UAB
Universitat Autònoma de Barcelona

Linear Algebra II

Code: 107839
ECTS Credits: 6

2025/2026

Degree	Type	Year
Mathematics	FB	1

Contact

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Teaching groups languages

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

Prerequisites

It will be required that the student knows the basic notions of Linear Algebra I (vector space and subspace, linear independence, base, dimension, linear application) and is able to make calculations related to these basic concepts. It is also necessary certain level of abstraction and understanding of mathematical proofs.

Objectives and Contextualisation

The objectives of this subject are of two types: to achieve basic mathematical training and to acquire knowledge and skills of the Linear Algebra.

Among the objectives of a formative nature, we highlight the following: to understand and use mathematical language correctly, to see the need for proofs and to develop a critical sense in mathematical claims.

In order to acquire a good mathematical training, it is essential to fully understand the theory of the Linear Algebra. It is necessary to learn to manipulate the concepts that are introduced in the course because they are used not only in all branches of Mathematics but also in most sciences and engineering.

Learning Outcomes

1. CM01 (Competence) Write elementary proofs in the field of algebra and analysis in an orderly and precise manner.
2. CM02 (Competence) Develop autonomous strategies for solving basic mathematical problems.
3. KM01 (Knowledge) Identify the basics of linear algebra and single-variable analysis.
4. KM04 (Knowledge) Describe the procedure for solving systems of linear equations in several variables.
5. SM01 (Skill) Apply the rules of algebra and single-variable analysis to the classification of applications according to various criteria (rank, determinant, Jordan forms, existence of maxima and minima, asymptotes).
6. SM02 (Skill) Apply the basics of linear algebra and analysis to a variable to solve mathematical problems.
7. SM03 (Skill) Relate the concepts of linear algebra to those of single-variable analysis (linearity of differential and integral operators or continuity of matrix operations, etc.).

Content

1. The vector space of linear maps. Dual space.

2. Diagonalization of endomorphisms.

3. Classification of endomorphisms. Jordan form.

4. Symmetric bilinear forms. Sylvester's theorem. Spectral Theorem.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	30	1.2	CM01, CM02, KM01, KM04, SM01, SM02, SM03, CM01
Problem sessions	14	0.56	CM01, CM02, SM02, CM01
Seminars	6	0.24	CM01, CM02, SM01, SM02, CM01
Type: Autonomous			
Preparing for interviews	4	0.16	CM01, CM02, KM04, SM01, SM02, SM03, CM01
Preparing written exercises to hand in	8	0.32	CM01, KM04, SM01, SM02, CM01
Problem solving	45	1.8	CM01, CM02, SM01, SM02, CM01
Study of the theory	30	1.2	CM01, CM02, KM01, KM04, SM01, SM02, SM03, CM01

There will be two hours a week of lectures, one hour a week of problems sessions, and 3 seminar sessions. Nevertheless, as in every mathematics course, what is most needed to reach the necessary level is the personal work and effort of the student. The course has been designed with this idea in mind.

During the lectures, the professor will explain and develop the contents of the course. These set the pace of the course and all other activities revolve around the contents explained in the lectures. In order to tackle the problems it is needed to know the definitions introduced in the lectures, and the statements of results, but it is also needed to understand the proofs, as similar techniques are used in solving the problems. Students must ask about all doubts they may have, both during lectures and in office hours. Special attention will be given to the correct and precise use of mathematical language. It is recommended to consult the references suggested as bibliography to complete the material covered and see different points of view.

During problem sessions, the resolution of problems proposed periodically will be explained. These problems are given in lists based on the material covered in the lectures and guide the student to develop and apply the results and ideas seen in them. It is most important that the student tries hard to solve the problems before attending the problem sessions, to compare their ideas with peers and with the professors'.

Seminars are a complement of lectures and problem sessions. During each seminar session a list of exercises will be proposed, to develop some idea or technique of the course in depth. In the classroom the students will work in small groups on the exercises, checking with the lecturer as much as needed, and discussing in group possible strategies. The lecturer will explain the most significant aspects of the solutions. In all activities of the

course the participation of students is essential, but in the case of seminars the session is structured around students' inputs, so it is of the greatest importance that they study the material given in the lectures before each seminar.

Along the course, exercises will be proposed that the students have to complete and hand in. There will be an interview relative to some of the given exercises. Each student will keep a copy to prepare the interview.

All professors and lecturers will have office hours to answers students' questions.

The course also has a webpage in the Campus Virtual of the UAB where exercise lists will be available, alongside all material deemed relevant.

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.

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Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam	50%	4	0.16	CM01, CM02, KM01, KM04, SM01, SM02, SM03
Mid term written exam	35%	4	0.16	CM01, CM02, KM01, SM01, SM02, SM03
Second chance exam	85%	4	0.16	CM01, CM02, KM01, KM04, SM01, SM02, SM03
Written exercises and interviews	15%	1	0.04	CM01, CM02, KM01, SM01, SM02

The course lasts for the whole academic year, and it results in a single grade, determined at the end, in July.

15% of the grade corresponds to submitted exercises and the interview corresponding to them. The rest of the grade corresponds to exams done throughout the semester, with 35% for the mid-term exam and 50% for the final exam.

The course is passed if, according to the fixed weights, the grade is equal to or larger than 5, with the requirement that the grade obtained in the final exam is at least 4.

After this final exam, there will be a second-chance final exam, in which it is possible to improve the part of the grade corresponding to exams. Thus, this (non-mandatory) exam will account for 85% of the grade, and the remaining 15% will still correspond to the submitted exercises and interviews (which have no second-chance).

A student who does not take part in assessment activities corresponding to at least 50% of the grade will not be evaluated.

Unique assessment:

Those students who opt for the unique assessment will take a single exam in which the theory and practice content of the subject will be assessed. Also, on the day of the test, students will need to hand in a dossier with the different assignments that have been planned during the course. The exam will have a weight of 90% of the final mark and the remaining 10% will be obtained from the content of the delivered exercise file. The exam

will be held at the same time as the exam of the second part of the subject. For this exam, the same "second-chance exam" system as for the continuous assessment will be applied, albeit with the weightings of the single assessment.

Bibliography

S. Axler, *Linear Algebra Done Right*, 3rd ed, Springer, 2015

F. Cedó, A. Reventós. *Geometria plana i àlgebra lineal.* Manuals de la UAB, Servei de Publicacions de la UAB, Bellaterra, 2004.

R. Camps, E. Nart, G. Solanes i X. Xarles. *Apunts d'Àlgebra Lineal i Multilineal.*

M. Masdeu i A. Ruíz, *Apunts d'Àlgebra Lineal.*

W. Greub, *Linear Algebra*, Springer 1975.

J. Hefferon, *Linear Algebra*. Accessible online a: http://joshua.smcvt.edu/linearalgebra/

A. Kostrikin, Y. Manin. *Linear algebra and Geometry.* Gordon and Breach Science Publishers, Amsterdam 1989. (Segona edició: 1997.)

L. Merino, E. Santos. *Álgebra lineal con métodos elementales.* Ed. Thomson, Madrid, 2006.

G. Strang, *Linear algebra and its applications*.4th ed, Thomson, 2006

Problem books

F. Cedó i V. Gisin. *Àlgebra bàsica.* Manuals de la UAB, Servei de Publicacions de la UAB, Bellaterra, 1997.

J. Rojo e I. Martín. *Ejercicios y problemas de Álgebra lineal.* Mc. Graw-Hill, Madrid, 1994.

Software

The SAGE free software will be very useful to work on high-dimensional examples, where the theory becomes more necessary.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	2	Catalan	second semester	morning-mixed
(SEM) Seminars	1	Catalan	second semester	morning-mixed
(SEM) Seminars	2	Catalan	second semester	morning-mixed

(SEM) Seminars	3	Catalan	second semester	morning-mixed
(SEM) Seminars	4	Catalan	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	morning-mixed