

Course Unit	Linear Algebra			Field of study	Mathematics	
Bachelor in	Management Informatics			School	School of Technology and Management	
Academic Year	2023/2024	Year of study	1	Level	1-1	ECTS credits 6.0
Туре	Semestral	Semester	1	Code	9186-709-1101-00-23	
Workload (hours)	162	Contact hours	T - Lectures; TP - Lectures a	60 PL - T	C - S - solving, project or laboratory; TC -	E · OT · O · Fieldwork; S · Seminar; E · Placement; OT · Tutorial; O · Other

Name(s) of lecturer(s)

Paula Maria Pereira de Barros

- Learning outcomes and competences
- At the end of the course unit the learner is expected to be able to:
- Perform the elementary operations of matrix algebra and solve matricial equations and identify special matrices. Check if a matrix is invertible and calculate its inverse.

- Classify and solve systems of linear equations, in matrix notation, using the methods of Gauss, Gauss-Jordan and Cramer.
   Classify and solve systems of linear equations, in matrix notation, using the methods of Gauss, Gauss-Jordan and Cramer.
   Clastify if a set, V, can be given a structure of vector space over a field of the real numbers, R.
   Determine if a given subset M of V is a vector subspace of V (over R).
   Identify if a given transformation between two vector spaces is linear, and determine the matrix of a linear transformation using the canonical basis of both spaces.
   Calculate the kernel and the range of a linear transformation.

#### Prerequisites

Before the course unit the learner is expected to be able to: Perform the basic operations of elementary calculus.

#### Course contents

Matrices. Determinants. Systems of Linear Equations. Vector Spaces. Linear Transformations. Eigenvalues and Eigenvectors.

### Course contents (extended version)

#### 1. Matrices

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This

- Definitions, terminology and notations.
- Matrix operations.
   Rules of matrix arithmetic.
- Inverse of square matrix.
   Triangular, diagonal and symmetric matrices.
- 2. Determinants

  - Definition and properties of determinants.
     Evaluation of determinants by row reduction.
     Evaluation of determinants by cofactor expansion.
  - Adjoint matrix.
- Adjoint matrix.
   Calculating the inverse of an invertible matrix using the adjoint matrix.
   Systems of Linear Equations

   Consistency of linear systems.
   Inverse, Gaussian elimination and Gauss-Jordan methods.
   Cramer's rule.
   Calculating the inverse of a matrix using Gauss- lordan method.
- Calculating the inverse of a matrix using Gauss-Jordan method.
   Vector Spaces
   Definitions and examples.

- Vector subspace.
  Linear independence/dependence.
  Basis and dimension.
  n-dimensional Euclidean vector space.
- Norm, dot product and projections.
  Cross product in R^3.
- Schwarz inequality.
  Linear Transformations

  - Definitions and examples.
     Kernel and range of a linear transformation. Matrix of a linear transformation.
     Invertibility.

- Eigenvalues and Eigenvectors

   Definitions and examples.
  - Characteristic polynomial.
  - Eigenspace.
  - Matrix diagonalization.

## Recommended reading

- Howard, A & Rorres, C. (2014). Elementary Linear Algebra Applications version (11th ed.). Wiley.
   Penney, R. C. (2008). Linear Algebra Ideas and applications (3rd ed.). Wiley.
   Strang, G. (2005). Linear Algebra and its applications (4th ed.). Brooks Cole.
   Trigo, J. A. (2004). Noções sobre matrizes e sistemas de equações lineares. Porto: FEUP edições.

## 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 schedule to accompany the student's work. The use of software will be encouraged.

## Assessment methods

- Alternative 1 (Regular, Student Worker) (Final, Supplementary)

   Practical Work 20%
   Intermediate Written Test 40%
   Final Written Exam 40%

   Alternative 2 (Regular, Student Worker) (Final, Supplementary)

   Intermediate Written Test 50%
   Final Written Exam 50%

   Alternative 3 (Regular, Student Worker) (Supplementary, Special)

   Final Written Exam 100% (The written exam may be complemented with an oral test to defend the grade.)

# Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation			
Paula Maria Pereira de Barros	Florbela Alexandra Pires Fernandes	José Carlos Rufino Amaro	Nuno Adriano Baptista Ribeiro
11-10-2023	16-10-2023	31-10-2023	06-11-2023