INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Linear Algebra and Analytic Geometry	Field of study	Mathematics
Bachelor in	Biomedical Technology	School	School of Technology and Management
Academic Year	2023/2024	Year of study	1
Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	1
Code	9600-752-1101-00-23		

Workload (hours)	Contact hours	T	TP	PL	TC	S	E	OT	O
162		-	60	-	-	-	-	-	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Maria Fátima Moreira da Silva Pacheco

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Operate with the set of complex numbers in multiple representations.
2. Use the calculation matrix for solving systems of linear equations.
3. Identify and manipulate algebraically lines, planes, conics and quadrics.
4. Understand the basic concepts and dimension of a vector space.
5. Identify and represent in matrix linear applications.
6. Determine the eigenvectors and eigenvalues of a linear operator and understand their properties.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Know and apply the algebraic calculation taught in secondary education.
2. Recognize and write the equations of the line and the plane.
3. Use trigonometric functions.

Course contents

1. Complex Numbers 2. Matrices and Determinants 3. Linear Systems 4. Analytic Geometry 5. Vector Spaces 6. Linear Transformations 7. Eigenvalues and Eigenvectors

Course contents (extended version)

1. Complex Numbers
   - Algebraic, trigonometric and exponencial form.
   - Geometric representation.
   - Operations with complex numbers.
   - Geometric representation of conditions involving complex numbers.
2. Matrices and Determinants
   - Definitions and notations.
   - Matrix operations.
   - Inverse of square matrix.
   - Determinant definition and properties.
   - Laplace's Theorem.
   - Adjoint matrix.
   - Calculating the inverse of an invertible matrix using the adjoint matrix.
3. Linear Systems
   - Classification systems of linear equations for the number of solutions.
   - Solving systems via inverse of the coefficient matrix and the Cramer's rule.
   - Assessment and resolution of systems by methods of Gaussian elimination and Gauss-Jordan.
   - Discussion and classification systems of linear equations based on certain parameters.
4. Analytic Geometry
   - Lines and planes on R^3.
   - Distance and angles defined by lines and planes.
   - Relative position of lines and planes.
   - Quadratic forms and its classification.
5. Vector Spaces
   - Definition and examples.
   - Subspaces.
   - Linear combination.
   - Linear independence/dependence.
   - Basis and dimension.
   - Change of basis.
   - Orthonormalization.
   - Gram-Schmidt technique.
6. Linear Transformations
   - Definition and examples.
   - Kernel and range.
   - Matrix representation.
   - Invertibility.
7. Eigenvalues and Eigenvectors
   - Definitions, examples and properties.
   - Characteristic polynomial.
   - Eigenspace.
   - Matrix diagonalization.

Recommended reading

1. Pacheco, Maria F. , Apontamentos de Álgebra Linear e Geometria Analítica (atualizado em Out. 2021).
2. Strang, G. (2006), Linear Algebra and its Applications. Harcourt Brace Jovanovich College Publishers.
3. mathe.pixel-online.org
4. Nicholson, W. K. (2006). Álgebra Linear. São Paulo: McGraw-Hill.
5. Anton, H. & Chris, R. (2011). Elementary Linear Algebra. John Wiley and Sons.

Teaching and learning methods

The themes will be presented and discussed throughout the classes, using the resolution of tasks to deepen them. There will be individual and group sessions outside class, as well as tutoring sessions at Mentoring Academy, to accompany the student's work. The use of collaborative software tools such as the MathE and Google Docs platforms will be encouraged.

Assessment methods

1. Distributed Assessment - (Regular, Student Worker) (Final)
   - Practical Work - 25% (Exercises, bibliographical research, online tests, attendance at tutorials, attitudes and others.)
   - Intermediate Written Test - 25%
   - Intermediate Written Test - 25%
   - Intermediate Written Test - 25%
2. Final Exam - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 100%

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Maria Fátima Moreira da Silva Pacheco	Florbela Alexandra Pires Fernandes	Joana Andrea Soares Amaral	José Carlos Rufino Amaro
03-10-2023	16-10-2023	22-10-2023	31-10-2023