SUBJECT TEACHING GUIDE

G1953 - Calculus

Degree in Civil Engineering

Academic year 2022-2023

1. IDENTIFYING DATA					
Degree	Degree in Civil Engineering			Type and Year	Core. Year 1
Faculty	School of civil Engineering				
Discipline	BASIC MATHEMATICS FOR ENGINEERING				
Course unit title and code	G1953 - Calculus				
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	JOAQUIN BEDIA JIMENEZ
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Other lecturers	

3.1 LEARNING OUTCOMES

- Knowledge and manipulation of elementary univariate functions. Comprehension and application of the concepts of limit and continuity of a function at a point. Differentiate real functions with ease and application to optimization problems. Differentiate an implicit function. Study the differentiability of functions at a point and within an interval. Deal with numerical series and power series. Use Taylor's polynomials to approximate real functions. Know how to numerically implement local approximations of a function using Taylor polynomials, providing an error estimate.
- Knowledge and manipulation of multivariate functions and vector fields. Calculation of partial derivatives, directional derivatives and gradients. Find the tangent plane to a surface at a point. Calculation of higher order partial derivatives and hessian matrices. Solve minima and maxima problems in surfaces.
- Applications of the most usual analytical integration techniques of univariate functions and calculation of arc lengths, areas and volumes using univariate integral calculus. Application of formulas for change of variable to polar coordinates. Learn to parametrize common curves. Calculate line integrals on scalar and vector fields.
- Learn to use a symbolic calculation program to complete the assimilation of the concepts studied in the theoretical classes of each unit; solve exercises; recognize the importance of software as a tool for the efficient resolution of complex problems.

4. OBJECTIVES

In the context of the syllabus of Civil Engineering, the Calculus course serves as an introduction to an important part of the main mathematical tools that students will need throughout their studies. The objectives are: to start with the language and mathematical reasoning; acquire habits of intellectual work; get started on the potential of calculus as a modeling tool; acquire an operational handling of mathematical functions and their main properties; know, understand and manage the basic elements of differential and integral calculus in one and more variables and their applications to problems in physics and engineering ; recognition of specific software and programming tools as key to learning and solving complex problems; instill in the student the habit of continued study and autonomous work, both individually and in groups.

6. COURSE ORGANIZATION

	CONTENTS
1	BLOCK I: REAL AND COMPLEX NUMBERS. SEQUENCES AND NUMERICAL SERIES. REAL UNIVARIATE FUNCTIONS. LIMITS. CONTINUITY AND DERIVABILITY. UNIT 1. REAL AND COMPLEX NUMBERS. NUMERICAL SEQUENCES, SERIES AND POWER SERIES. 1.1. real numbers. Axiomatics of real numbers 1.2. Geometric representation and other key concepts about the real line 1.3. Complex numbers. Definition 1.4. Geometric representation of complex numbers 1.5. Operations with complex numbers 1.6. Numerical sequences and numerical series. Definitions 1.7. Convergence criteria for numerical series UNIT 2. REAL UNIVARIATE FUNCTIONS 2.1. Concept. Definitions. Operations with functions 2.2. Elementary functions 2.3. even and odd functions; periodicity; symmetry; dimension 2.4. Limit of a function at a point. Definition and Properties 2.5. Indeterminate forms 2.6. Continuous function at a point and within an interval. Types of discontinuities 2.7. Theorems about continuous functions 2.8. Differentiable functions at a point and within an interval. Properties 2.9. Rolle and Mean Value Theorems. 2.10. Application of the derivative to the calculation of limits: L'Hôpital's rule 2.11. Representing functions as power series. Taylor and Mac-Laurin formulas. Local approximation of functions.
2	BLOCK II: INTEGRAL CALCULUS OF FUNCTIONS OF ONE VARIABLE UNIT 3. INTEGRAL CALCULUS 3.1. Calculation of primitives. Definitions and properties 3.2. Integration Methods 3.3. Riemann integral. Interpretation and Properties 3.4. Mean value theorem. Fundamental Theorem of Calculus. Barrow's rule 3.5. Improper integrals 3.6. Parameterization of curves. Polar coordinates. 3.7. Applications of integrals to the calculation of planar areas, volumes of revolution, surfaces of revolution and lengths of curves, in Cartesian, parametric and polar coordinates.

3	BLOCK III. REAL FUNCTIONS OF SEVERAL VARIABLES UNIT 4. REAL FUNCTIONS OF SEVERAL VARIABLES. VECTOR FIELDS 4.1. First notions about functions of several variables 4.2. Limits of functions of two variables 4.3. Limits of vector functions 4.4. Continuity of functions of several variables 4.5. Partial derivatives. Introduction. Definition. geometric interpretation. 4.6. Continuity and partial derivatives. Partial derivatives of higher orders 4.7. Differential. Differentiability and continuity. Sufficient condition for differentiability. 4.8. Gradient. Definition. Gradient vector and directional derivative. Gradient and contour lines. 4.9. Extremes. Optimization. Lagrange multipliers. 4.10. Line integral. Definition. Properties. Applications.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Computer lab Reports	Laboratory evaluation	No	No	12,00
Continuous evaluation activities	Others	No	No	28,00
Partial Exam Block I	Written exam	No	Yes	15,00
Partial Exam Block II	Written exam	No	Yes	15,00
Partial Exam Block III	Written exam	Yes	Yes	30,00
TOTAL				100,00

Observations

Students who attend the extraordinary call will take a single exam, corresponding to 60% of total course grade, which will cover all subjects, regardless of whether any of these were previously approved.

In tests with an established format (report templates, space reserved for answers in written exams, etc.), non-compliance with the format will be expressly penalized. Likewise, the following will be penalized (among others):
- The answers that are not duly justified.
- The inappropriate use of terminology and mathematical notation.
- Messy work, difficult to read, excessive strikethrough, etc.
- The excessive presence of misspellings / grammar.
- The procedures that demonstrate the lack of acquisition of basic mathematical competences.

Only for duly justified causes (e.g. health restrictions) the evaluation tests may be organized remotely, with prior authorization from the Faculty's Board.

Observations for part-time students

The course can be followed from the Moodle platform. Part-time students must take the same assessment items as the rest of the students. The work and continuous assessment exercises proposed throughout the course may in this case be carried out individually, and may be delivered in electronic format.

Optionally, and in addition to laboratory practices, part-time students (and only these) may take a single written exam that encompasses the contents of the three thematic blocks, weighting 60% of the overall mark, to be held on the date of the final exam.

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
Larson, L. y Edwards, B. H. Cálculo I y II. 9ª ed. Mc Graw Hill. ISBN: 978-970-10-5710-0. http://catalogo.unican.es/cgi-bin/abnetopac/?TITN=263113
Material puesto a disposición para clase (presentaciones, ejercicios, piezas audiovisuales y programas de software y código)