Course guide
330501 - ALG - Algebra

Last modified: 12/09/2023

Unit in charge: Manresa School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Alsina Aubach, Montserrat

Others: Giménez Pradales, José Miguel

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE1. Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial derivatives; numerical methods; numerical algorithms; statistics and optimization.

Generical:
CG3. Knowledge of basic and technological subjects that will enable students to learn new methods and theories and that will endow them with the versatility needed to adapt to new situations.
CG10. The ability to work in a multilingual and multidisciplinary environment.

Transversal:
1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
2. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
3. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Basic:
CB1. Students will be able to demonstrate their knowledge of a field of study that builds on secondary education and is usually found at a level that, while supported by advanced textbooks, also includes aspects that involve knowledge of the latest developments in the field of study.
CB2. Students will be able to apply their knowledge to their work or vocation in a professional manner and demonstrate that they possess the competencies that are typically demonstrated by elaborating and defending arguments and solving problems in the field of study.

TEACHING METHODOLOGY

MD1 Master class or lecture (EXP)
MD2 Problem solving and case study (RP)
MD5 Small-scale project, activity or assignment (PR)
MD6 Large-scale project, activity or assignment (PA)
MD7 Assessment activities (EV)

LEARNING OBJECTIVES OF THE SUBJECT

Students should learn and understand the fundamental concepts of linear algebra and geometry; develop their analytical abilities and logical thinking, increasing their capacity for abstraction and generalisation; learn to apply linear algebra techniques to set and solve problems and to think of methods and algorithms for solving them; and learn to obtain and interpret results by means of computer programs, what helps to highlight the role of mathematical models.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours small group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1. Algebraic structures

Description:
Natural numbers, integers, rational numbers and real numbers. Complex numbers. Polynomials. Matrices and systems of linear equations. Applications.

Specific objectives:
To learn different algebraic structures and their properties. To learn to solve systems of linear equations by using matrices.

Related activities:
TA, A12, E12, E1234

Full-or-part-time: 40h
Theory classes: 8h
Laboratory classes: 8h
Self study : 24h

2. Vector spaces and applications

Description:
Vector spaces: subspaces, bases, coordinates, change of bases, intersection and sum of subspaces. Linear transformations: matrix representations, change of basis, kernel and range. Determinants. Applications.

Specific objectives:
To learn the fundamental concepts of linear algebra in the framework of vector spaces, linear transformations and their matrix representations.

Related activities:
TA, A12, E12, E1234

Full-or-part-time: 40h
Theory classes: 8h
Laboratory classes: 8h
Self study : 24h

3. Eigenvalues and eigenvectors

Description:
Eigenvalues and eigenvectors; characteristic polynomials, diagonalisation. Non-diagonalisable matrices. Applications.

Specific objectives:
To learn to compute and interpret eigenvalues and eigenvectors to classify matrices and solve related problems.

Related activities:
TA, A34, E34, E1234

Full-or-part-time: 40h
Theory classes: 8h
Laboratory classes: 8h
Self study : 24h

4. Linear variety, quadratic forms and geometric transformations

Description:
Affine geometry, equations and reference systems. Inner products. Quadratic forms and symmetric matrices. Motions and isometries.

Specific objectives:
To generalise and apply the above content to geometry in order to understand representations of objects and motions.

Related activities:
TA, A34, E34, E1234

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study : 18h

ACTIVITIES

Algebra lab - TA

Description:
Introduction and practice of software for symbolic manipulation and numerical computations involving the content of the course, in order to solve related problems. It includes the assessment of the level of learning achieved in the use of software to solve proposed challenges.

Specific objectives:
To learn to use software to solve problems related to the course topics.

Material:
Suitable software available on the computers in the lab (Matlab or similar). Lab guidelines or assignments, and quizzes, or equivalent material.

Delivery:
Assignments must be submitted to the professor.

Full-or-part-time: 8h
Laboratory classes: 2h
Self study: 6h

Assignment - A12

Description:
Practical activity as a project. It will be developed by the student, with the guidance of the teacher, and the follow-up and the final report will be assessed.

Specific objectives:
To review the achievement of the aims of Topics 1 and 2, in order to check whether students need to review their learning process.

Material:
Assignment guidelines, virtual campus material and suitable course notes.

Delivery:
Assignments must be submitted to the professor.

Full-or-part-time: 12h
Laboratory classes: 3h
Self study: 9h

Written exam - E12

Description:
Individual written exam to assess the learning goals of Topics 1 and 2.

Specific objectives:
To assess the achievement of the aims of Topics 1 and 2.

Material:
Exam paper delivered by the professor.

Delivery:
Completed exam must be submitted to the professor.

Full-or-part-time: 8h
Theory classes: 2h
Self study: 6h

Written exam - E34

Description:
Individual written exam to assess the learning goals of Topics 3 and 4.

Specific objectives:
To assess the achievement of the aims of Topics 3 and 4.

Material:
Exam paper delivered by the professor.

Delivery:
Completed exams must be submitted to the professor.

Full-or-part-time: 12h
Theory classes: 3h
Self study: 9h

Global written exam - E1234

Description:
Individual written exam to assess the learning goals of Topics 1, 2, 3 and 4.

Specific objectives:
To assess the achievement of the aims of course.

Material:
Exam sheet delivered by the professor.

Delivery:
Written exams must be submitted to the professor.

Full-or-part-time: 12h
Theory classes: 3h
Self study: 9h

GRADING SYSTEM

The COURSE MARK (NC) is computed from the activities carried out during the semester, as follows:

NC= 0.20(A1) + 0.10(TA) + 0.70(E12+E34)/2

The FINAL MARK (NF) allows the COURSE MARK (NC) to be improved and is computed from the activity Algebra Lab (TA) and the final written exam (E1234) (compulsory only if the course mark is less than 5) as follows:

NF = maximum (NC, 0.10(TA) + 0.90(E1234))

EXAMINATION RULES.

Regular attendance is expected, because it is critical for success and activities A1 and TA are devolped during regular sessions; in any case, the responsibility lies with the students; attendance would be only recorded for the activities.

Activities are compulsory for all the students, except activity E1234, which will be optional if the Course Mark NC is greater than or equal to 5.

Activities not submitted will count as 0 in the calculation of marks.

BIBLIOGRAPHY

Basic:
- Lipschutz, Seymour; Lipson, Marc. Linear algebra [on line]. 5th ed. New York: McGraw-Hill, cop. 2013 [Consultation: 31/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=6255343. ISBN 9780071794565.
- Kolman, Bernard; Hill, David R; Kolman, Bernard. Elementary linear algebra with applications [on line]. 9th ed. Harlow, Essex: Pearson, 2014 [Consultation: 31/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=5174187. ISBN 9781292023656.
- Larson, R. Elementary linear algebra. 7th ed. Australia: Brooks/Cole Cengage Learning, 2013. ISBN 9781133111344.
- Leon, Steven J., de Pillis, L. Linear algebra with applications [on line]. 10th ed. Boston: Pearson, 2020 [Consultation: 31/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=6419866. ISBN 9781292354866.

Complementary:

- Anton, Howard; Busby, Robert C. Contemporary linear algebra. Hoboken: John Wiley & Sons, 2003. ISBN 9780471163626.
- Penney, Richard C. Linear algebra: ideas and applications. 3rd ed. Hoboken: John Wiley, 2008. ISBN 9780470178843.
- Strang, Gilbert. Linear algebra and its applications. 3rd ed. San Diego: Harcourt Brace Jovanoich College Publishers, 1988. ISBN 0155510053.