

<b>POLI</b> ESCOLA SUPERIOR TECNOLOGIA GESTÃO <b>TÉCNICO</b> <b>GUARDA</b>	<b>SUBJECT DESCRIPTION</b>	<b>MODELO</b> PED.013.03
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<i>Course</i>	<b>Data Science and Artificial Intelligence</b>					
<i>Subject</i>	<b>Linear Algebra and Analytical Geometry</b>					
<i>Academic year</i>	2023/2024	<i>Curricular year</i>	1st	<i>Study period</i>	1st semester	
<i>Type of subject</i>	Compulsory	<i>Student workload (H)</i>	Total: 168	Contact: 90	<i>ECTS</i>	6
<i>Professor(s)</i>	Fernando Marcos					
<input checked="" type="checkbox"/> <i>Area/Group Coordinator</i> <input type="checkbox"/> <i>Head of Department</i>	<i>(select)</i> Graça Tomaz					

**PLANNED SUBJECT DESCRIPTION**
**1. LEARNING OBJECTIVES**

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

1. Operate with complex *numbers*.
2. Operate with matrices and solve linear equations systems with matrix calculus.
3. Define and apply concepts associated with vector spaces.
4. Deal with the concept of linear transformations.
5. Solve vector and analytical geometry problems.

**2. PROGRAMME**
**1 Complex Numbers**

Geometric and trigonometric representation  
 Operations and properties. Geometric transformations.

**2 Vector Spaces**

Definition. Properties. Notion of vector subspace. Intersection, union and sum of subspaces.  
 Subspace spanned by a set of vectors. Linear Independence, basis and dimension of a vector space.

**3 Matrices**

Algebra of matrices and their properties. Condensation and inversion of matrices.  
 Solve linear equations systems. Rank row and column spaces and their respective bases

**4 Determinants**

Definition and calculus rules. Properties. Laplace Theorem. Inverse matrix.  
 Rouché's Theorem. Eigenvalues and eigenvectors calculus.

**5 Linear Transformations**

Definition. Matrix of a linear transformation. Matrix change of basis.  
 Kernel and image. Rank and nullity. Inverse of a linear transformation.

**6 Vector product and Analytical Geometry**

Inner product and norm, cross product and scalar triple product. Calculation of areas and volumes  
 Straight line and plane equations. Metric and non-metric problems.

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### 3. COHERENCE BETWEEN PROGRAMME AND OBJECTIVES

*Content 1 is consistent with Objective 1 because it focuses on the geometric and trigonometric representation of a complex number, operations and geometric transformations considering the complex numbers as operators. Contents 3 and 4 are consistent with Objective 2 because they focus on matrices algebra and their properties, condensation and inversion of a matrix, matrix determinant and calculus rules. Solving linear equation systems is taught applying matrix and determinant theories. Content 2 is consistent with Objective 3 because it focuses on the definition and properties of a vector space, a subspace spanned by a set of vectors and their dimensions. Content 5 is consistent with Objective 4 because the definition of a linear transformation, its matrix representation and the inverse of a linear transformation are taught. Content 6 is consistent with Objective 5 because it focuses on vector product and its applications, straight line, plane equations and metric and non-metric problems.*

### 4. MAIN BIBLIOGRAPHY

**COMPULSORY:**

1. Monteiro, A.; Pinto, G. e Marques, C., *Álgebra Linear e Geometria Analítica (Problemas e Exercícios)*, McGraw-Hill, 1997.
2. Ribeiro, C.; Reis, L.; Reis, S., *Álgebra Linear. Exercícios. e Aplicações*, McGraw-Hill, 1990.
3. Giraldes, E., Fernandes, V.H. e Smith, M.P.M., *Curso de Álgebra Linear e Geometria Analítica*, McGraw-Hill de Portugal, 1995.
4. Santana, A., Queiró, J., *Álgebra Linear e Geometria Analítica*, Departamento de Matemática da Universidade de Coimbra, 2003.
5. Simões, M., *Caderno de Exercícios, material didático elaborado para a UC de Álgebra Linear e Geometria Analítica*, ESTG/IPG, 2019/2020.
6. Simões, M., Marcos, F., *Álgebra e Geometria Analítica, material didático elaborado para a UC de Álgebra e Geometria Analítica*, ESTG/IPG, 2019/2020

**RECOMMENDED:**

1. Lipschutz, S., *Álgebra Linear*, McGraw-Hill, 1994.
2. Magalhães, Luis T., *Álgebra Linear como Introdução à Matemática Aplicada*, Texto Editora, 1991.
3. Dias Agudo, F. R., *Introdução à Álgebra Linear e Geometria Analítica*, Escolar Editora, 1996.

### 5. TEACHING METHODOLOGIES (INCLUDING EVALUATION)

*The methodology that will meet the objectives established for the subject will be lecture and interactive class, addressing the issues in a practical and objective way, with immediate application in solving exercises involving students in their learning and debugging. In the tutorial classes students are encouraged to solve exercises under the guidance of the teacher, involving them in their learning with eventual Active Learning guidance.*

*Face-to-face regime and sharing of diverse content and information through the Moodle and Sigarra platforms.*

**Continuous Assessment:** *Two written tests with a minimum of 5 values in each test and final classification (arithmetic average) greater than or equal to 10.*

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**Evaluation by final exam** at the regular period, extra period or special period, with final classification greater than or equal to 10/20 to obtain approval.

**Oral test** is mandatory for ratings above 16/20. The use of materials, calculator or mobile phones is prohibited.

**6. COHERENCE BETWEEN TEACHING METHODOLOGIES AND OBJECTIVES**

Lecture is consistent with the objectives, because one has to introduce students to the theoretical concepts necessary for understanding and manipulation of complex numbers, matrices, determinants, vector spaces, linear transformations, vector product and analytical geometry.

Interactive lesson is consistent with the objectives because the teacher solves some exercises requiring student participation thus promoting the exchange of ideas in the classroom, among all stakeholders.

Problem solving is consistent with objectives because applying the theoretical concepts to practical exercises helps the students to consolidate the subject taught.

**7. ATTENDANCE**

NA

**8. CONTACTS AND OFFICE HOURS**

Fernando Marcos, marcos@ipg.pt, office 47; Ext. 1247

Office Hours

Wednesday 15:00 – 17:00

Thursday 15:00 – 17:00

Area Coordinator

Graça Tomaz, gtomaz@ipg.pt, office 33, Ext. 1233

**9. OTHERS**

NA

**DATE**

**20 de setembro de 2023**

**SIGNATURES**

Professor

(signature)

Area/Group Coordinator

(signature)