SUBJECT TEACHING GUIDE

G2007 - Calculus

Degree in Civil Engineering
BILINGUAL UC-CU CIVIL ENGINEERING PROGRAM

Academic year 2022-2023

1. IDENTIFYING DATA				
Degree	Degree in Civil Engineering BILINGUAL UC-CU CIVIL ENGINEERING PROGRAM		Type and Year	Core. Year 1 Compulsory. Year 1
Faculty	School of civil Engineering			
Discipline	BASIC MATHEMATICS FOR ENGINEERING			
Course unit title and code	G2007 - Calculus			
Number of ECTS credits allocated	6	Term	Semester based (1)	
Web				
Language of instruction	English		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

- Know and manipulate elementary univariate functions. Understand and use the concepts of limit and continuity at a point of a function. Calculate derivatives of real functions with ease and apply them to solve optimization problems. Find the derivative of an implicitly defined function. Study the derivability of functions at a point and within an interval. Knowledge and ability to work with deal with numerical sequences, numerical series and power series. Use Taylor expansions to approximate real functions. Know how to implement numerical local approximations of a function using Taylor polynomials , providing an error estimate.
- Know and manipulate real multivariate functions and vector fields. Calculate partial derivatives, directional derivatives and gradients. Calculate the plane that is tangent to a surface at a point. Compute higher order partial derivatives and Hessian matrices. Formulate and solve maximum and minimum problems using differential calculus .
- Use the most usual techniques of analytical integration of univariate functions and know how to calculate arc lengths, planar areas and volumes of revolution using univariate integral calculus. Know how to apply formulas for changing variables to polar coordinates. Learn to parameterize common curves. Compute line integrals over scalar and vector fields.
- earn 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 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	%
Lab practice reports	Laboratory evaluation	No	No	12,00
Continuous asessment	Others	No	No	28,00
Partial examination of Block I	Written exam	No	Yes	15,00
Partial examination of Block II	Written exam	No	Yes	15,00
Partial Examination of Block III	Written exam	Yes	Yes	30,00
TOTAL				100,00

Observations

The final mark of the extraordinary call, will be the weighted average of the different evaluation items described in the teaching guide, carried out during the course. Students who attend the extraordinary call, will take a single exam, corresponding to the 60% recoverable, which will include the whole course syllabus, regardless of whether any of its parts was previously approved during the ordinary evaluation.
The non-adaptation to the format in tests with an established format (templates for practice reports, space reserved for answers in written exams, etc.), will be penalized. Likewise, the following will be penalized (among others):
- Answers that are not duly justified.
- An inappropriate use of terminology and mathematical notation.
- Messy work that is hard to read, excessive crossing out, etc.
- Too many spelling/grammar mistakes.
- Procedures that demonstrate the lack of basic mathematical skills.

Only for duly justified reasons (e.g. healthcare restrictions) the assessment tests may be remotely undertaken, with prior authorization from the Academic Authority.

Observations for part-time students

The course can be followed from the University of Cantabria Moodle platform. Part-time students must fulfill the same evaluation requirements than full-time students. However, in this case, the continuous evaluation assignments proposed throughout the course may be carried out individually, and may be delivered in electronic format. Optionally, and in addition to computer practices, part-time students (and only them) may take a single written exam that encompasses the contents of the three thematic blocks, with a weight of 60% of the overall grade, 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.
See also electronic book version: https://catalogo.unican.es/cgi-bin/abnetopac/O7448/IDd1bea231/NT1

Electronic material available in Moodle (exercises, slides, videos, software scripts etc.)