Course guide

240711 - 240711 - Algebra and Geometry

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: 2022  ECTS Credits: 6.0  Languages: English

LECTURER

Coordinating lecturer: Amoros Torrent, Jaume
Others: Amoros Torrent, Jaume

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 assessment based on linear algebra and Euclidean geometry.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Hours large group</td>
<td>56.0</td>
<td>37.33</td>
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<tr>
<td>Hours small group</td>
<td>4.0</td>
<td>2.67</td>
</tr>
<tr>
<td>Self study</td>
<td>90.0</td>
<td>60.00</td>
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</tbody>
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Total learning time: 150 h
CONTENTS

Curriculum

Description:
Lesson 1: Some prerequisites.
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 applying the following formula:

\[ N = \max \{ 0.6 \times E + 0.3 \times PAR + 0.1 \times PRAC, 0.9 \times E + 0.1 \times PRAC \} \]

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.
BIBLIOGRAPHY

Basic:

Complementary: