

## FUNDAMENTALS OF MATHEMATICS

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Code: 322048

Main Scientific Area: Mathematics and Applied Statistics

Lecturer: Ana Isabel Oliveira Araújo

Language of Instruction: Portuguese

Regime: S1

Contact Hours: 60h Total Workload: 90h

ECTS: 6,0

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### **Objectives**

The knowledge about functions, indispensable to the understanding of the world in which we live, will be enlarged based on numerical and graphical study, privileging intuitive work with functions such as trigonometric functions. This theme has a marked emphasis on the connection between formulas and geometric representations. This connection is very important for everyone who uses math. The capacity to relate them is a fundamental capacity for the world of today and the future, and so this theme should provide a life-long training as basic as the multiplication table.

### **Learning Outcomes**

At the end of the course, students should:

Understand the definition of real function of a real variable and how to interpret and apply concepts associated with it: function domain calculation, function limit calculation, function continuity, derivation rules, continuity theorems and differential calculus theorems;

Calculate angles and solve problems involving trigonometry;

Solve problems analytically;

Identify and operate with complex numbers, represent complexes in the plane, distinguish real and imaginary part of a complex number, represent complex numbers in their trigonometric form, and apply complex numbers in problem solving.

### **Course Contents**

1. Generalities about functions

1.1. Definition and Properties

1.2. Graphic study

1.2.1. Domain, contradiction, monotony, intersection with coordinate axes

1.2.2. Limits:

1.2.2.1. Intuitive notion of limit (geometric interpretation);

1.2.2.2. Points of accumulation, isolated;

- 1.2.2.3. Definition and operations with limits;
- 1.2.2.4. Indeterminations.
- 1.3. Continuity
  - 1.3.1. Intuitive notion
  - 1.3.2. Definition: continuity at one point and at intervals (limited and unlimited)
- 1.4. Differentiability
  - 1.4.1. Definition of derivative at a point and interval
    - 1.4.1.1. Side Derivatives
    - 1.4.1.2. Differentiability and continuity
  - 1.4.2. Geometric interpretation and its applications
  - 1.4.3. Derivatives rules
  - 1.4.4. Derivatives of functions and their applications
    - 1.4.4.1. Study of extremes and monotony
- 2. Study of Exponential and Logarithmic Function
  - 2.1. Definition and its properties
  - 2.2. Study of the relations between exponential and logarithmic functions
  - 2.3. Problems involving exponentials and logarithms
- 3. Trigonometric Functions
  - 3.1. Sine, cosine, and tangent function
    - 3.1.1. Definition and Properties
      - 3.1.1.1. Domain, Countermand, zeros, periods, parity, asymptotes and monotony
      - 3.1.1.2. Relations between trigonometric functions
      - 3.1.1.3. Optimization problems involving trigonometric functions
- 4. Complex numbers
  - 4.1. Complex number set: definition and properties
  - 4.2. Operation with complexes

- 4.3. Complexes in algebraic form
- 4.4. Complexes in trigonometric form
- 4.5. Geometric representation and interpretation
- 4.6. Equations involving complexes
- 4.7. Problems resolution

### **Recommended Bibliography**

Spivak, M: Cálculos, New York, W. A. Benjamim

Apostol, T.: Cálculos – Vol 1, Blaidell Publishing Company

Campos Ferreira, J.: Introdução à Análise Matemática, Fundação Calouste Gulbenkian

Matemática Zero, Filipe carvalho e Sílvia Carvalho, 1ª edição, Edições Sílabo

### **Learning and Teaching Methods**

The understanding, manipulation and application of the concepts continuity of differentiability of real functions of a real variable provide a base set of mathematical knowledge required for the proper functioning of other units of the course curriculum. They also allow to develop the scientific reasoning and the mathematical ability to the application of the mathematical concepts.

### **Assessment Methods**

Continuous evaluation:

2 Partial Written Tests - T1 and T2 - whose average has a weight of 80% of the assessment and a Practical Assessment Work - TP - with a weight of 20%. This is:

Final classification =  $80\% (T1 + T2) / 2 + 20\% TP$

All assessment elements will be carried out in person and have no minimum grade.

Assessment by Exam:

Final classification = Exam grade