POLI
ESCOLA SUPERIOR
TECNOLOGIA
GESTÃO
TÉCNICO
GUARDA

# SUBJECT DESCRIPTION

| Course | **Topographic Engineering** | | | | | |
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| Subject | **Algebra and Analytic Geometry** | | | | | |
| Academic year | 2023/2024 | *Curricular year* | 1st | *Study period* | 1st semester | |
| Type of subject | Compulsory | *Student workload (H)* | Total: 168 | Contact: 75 | *ECTS* | 6 |
| Professor(s) | Maria Cecília dos Santos Rosa | | | | | |

| ☒ *Area Coordinator*  ☐ *Head of Department* | Graça Maria Oliveira Tomaz |
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## PLANNED SUBJECT DESCRIPTION

### 1. LEARNING OBJECTIVES

This curricular unit allows the student to acquire basic knowledge of linear algebra and analytical geometry. The learning process favours the development of capacities of abstraction, logical/deductive rationale, and a critical spirit on the part of the student.

Upon completion of the UC, students should be able to:

• Operate with complex numbers.

• Operate with matrices and solve linear equations systems with matrix calculus.

• Define and apply concepts associated with vector spaces.

• Deal with the concept of linear transformations.

• Solve vector and analytical geometry problems.

### 2. PROGRAMME

**I -** Complex numbers: Geometric and trigonometric representation; Operations and properties; Geometric transformations.

**II -** Matrices and linear equation systems: operations with matrices and properties; Gauss and Gauss-Jordan elimination method; inverse of a matrix.

**III -** Determinants: properties; Laplace's Theorem; Adjunct matrix; inverse of a matrix; Cramer's Rule.

**IV -** Vector spaces: vector subspaces; generated space; linear independence; bases; dimension.

**V -** Eigenvalues and eigenvectors: diagonalization; orthogonal diagonalization of symmetric matrices.

**VI -** Linear transformations: Definition and examples; Matrix of a linear transformation; Change of basis matrix; Null space and codomain; rank and nullity; Inverse of a linear transformation.

**VII -** Vector product and analytic geometry: Norm, inner, outer, and mixed product; Lines and planes in $IR^3$; Relative positions between lines and/or planes; Angles and distances.

## 3. COHERENCE BETWEEN PROGRAMME AND OBJECTIVES

In the first chapter of the course contents the learner is expected to be able to operate with complex numbers. The second and third chapters will develop the student's abilities in matrix calculus and solving systems of linear equations. The fourth, fifth and sixth chapters, Vector spaces, eigenvalues and eigenvectors and linear transformations will develop the student's understanding and interpretation skills. Chapter 7 is intended for the student to apply the knowledge of the vector product and analytic geometry in problem solving.

## 4. MAIN BIBLIOGRAPHY

MANDATORY:

1. Giraldes, E., Fernandes, V.H. e Smith, M.P.M., Curso de Álgebra Linear e Geometria Analítica, McGraw-Hill de Portugal, 1995.

2. Lay David C. , Álgebra Linear e Suas Aplicações, 4ª ed., Livros Técnicos e Científicos Editora Ltda. (LTC), 2013.

3. Rosa, C., Caderno de Exercícios, material didático elaborado para a UC de Álgebra e Geometria Analítica, ESTG/IPG, 2014/15.

4. Rosa, C., Apontamentos de Álgebra Linear, material didático elaborado para a UC de Álgebra e Geometria Analítica, ESTG/IPG, 2015/16.

RECOMMENDED:

1. Lipschutz, S., Álgebra Linear, McGraw-Hill, 1994.

2. Dias Agudo, F. R., Introdução à Álgebra Linear e Geometria Analítica, Escolar Editora,1996.

3., Meyer C. D., Matrix Analysis and Applied Linear Algebra, Society for Industrial and Applied Mathematics, 2000.

4. A.G.Hamilton, A first course in linear álgebra, Department of Computing Science, University of Stirling, Cambridge University Press, 1987.

## 5. TEACHING METHODOLOGIES (INCLUDING EVALUATION)

The methodology that will meet the objectives set for the UC will be the expository and interactive class, addressing the issues in a practical and objective way, with immediate application in the resolution of exercises, involving students in their learning and eliminating errors.

Continuous assessment: Two written tests with a minimum of 5 marks in each test and a final classification (arithmetic mean) higher or equal to 10 marks, to obtain approval.

Final exam: Normal season and appeal season, with a final classification higher or equal to 10 points, for approval.

Mandatory oral exam for marks higher than 16. The use of materials, calculator or mobile phones is prohibited.

## 6. COHERENCE BETWEEN TEACHING METHODOLOGIES AND OBJECTIVES

Expository lecture is in accordance with the objectives because it is necessary to present to the students the theoretical concepts necessary to understand and manipulate complex numbers, matrices, determinants, vector spaces, linear transformations, vector product and analytic geometry. Interactive lecture is coherent with the objectives because the teacher solves some exercises asking the students to participate, thus promoting the exchange of ideas in the classroom among all the intervenients. Problem-solving is consistent with the objectives because the application of theoretical content to practical exercises related to the objectives of the course helps to consolidate the subject taught.

## 7. ATTENDANCE

Not applicable.

## 8. CONTACTS AND OFFICE HOURS

Professor: Maria Cecília Rosa, cecirosa@ipg.pt, Gab. 45, ESTG

Office Hours: Monday: 11:30 – 13:30

Area Coordinator:  Graça Tomaz, gtomaz@ipg.pt

## 9. OTHERS

Not applicable.

**DATE**

**18 September 2023**

**SIGNATURES**

Professor

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(signature)

Area Coordinator

(signature)