Course guide
240711 - 240711 - Algebra and Geometry

Last modified: 06/07/2023

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

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGIES AND ECONOMIC ANALYSIS (Syllabus 2018). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Coltraro Ianniello, Franco

Others: Amoros Torrent, Jaume
Coltraro Ianniello, Franco

REQUIREMENTS

Oral and written fluency in English.

TEACHING METHODOLOGY

Half of the time will be devoted to the presentation by the teacher of the contents of the subject and the other half will be devoted to the discussion and resolution of problems related to the contents.

LEARNING OBJECTIVES OF THE SUBJECT

- Familiarization with the Superposition Principle, and its application through matrix computations in a wide range of scientific and engineering problems.
- Familiarization with geometric operations in Euclidean plane and space and, specially for orthogonal projection, their extension to higher dimensions.
- Understanding numerical methods for computation and error asessment based on linear algebra and Euclidean geometry.

STUDY LOAD

Type	Hours	Percentage
Hours large group	56,0	37.33
Hours small group	4,0	2.67
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Curriculum

Description:
Lesson 1: Some prequisites.
Complex numbers.
Polynomials.
Theory 2h, problems 2h, personal work 6h

Lesson 2: Matrices and linear systems of equations
Matrix arithmetic.
Matrix form of a linear system, row-echelon reduction, Rouche-Frobenius theorem.
Inversion of matrices.
Theory 2h, problems 3h, personal work 7.5h.

Lesson 3: Linear maps and vector spaces
The superposition principle and vector spaces. Linear independence, generating systems, bases, dimension, subspaces. Bases and coordinate systems.
Linear maps, matrices.
Theory 8h, problems 7h, personal work 22.5h.

Lesson 4: Diagonalization
Eigenvalues, eigenvectors, diagonalization of an endomorphism. Invariant subspaces.
Linear dynamics: powers and exponential of an endomorphism, applications.
Theory 4h, problems 4h, personal work 12h.

Lesson 5: Euclidean geometry
The Euclidean inner product. Distances, angles, orthogonality and orthogonal projections.
Geometry of lines and planes in R2 and R3. Reference systems.
The spectral theorem. Index of a symmetric matrix.
Theory 7h, problems 7h, personal work 21h.

Lesson 6: Numeric linear algebra
Linear regression: the least square method.
The singular value decomposition. Matrix norms and condition numbers.
LU and QR decompositions.
Linear programming.
Theory 7h, problems 7h, personal work 21h.

Full-or-part-time: 150h
Theory classes: 30h
Practical classes: 30h
Self study : 90h

GRADING SYSTEM

The final qualification is the result of applicating the following formula:
N = max { 0.6*E+0.3*PAR+0.1*PRAC, 0.9*E+0.1*PRAC}

where E will be the qualification obtained by the student in a global exam that will be done at the end of the semester, PAR will be the qualification obtained in a partial exam that will be done at the middle of the semester, and PRAC will be the qualification of a computational assignment that the student will develop throughout the semester.

EXAMINATION RULES.

Exams must be solved individually by each student, parts of them wih a computer and other parts without a computer, as indicated during the exam.
The computing assignment must be solved by the group to which the student is assigned.

BIBLIOGRAPHY

Basic:
- Friedberg, Stephen H [et al.]. Linear algebra. 4th ed. Harlow, Essex: Pearson Education, 2014. ISBN 9781292026503.
- Hernandez, Eugenio. Álgebra y geometría [on line]. 2a ed. Madrid: Addison-Wesley, 1994 [Consultation: 27/04/2020]. Available on: http://www.ingebook.com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1210. ISBN 9788478290246.

Complementary:
- Palais, Richard S.. A modern course on curves and surfaces [on line]. Virtual Math Museum, 2003 [Consultation: 08/07/2022]. Available on: http://virtualmathmuseum.org/Surface/a/bk/curves_surfaces_palais.pdf.