INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Linear Algebra and Analytic Geometry			Field of study	Mathematics		
Bachelor in	Informatics Engineering			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	9119-706-1101-00-23		

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

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): Edite Martins Cordeiro, 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 envolving 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.
   - Conics and quadratic forms.
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. Cordeiro, Edite Martins, Álgebra Linear e Geometria Analítica, Slides com notas teóricas e práticas, ESTIG (2020)
2. Cordeiro, Edite Martins, Caderno de exercícios propostos com soluções, ESTIG (2020)
3. Agudo, F. R. D. , Introdução à Álgebra Linear e Geometria Analítica. Escolar Editora, 1992.
4. Strang, G. , Linear Algebra and its Applications. Harcourt Brace Jovanovich College Publishers, 1986.
5. Mustoe, L. R. and Barry, M. D. J. , Mathematics in Engineering and Science, John Wiley & Sons, 1998.

Teaching and learning methods

All topics will be introduced in classroom environment and will be worked through solving exercises. There will be individual and group sessions outside class to accompany the student's work. The use of MatLab and/or GeoGebra software will be encouraged.

Assessment methods

1. Distributed evaluation - (Regular, Student Worker) (Final, Supplementary)
   - Intermediate Written Test - 40% (Proof of 50 minutes for the evaluation of the competitions acquired in Theme 1, 2, 3 and 4.)
   - Intermediate Written Test - 40% (Proof of 50 minutes for the evaluation of the competitions acquired in Theme 5, 6 and 7.)
   - Practical Work - 20% (Classroom work.)
2. Final exam - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 100%
3. English Course Assessment - Method 2 - (Regular, Student Worker) (Final)
   - Intermediate Written Test - 40% (Chapters 1, 2 and 3.)
   - Intermediate Written Test - 40% (Chapters 4, 5, 6 and 7.)
   - Practical Work - 20%
4. English Course Assessment - Method 2 - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 100%

Language of instruction

1. Portuguese
2. English

Electronic validation

Edite Martins Cordeiro, Maria Fátima Moreira da Silva Pacheco	Florbela Alexandra Pires Fernandes	Luísa Maria Garcia Jorge	José Carlos Rufino Amaro
11-10-2023	16-10-2023	16-10-2023	31-10-2023