

Course Unit	Calculus I		Field of study	Mathematics	
Bachelor in	Mechanical Engineering		School	School of Technology and Management	
Academic Year	2022/2023	Year of study	1	Level	1-1
Type	Semestral	Semester	1	ECTS credits	6.0
Workload (hours)		162	Contact hours	T - TP 60 PL - TC - S - E - OT - O -	
<small>T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other</small>					

Name(s) of lecturer(s) Joao Paulo Pais de Almeida, Mário António Rodrigues Grande Abrantes

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. Basic Concepts
 - Arithmetic operations
 - Equalities and inequalities of one variable.
 - Trigonometric relations.
2. Real functions of one variable.
 - Domain, range and graph.
 - Inverse trigonometric functions.
 - Differentiation: rules for elemental functions and chain rule.
 - Cauchy's Theorem and indeterminate forms.
3. Integration
 - Infinite series.
 - Convergence tests of positive series. Convergence tests of alternating series.
 - The definite integral and applications with elemental functions.
 - Integration formulas.
4. Power series
 - Taylor and MacLaurin series; the interval of convergence.
 - Operations with power series.
5. Real functions of several variables.
 - Domain; level curves. Limits and continuity. Partial derivatives. Gradient vector and tangent plane.
 - Implicit differentiation; the chain rule. Optimal solution: constrained and unconstrained problems

Recommended reading

1. James Stewart. Cálculo, volume I, 5ª edição, Cengage Learning (2007).
2. James Stewart. Cálculo, volume II, 5ª edição, Cengage Learning (2007).
3. Florbela Fernandes. Cálculo I - Exercícios, ESTiG (2021).
4. Mário Abrantes. Sebenta de Cálculo I (2021).
5. Howard Anton, Irl Bivens, Stephen Davis. Cálculo, volume 1, Bookman (2014)

Teaching and learning methods

The topics of the course unit will be introduced and explored during the lessons - resolution 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% (Midterm exam during the semester.)
 - Intermediate Written Test - 50% (The second 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)
 - Practical Work - 50% (Exercises in Classes and Home Work)
 - Final Written Exam - 50% (Final Written Exam)
4. Final Exam (portuguese classes) - (Regular, Student Worker) (Supplementary, Special)

Language of instruction

1. English

Language of instruction

2. Portuguese

Electronic validation

Joao Paulo Pais de Almeida, Mário António Rodrigues Grande Abrantes	Carla Sofia Veiga Fernandes	João da Rocha e Silva	Paulo Alexandre Vara Alves
24-10-2022	24-10-2022	28-10-2022	29-10-2022