Universitat Autònoma de Barcelona

2021/2022

Algebra

Code: 103795
ECTS Credits: 6

Degree	Type	Year	Semester
2500895 Electronic Engineering for Telecommunication	FB	1	2
2500898 Telecommunication Systems Engineering	FB	1	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

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

Enric Nart Viñals
Laia Saumell Ariño
Joan Bosa Puigredon

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

(Google tranlation) This is an introduction to the most basic aspects of 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:

the abstract knowledge of a mathematical concept related to linear phenomena
Deepening in the knowledge of the same concept from its practical manipulation "manual"
Deepening the knowledge of the same concept from its practical manipulation with a computer.

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

Competences

Electronic Engineering for Telecommunication

- Communication
- Develop personal attitude.
- 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.
- 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

- Communication
- Develop personal attitude.
- 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.
- Perform measurements, calculations, estimations, valuations, analyses, studies, reports, task-scheduling and other similar work in the field of telecommunication systems.
- Work in a team.

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 curiosity and creativity.
7. Develop scientific thinking.
8. Develop the capacity for analysis and synthesis.
9. Manage available time and resources.
10. Manage available time and resources. Work in an organised manner.
11. Model systems and analyse their features.
12. Resolve the mathematical problems that can arise in engineering.
13. Work autonomously.
14. Work cooperatively.

Content

I. Matrices

1. Commutative fields. Marrices. 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. Directors vectors and dimension of linear varieties. Theorem of Rouché.

4. Determinant of a square matrix. Properties of the determinant. Direct calculation of the inverse of a matrix.

II. 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.

III. Diagonalization of matrices and inner products.

1. Eigenvalues and eigenvectors of a square matrix. Diagonalization criteria. Applications of diagonalisation: calculation of matrix powers and resolution of systems of linear differential equations with constant coefficients.

2. Bilinear forms, Euclidean vector spaces. Inner product and norm. Orthogonal subspaces, orthogonal projection. Orthogormal and orthonormal bases, Gramm-Schmidt method.

3. Diagonalization in symmetric and hermitian matrices.

Methodology

(Google translate)

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 master classes. In them they will show to the student the basic concepts set out in the syllabus and clear indications of how to complete and deepen these contents.

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.

Annotation: 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.

Activities

Title	Hours	ECTS	Learning Outcomes

Type: Directed			
Problem classes	15	0.6	4, 7, 8, 11, 12
Theory classes	30	1.2	4, 11, 12
Type: Supervised			
Seminars	4	0.16	1, 2, 3, 7, 8, 11, 14, 13
Type: Autonomous			
Problem-solving	60.5	2.42	4, 8, 6, 10, 12, 13
Study of the fundamentals of the theory	31	1.24	7, 13

Assessment

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 30% 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 10% 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 4 out of 10. Otherwise, the final grade will not exceed 4 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 two thirds 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 4, the weighted average of this grade, with 80% weight, and the note of the seminars, with 20% 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 doubts about 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.

Without prejudice to 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 suspending 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 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 published 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 be informed about these changes since it is understood that this is the usual platform for exchanging information between teachers and students

All students enrolled in the subject will also be evaluated according to the established criteria.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam	50%	3.5	0.14	4, 3, 5, 7, 8, 6, 9, 10, 12
Mid-term exam	30%	2	0.08	4, 3, 5, 7, 8, 6, 9, 10, 12
Seminars	20%	4	0.16	1, 2, 4, 3, 5, 9, 10, 11, 12, 14, 13

Bibliography

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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.
4. M.Castellet, I. Llerena, Àlgebra Lineal i Geometria. Manuals UAB, 1990, 2ona edició. Capítols: IV, V,VIII1,VIII2,XI1,XI2,XI3,XI5,XI.6,XI7.
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

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