UAB
Universitat Autònoma de Barcelona

Algebra

Code: 103795
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500895 Electronic Engineering for Telecommunication	FB	1
2500898 Telecommunication Systems Engineering	FB	1

Contact

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Teachers

Enric Nart Viñals

Teaching groups languages

You can view this information at the end of this document.

Prerequisites

No prerequisite is set. It would be good for the student to have assimilated the concepts rational number, real number, and complex number. It is also advisable to know some method of solving systems of linear equations.

Objectives and Contextualisation

This is a basic introduction to linear algebra, emphasizing the most functional and instrumental aspects of linear techniques.
A fundamental objective is to achieve an agile and efficient transition between the three following levels of knowledge:

- Abstract knowledge of mathematical concepts related to linear phenomena.
- Deepened knowledge of the same concept from its practical manipulation "by hand".
- Deepened knowledge of the same concept from its practical manipulation with a computer.

The most important fundamental objective is to learn to design efficient strategies to apply specific techniques to solve
complex problems.

Competences

Electronic Engineering for Telecommunication

- Communication
- Develop personal work habits.
- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.
- Perform measurements, calculations, estimations, valuations, analyses, studies, reports, task-scheduling and other similar work in the field of telecommunication systems
- Work in a team.

Telecommunication Systems Engineering

- Develop personal work habits.
- Develop thinking habits.
- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.

Learning Outcomes

1. Analyse measurements in the area of engineering, using statistical tools to extract and understand information.
2. Analyse measures in the area of engineering, using statistical tools to extract and understand information.
3. Apply, in the problems that arise in engineering, knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial derivative equations, numerical methods, numerical algorithms, statistics and optimisation.
4. Apply, to the problems that arise in engineering, knowledge of linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial derivative equations, numerical methods, numerical algorithms, statistics and optimisation.
5. Communicate efficiently, orally and in writing, knowledge, results and skills, both professionally and to non-expert audiences.
6. Develop scientific thinking.
7. Develop the capacity for analysis and synthesis.
8. Manage available time and resources.
9. Model systems and analyse their features.
10. Resolve the mathematical problems that can arise in engineering.
11. Work autonomously.
12. Work cooperatively.

Content

1. Matrices
    1. Matrices. Operations with marices. Special matrices: symmetric, Toeplitz, circulant, invertible, hermitian, orthogonal.
    2. Elemental transformations by rows. Gauss-Jordan's normal form of a matrix. Rank of a matrix. Invertibility and calculation of inverse matrices.
    3. Systems of linear equations and linear varieties. Gauss method. Direction and dimension of linear varieties. Rouché's Theorem.
3. Vector Spaces
    1. Definition of vector space and examples. Linear combinations of vectors. Subspaces. Generating systems.
    2. Linear maps. Matrix associated to a linear map. Composition of linear maps. Kernel and Image of a linear map. Isomorphisms.
    3. Linear dependence of vectors. Linear dependence criterion.
    4. Bases, dimensions and coordinates. Working with coordinates. Base changes.

5. Diagonalization of matrices and inner products.
    1. Determinant of a square matrix. Properties of the determinant.
    2. Eigenvalues and eigenvectors of a square matrix. Diagonalization criteria.
    3. Applications of diagonalisation: calculation of matrix powers and resolution of systems of linear differential equations with constant coefficients.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	30	1.2	3, 4, 6, 7
Problem sessions	15	0.6	3, 4, 6, 7, 9, 10
Type: Supervised			
Seminars	5	0.2	1, 2, 3, 4, 7, 9, 10, 11, 12
Type: Autonomous			
Individual problem solving	60.5	2.42	3, 4, 7, 8, 9, 10, 11
Personal study of the theory	31	1.24	6, 7, 8, 11

The central part of the learning process is the work of the student. The teacher's mission is to help the student in this task by providing information or showing the sources where they can be achieved, and directing 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:

- Theory classes The scientific and technical knowledge of the subject will be presented in the form of lectures. In them the basic concepts set out in the syllabus will be presented to the student and clear indications of how to complete and deepen these contents will be given.
- Problem classes. Where they will work the scientific and technical knowledge exposed to the theory classes to complete their comprehension and deepen them. In these classes the basic techniques of the course will also be practiced, based on the resolution of practical exercises.
- Seminars. The seminars will propose to the students the development of an activity (partly by means of a mathematical software), whose resolution allows to measure the assimilation of the presented knowledge and exercises to the theoretical and practical classes. There will be two deliveries, corresponding to two different activities explained during the seminar class. These deliveries will be evaluated by the seminar professors.

Note: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

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Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final test	.50	2.5	0.1	3, 4, 5, 6, 7, 8, 9, 10, 11
Mid-term test	0.35	2	0.08	3, 4, 5, 6, 7, 8, 9, 10, 11
Seminars	.15	4	0.16	1, 2, 3, 4, 5, 8, 9, 10, 11, 12

The evaluation will be carried out continuously. It will consist of:

1. A first written exam that will be given during the first part of the semester and will have a weight of 35% on the final grade.
2. A second written exam that will be given at the end of the semester and will have a weight of 50% on the final grade.
3. Two tutored seminars, at a rate of 7.5% each.

The final grade of the course is the weighted average of the written exams and the tutored seminars, as long as the weighted average of the written exams reaches a minimum of 3.5 out of 10. Otherwise, the final grade will not exceed 3.5 out of 10. If this final grade is 5 or higher, the course is considered as passed and it can not be subject to a new assessment.

If the final grade is less than 5, the student may opt for a reassessment in the terms described below, provided that he or she has attended a set of evaluation activities that represent a minimum of 60% of the total grade of the subject. The reassessment consists of a comprehensive written exam of the subject. If in such exam one gets a grade greater than or equal to 3.5, the weighted average of this grade, with 85% weight, and of the seminars, with 15% weight, will be calculated. If this weighted average is equal to 5 or higher, the final qualification is
passed with a grade of 5.0. Otherwise, the subject will be qualified as failed with the obtained grade.

The qualification with Honours (MH) is a decision of the teaching staff responsible for the subject. The UAB regulations indicate that MH can only be awarded to students who have obtained a final grade of at least 9.00 out of 10.00. It can be granted to up to the 5% of the total number of students enrolled.

A student will be considered non-evaluable (NA) if he or she does not attend at least 50% of the activities of evaluation of the subject.

For each of the assessment activities, the teacher will establish a date to handle claims or clarify doubtsabout the qualification obtained. Whenever the calendar of evaluations and closing of acts allows it, this review of examinations will take place approximately one week after the qualifications have been made public.

Notwithstanding other disciplinary action deemed appropriate and in accordance with current academic standards, any irregularity committed by the student that may lead to a change in the qualification of an act of assessment will convey a grade of zero. Therefore, copying or allowing to copy in any assessment activity will involve failing it with a zero. Also, if passing such activity is necessary to pass the course, the entire course will be graded as fail. The activities failed due to violations of the code of honor will not be recoverable course will be graded as fail. The activities failed due to violations of the code of honor will not be recoverable by the assessments described and the course will be graded as fail directly without the opportunity to recover in the same academic year.

The dates of evaluation activities and seminars will be announced on the virtual campus and may be subject to possible changes of programming for reasons of adaptation to possible incidents. The virtual campus will always report about these changes since it is understood that this is the usual platform for exchanging information between teachers and students.

Bibliography

1. M. Masdeu, A. Ruiz, Apunts d'Àlgebra Lineal, https://mat.uab.cat/~albert/wp/wp-content/uploads/2020/02/MR_Apunts_d__lgebra_Lineal2020.pdf
2. E. Nart X. Xarles, Apunts d'àlgebra lineal, Materials de la UAB, núm. 237, 1a edició.
3. S. I. Grossman, Álgebra lineal con aplicaciones, McGraw-Hill, 1991.
5. P. Lancaster, Theory of Matrices, Academic Press, NY, 1969.
6. J. Arvesu, F.J. Marcellán, J. Sánchex Ruiz, Problemas resueltos de álgebra lineal , S.A. EDICIONES PARANINFO

Software

- ACME
- Sagemath / Python

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	311	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	312	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	331	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	332	Catalan	second semester	morning-mixed
(SEM) Seminars	311	Catalan	second semester	morning-mixed
(SEM) Seminars	312	Catalan	second semester	morning-mixed
(SEM) Seminars	313	Catalan	second semester	morning-mixed
(SEM) Seminars	314	Catalan	second semester	morning-mixed
(SEM) Seminars	315	Catalan	second semester	morning-mixed
(SEM) Seminars	316	Catalan	second semester	morning-mixed
(SEM) Seminars	317	Catalan	second semester	morning-mixed
(SEM) Seminars	318	Catalan	second semester	morning-mixed
(TE) Theory	31	Catalan	second semester	morning-mixed
(TE) Theory	33	Catalan	second semester	morning-mixed