

## SUBJECT TEACHING GUIDE

### G272 - Calculus I

Degree in Industrial Electronic Engineering and Automatic Control Systems  
 First Degree in Industrial Electronic Engineering and Automatic Control Systems

Academic year 2023-2024

1. IDENTIFYING DATA					
Degree	Degree in Industrial Electronic Engineering and Automatic Control Systems			Type and Year	Core. Year 1 Core. Year 1
Faculty	School of Industrial Engineering and Telecommunications				
Discipline	Subject Area: Mathematics Basic Training Module				
Course unit title and code	G272 - Calculus I				
Number of ECTS credits allocated	6	Term	Semester based (1)		
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. MATEMATICA APLICADA Y CIENCIAS DE LA COMPUTACION				
Name of lecturer	VERA EGOROVA				
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Other lecturers	ANTONIO DIEZ PEDRERO				

### 3.1 LEARNING OUTCOMES

- Know and work with different numerical sets: Natural, Real, Rational, Irrational and Complex. Definition and structure of complex numbers.
- Know and manipulate the elementary functions of one variable. Understand and use the concepts of limit and continuity of a function at a point. Calculate derivatives of real functions with singularities. Derive an implicitly defined function. Study the derivability of functions at a point and in an interval. Know how to apply Rolle's Theorems, Medium Value and L'Hopital Rule to the separation of roots, the study of inequalities and the calculation of limits. Use Taylor's developments to approximate real functions. Know how to numerically implement Taylor approximations to calculate functions. Understand and manipulate power series.
- Calculate partial derivatives, gradients and Jacobians. Know how to apply change of variables to polar and spherical coordinates. Determine the tangent plane to the surface at a point. Compute higher order partial derivatives and Hessian matrices. Taylor series. Propose and solve, using differential calculus, problems of maximum and minimum.
- Use the most usual techniques of analytical integration of functions of a variable and know how to calculate length, area and volume using integral calculus

### 4. OBJECTIVES

In the context of a curriculum of a degree in Engineering, the subject of Calculus serves as an introduction to an important part of the main mathematical tools that students will need throughout their studies.

The objectives are:

- Introduction to mathematical language and reasoning;
- Obtain habits of intellectual work;
- Understand the potential of calculus as a modelling tool;
- Obtain an operational management of mathematical functions and their main properties;
- Know, understand and manage the basic elements of differential and integral calculus in one and several variables.

6. COURSE ORGANIZATION	
CONTENTS	
1	PART 1: Sets of numbers
1.1	Concepts related to $\mathbb{R}$ . Natural numbers ( $\mathbb{N}$ ): Principle of Induction. Amplifications of the set $\mathbb{N}$ : integers ( $\mathbb{Z}$ ), rational ( $\mathbb{Q}$ ), irrational ( $\mathbb{I}$ ), real ( $\mathbb{R}$ ). Properties of the set $\mathbb{R}$ . Absolute value
1.2	Complex Numbers ( $\mathbb{C}$ ): Definition and structure. Types of representation. Elementary operations.
2	PART 2: Real Functions of a Real Variable
2.1	Real function of real variable: Elementary Functions; Even and odd functions; Periodic functions; Symmetries; Boundedness; Inverse function.
2.2	Limit: Concept, types of indeterminations. Continuity: properties, theorems
2.3	Derivative: concept. Geometric interpretation. Derivatives of elementary functions. Derivation rules. Derivative of composite function; Implicit function. Derivatives of higher order. Leibniz formula for the product. Theorems on derivable functions: Rolle; Lagrange's Mean Value Theorem; Cauchy. Application of the derivative to Calculation of Limits: L'Hopital Rule. Taylor's formula: expression of Taylor's formula of functions Elemental Infinitésimos equivalentes: application to the calculation of limits.
3	PART 3: Power series: sequences and numerical series. Field of convergence. Development in power series of a function. Sum of a power series.
3.1	Sequences and numerical series. Convergence field. Power series expansion of a function. Sum of a power series.
3.2	Fourier Series. Development of even and odd functions in Fourier series. Complex form of the Fourier series.
4	PART 4: Integration
4.1	Concept of antiderivative. Properties of the indefinite integral. Methods of integration: Immediate, by parts, by substitution, integration of rational, irrational and trigonometric functions.
4.2	Riemann Integral: interpretation and properties. Theorem of the mean value. Fundamental Theorem of Integral Calculus. improper Integrals. Applications of a simple Integral: calculation of areas, logitudes of curves, surfaces and volume of revolution.
5	PART 5: Vector Functions
5.1	Real function of two or more real variables. Vector function of vector variable. Limit. Continuity. Partial derivatives. Tangent plane.
5.2	Taylor series. Differentiability. Relative and absolute extrema. Conditioned Extreme

7. ASSESSMENT METHODS AND CRITERIA				
Description	Type	Final Eval.	Reassessn	%
First partial exam	Written exam	No	Yes	25,00
Second partial exam	Written exam	No	Yes	25,00
Third partial exam	Written exam	No	Yes	25,00
Final exam	Written exam	Yes	Yes	0,00
Computer practices	Others	No	Yes	25,00
<b>TOTAL</b>				<b>100,00</b>
<b>Observations</b>				
<p>There will be three partial exams throughout the course, apart from the final exam of the course. Each partial exam will represent 25% of the grade. The remaining 25% of the grade will correspond to computer practices.</p> <p>The final grade is the weighted average of all the previous evaluation activities. Moreover, the first three partial exams may be recovered in the final exam. Students may take the final exam only with the part / s suspended in the partial exams or with the whole course.</p> <p>Note: According to Royal Decree RD 1125/2003 on the European credit system and the grading system for university degrees of official character and valid throughout the national territory, the results obtained by the student in each of the subjects of the plan of studies will be graded according to the following numerical scale from 0 to 10, with the expression of a decimal, to which their corresponding qualitative qualification may be added:</p> <p>0.0-4.9: Suspense (SS).                      5.0-6.9: Approved (AP).                      7.0-8.9: Notable (NT).                      9.0-10: Excellent (SB).</p> <p>In the case that extraordinary and duly justified causes are given (for example, sanitary restrictions), part or all of the evaluation tests contemplated in this Guide could be carried out online.</p>				
<b>Observations for part-time students</b>				
Part-time students may attend the final exam (75% of the grade) and computer practice (25%).				

8. BIBLIOGRAPHY AND TEACHING MATERIALS
<b>BASIC</b>
Ron Larson, Bruce H. Edwards. Cálculo. McGraw Hill, 2009.
Bradley, G. L. And Smith, K. Calculo de una variable y Cálculo de varias variables. Volumen I y II. Prentice Hall, 1998.