DISCRETE MATHEMATICS AND LINEAR ALGEBRA

Code: 322067

Main Scientific Area: Mathematics and Applied Statistics

Lecturer: Liliana Angélica Costa Matos Pereira

Language of Instruction: Portuguese

Regime: S2

Contact Hours: 60h Total Workload: 108h

ECTS: 6,0

Objectives

It is intended with this course to give mathematical basic formation for the specific courses of theundergraduate programme, in order to help students to develop their capacities of calculation, logical and abstractreasoning; acquiring the necessary knowledge for applications in the most diverse scientific branches, especially intechnological areas.

Learning Outcomes

Skills to develop: operate with matrices and solve systems of linear equations using matrix calculations;interpret and apply concepts associated with vector spaces; calculate the determinant of a matrix; know thelanguage of graph theory and its applications in real life situations.

Course Contents

Part I - Linear Algebra

1. Matrices

1.1 General Concepts:

1.1.1 Matrices as representation of concrete situations

1.1.2 Matrix operations. Properties

1.2 Characteristic of a matrix:

1.2.1 Elementary operations with matrices

1.2.2 Condensation Method

1.3 Inverse matrix:

1.3.1 Definition. Properties

1.3.2 Calculation of the inverse matrix by condensation

1.4 Determinant:

1.4.1 Definition. Properties

1.4.2 Sarrus rule

1.4.3 Laplace's theorem

1.4.4 Inverse matrix by calculating the Adjunct Matrix

2. Systems of Linear Equations.

2.1 General Concepts. Matrix form

2.2 Classification of systems of linear equations

2.3 Resolution of systems of linear equations: Gaussian Elimination Method

2.4 Characteristic of a matrix and discussion of systems of linear equations

2.5 Resolution of systems of linear equations by determinants: Cramer systems

3. Vector spaces

3.1 Definition

3.2 Subspace of a vector space

3.3 Linear combinations

3.4 Generated subspaces

3.5 Dependence and linear independence of vectors

3.6 Bases and dimension

Part II - Discrete Mathematics

1. Graph Theory:

1.1 Basic definitions

1.2 Subgraph of a graph and partial graph. Bipartite graphs and complete graphs. Isomorphic graph

1.3 Chains and path of a graph. Eulerian and Hamiltonian paths

1.4 Connectivity of a graph

1.5 Boolean matrix of the graph

1.6 Direct and reverse transitive closure of a vertex

1.7 Planar graphs

2. Network Analysis

2.1 Networks

2.2 Minimal extension problems

2.3 Minimum travel problems

Recommended Bibliography

Gonçalves, R. (2018). Álgebra Linear - teoria e prática(2ª ed.). Lisboa: Sílabo.

Learning and Teaching Methods

Contents: Matrices. Matrix language. Matrix operations. Matrices as representation of concrete situations.Systems of linear equations. Approach to the study of systems of linear equations. Systems of two equations andtwo unknowns. Systems of three equations and three unknowns. Systems of m equations and n unknowns. Solvingsystems of linear equations. Limitations of the methods of solving systems of linear equations. Gauss eliminationmethod. Characteristic of a matrix and another discussion of system of linear equations. Algorithm to determine theinverse matrix.

Main Objectives: operate with matrices and solve systems of linear equations using matrix calculations.

Contents: Determinants. Definition and properties. Algorithm for the calculation the determinant of any order.The determinants and the inverse of a matrix. Determinants in solving systems of linear equations.

Main Objectives: calculate the determinant of a matrix.

Contents: Real vector spaces. Finding new “vectors”. Vector subspaces. Linear combination. Span of aset of vectors. Linear independence and dependence. Basis and dimension.

Main Objectives: interpret and apply concepts associated with vector spaces.

Contents: : Graph theory. Definitions and examples. Subgraphs. Bipartite and complete graphs. Isomorphismof graphs. Paths and cycles. Eulerian paths and Hamiltonian cycles. Connectivity. Boolean matrix. Transitiveclosure. Planar graphs. Network analysis. Networks. Minimum-spanning-tree problem. Shortest-path problem.

Main Objectives: know the language of graph theory and its applications in real life situations.

Assessment Methods

Continuous evaluation:

Final grade = 0.35*T1 + 0.35*T2 + 0.20*QA + 0.10 TP

QA is an individual class question, to be held ion a date to be combined;

TP are practical exercises, to be held in class;

T1 and T2 partial tests to be performed on a date to be combined.

Exam Evaluation:

Final grade = exam grade