Course Unit	Calculus I		Field of study	Mathematics	
Bachelor in	Civil Engineering		School	School of Technology and Management	
Academic Year	2022/2023	Year of study	1	Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9089-322-1102-00-22

| 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) | Joao Paulo Pais de Almeida |

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Use a rigorous notation in mathematics communication (oral and written).
2. Analyze graphically a real function and calculate limits involving indeterminate forms resorting to Cauchy's theorem.
3. Identify and apply some integration formulas. Apply the fundamental theorem of calculus. Identify improper integrals and analyze their convergence.
4. Identify positive series and alternating series and determine their nature.
5. Represent a function as power series. Relate the concepts of numerical series and power series and determine the sum of a numerical series.
6. Analyze a real function of several variables analytically to determine domains, limits and continuity.
7. Understand the analytical and geometrical concept of partial and total derivative; apply this to calculate the implicit and composed derivatives and the equation of a tangent plane.
8. Interpret and model problems and determine their optimum.

Prerequisites

Before the course unit the learner is expected to be able to:
Know and to apply mathematical concepts taught during high school.

Course contents

Real functions of one variable. Infinite series and power series. Real functions of several variables.

Course contents (extended version)

1. Real functions of one variable.
   - Inverse trigonometric functions.
   - Cauchy's Theorem and indeterminate forms.
   - Antiderivative of a function and integration formulas.
   - The definite integral and applications.
   - Improper integrals.
2. Infinite series and power series.
   - Convergence tests of positive series.
   - Convergence tests of alternating series.
   - Power series: Taylor and MacLaurin series; the interval of convergence.
   - Operations with power series.
3. Real functions of several variables.
   - Domain of a function and level curves. Limits and continuity.
   - Partial and total derivatives. Gradient vector and tangent plane.
   - Implicit differentiation and the chain rule.
   - Optimal solution: constrained and unconstrained problems.

Recommended reading

1. Cálculo, volume I, 5ª edição, James Stewart, Cengage Learning (2007).
2. Cálculo, volume II, 5ª edição, James Stewart, Cengage Learning (2007).
3. Cálculo I --- Exercises, Florbela Fernandes - ESTiG (2021)

Teaching and learning methods

The topics of the course unit will be introduced and explored during the lessons in the classroom and/or virtually. The solving of exercises will complement the theoretical concepts. Outside the classes, the students must solve practical exercises.

Assessment methods

1. Alternative 1 (students with english classes) - (Regular, Student Worker) (Final, Supplementary)
   - Intermediate Written Test - 50% (The midterm exam will be held during the classes.)
   - Intermediate Written Test - 50% (The Final exam will be held at the final exam's day.)
2. Alternative 2 (students with english classes) - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 100%
3. Alternative 3 (portuguese classes) - (Regular, Student Worker) (Final)
   - Intermediate Written Test - 50% (Midterm exam)
   - Intermediate Written Test - 50% (Exam on the final exam day.)
4. Alternative 3 (portuguese classes) - (Regular, Student Worker) (Supplementary, Special)

Language of instruction

1. English
2. Portuguese

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Electronic validation

Joao Paulo Pais de Almeida	Carla Sofia Veiga Fernandes	António Miguel Verdelho Paula	Paulo Alexandre Vara Alves
17-10-2022	19-10-2022	24-10-2022	24-10-2022