SUBJECT TEACHING GUIDE

G2007 - Calculus

First Degree in Civil Engineering

Degree in Civil Engineering

BILINGUAL UC-CU CIVIL ENGINEERING PROGRAM

Academic year 2024-2025

1. IDENTIFYING DATA				
Degree	First Degree in Civil Engineering Degree in Civil Engineering BILINGUAL UC-CU CIVIL ENGINEERING PROGRAM		Type and Year	Core. Year 1 Core. 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)	
Knowledge Field				
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	

4. OBJECTIVES

General Objective:
To develop a thorough understanding of differential and integral calculus and its application in various science and engineering contexts, fostering analytical, critical and communication skills that will be essential in students' professional and academic careers.

Specific Objectives:
- Mathematical Language Proficiency: become familiar with mathematical language and reasoning to interpret and construct logical and rigorous arguments.
- Develop the ability to read, write and communicate mathematical concepts with clarity and precision.
- Intellectual Work Habits: Instill a work ethic that promotes discipline, curiosity and perseverance in independent and collaborative study.
- Mathematical Modeling: To explore the potential of calculus as a modeling tool in real and theoretical situations , extending its application to fields related to Civil Engineering.
- Mathematical Functions and their Properties: Acquire an operative handling of mathematical functions, emphasizing their behavior, applications and relevance in practical contexts.
- Differential and Integral Calculus: To understand and apply the basic elements of differential and integral calculus in one and several variables. Solve practical problems in physics and engineering using these mathematical tools.
- Technology and Programming: Recognize and use mathematical software and programming languages as fundamental resources for the analysis and resolution of complex problems. Integrate emerging technologies such as artificial intelligence into the learning and application of calculus.
- Communication and Collaboration: Develop effective mathematical communication skills , both written and oral, to present and defend results and methods.
- Encourage interdisciplinary collaboration on projects requiring the application of calculus, preparing students for teamwork environments.
- Critical Thinking and Problem Solving: Stimulate critical thinking and the ability to approach and solve open-ended and complex problems requiring a creative and analytical approach.
- Continuous Assessment and Feedback: Implement a continuous assessment system that allows students to receive timely and constructive feedback, promoting adaptive and conscious learning.

6. SUBJECT PROGRAM	
	CONTENTS
1	BLOCK I: REAL AND COMPLEX NUMBERS, SEQUENCES, AND NUMERICAL SERIES. REAL UNIVARIATE FUNCTIONS. 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 key concepts of 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 series: Definitions. 1.7. Convergence criteria for numerical series. UNIT 2: REAL UNIVARIATE FUNCTIONS. 2.1. Concept and definitions of functions. Operations with functions. 2.2. Elementary functions. 2.3. Properties of even and odd functions, periodicity, symmetry, and 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. Properties of differentiable functions at a point and within an interval. 2.9. Rolle's and Mean Value Theorems. 2.10. Application of the derivative to the calculation of limits: L'Hôpital's rule. 2.11. Representation of 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. MULTIVARIATE REAL FUNCTIONS UNIT 4. MULTIVARIATE SCALAR AND VECTOR-VALUED FUNCTIONS 4.1. First notions about multivariate functions 4.2. Limits of scalar functions 4.3. Limits of vector-valued functions 4.4. Continuity of multivariate functions 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.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Lab practice reports	Work	No	No	12,00
Continuous asessment	Work	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 grade for the extraordinary assessment will be determined by the weighted average of various evaluation components outlined in the course's teaching guide. Students attending the extraordinary assessment will take a comprehensive exam, accounting for 60% of the final grade, covering the entire course syllabus, irrespective of prior pass of individual parts during regular evaluation.

Failure to adhere to prescribed test formats (e.g., report templates, designated answer spaces in written exams) will result in penalties. Additionally, the following actions will be penalized:

Unjustified answers.
Inappropriate use of terminology and mathematical notation.
Untidy work, excessive corrections, etc.
Frequent spelling/grammar errors.
Demonstrating a lack of fundamental mathematical skills in procedures.

In exceptional cases supported by valid justifications (e.g., health restrictions), remote completion of assessment tests may be permitted with prior authorization from the Academic Authority.

Observations for part-time students

The course is accessible through the University of Cantabria Moodle platform. Part-time students are required to meet the same evaluation criteria as full-time students. However, in their case, the continuous assessment tasks assigned throughout the course may be completed individually and submitted in electronic format. Additionally, part-time students have the option, exclusive to them, to take a single written exam covering the material from all three thematic blocks. This exam carries a weight of 60% towards the final grade and will be administered on the scheduled final exam date.

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, Geogebra applets, videos, software scripts etc.)