject. These irregularities include, among others:

- the total or partial copy of a workshop, report, or any other activity of assessment;
- let someone else copy;
- present a group work not done entirely by the members of the group (applied to all members, not only to those who have not worked);
- present as own materials prepared by a third party, even if they are translations or adaptations, and generally work with non-original and exclusive elements due to the student;
- Have communication devices (such as mobile phones, smart watches, camera pens, etc.) accessible during theoretical-practical assessment tests (individual exams);
- Talk with classmates during the theoretical-practical assessment tests (exams);
- Copy or attempt to copy from other students during the theoretical-practical assessment tests (exams);
- Use or attempt to use written material related to the subject during the theoretical-practical evaluation tests (exams), when these have not been explicitly allowed.

The dates for tests corresponding to continuous assessment will be published on the virtual campus and may be subject to possible changes of programming, due to possible incidents; the virtual campus will be the usual platform for exchanging information between lecturers and students. For each of the different assessment activities, the lecturer will establish a date to handle claims or clarify doubts about the mark obtained. Whenever the academic calendar allows it, this review of examinations will take place approximately one week after the marks have been made public. Students with a mark greater than or equal to 9.4 will be able to obtain a "Matrícula d'Honor" and these will be decided upon the completion of all the evaluation tests. This will depend on the lecturer of the group to which the student(s) belongs, with the help of all the lecturers of the course if necessary.

The assigned transversal competence is in all the evaluations and workshops of the subject, but more explicitly in the theoretical part of the theoretical-practical tests, where scientific thinking is absolutely necessary to be able to answer them. In particular, there will be a question about reasoned argumentation of scientific statements of the subject.

In case of doubt about the interpretation of the evaluation method, the Catalan written version remains as the reference.

## Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
2 Written tests	60%	18	0.72	2, 3, 1
3 Workshops	40%	6	0.24	2, 3, 1

## Bibliography

- E. Nart, X. Xarles, Apunts d'àlgebra lineal, Materials de la UAB, núm. 237, 2016.
- E. Nart, Notes d'àlgebra lineal, Materials de la UAB, núm. 130, 2a edició, 2006.
- S. I. Grossman, Álgebra lineal con aplicaciones, McGraw-Hill, 1991.
- J.A. Carballo, F.M. Español, J.S. Ruiz. Problemas resueltos de àlgebra lineal. Ediciones Paraninfo. S.A., 2015.