

Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos

GUÍA DOCENTE DE LA ASIGNATURA

G2007 - Calculus

Grado en Ingeniería Civil

Arquitectura, construcción, edificación y urbanismo, e ingeniería civil
Básica. Curso 1

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Programa Cornell

Obligatoria. Curso 1

Curso Académico 2024-2025

1. DATOS IDENTIFICATIVOS

Título/s	Grado en Ingeniería Civil Grado en Ingeniería Civil Programa Cornell		Tipología y Curso	Básica. Curso 1 Básica. Curso 1
Centro	Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos			
Módulo / materia	FORMACIÓN BÁSICA MATEMÁTICAS BÁSICAS PARA LA INGENIERÍA			
Código y denominación	G2007 - Calculus			
Créditos ECTS	6	Cuatrimestre	Cuatrimestral (1)	
Ámbito de conocimiento	Arquitectura, construcción, edificación y urbanismo, e ingeniería civil Arquitectura, construcción, edificación y urbanismo, e ingeniería civil			
Web				
Idioma de impartición	Inglés	Forma de impartición	Presencial	

Departamento	DPTO. MATEMATICA APLICADA Y CIENCIAS DE LA COMPUTACION
Profesor responsable	JOAQUIN BEDIA JIMENEZ
E-mail	joaquin.bedia@unican.es
Número despacho	E.T.S. de Ingenieros de Caminos, Canales y Puertos. Planta: + 1. DESPACHO (1047)
Otros profesores	

2. CONOCIMIENTOS PREVIOS

The previous knowledge required will be that acquired during high school, for which an adequate training in mathematics is assumed. It is recommended a profile of scientific-technical high schools or a higher degree training in engineering and/or technology.

3. RESULTADOS DEL PROCESO DE FORMACIÓN Y APRENDIZAJE

Habilidades o Destrezas
Conocer y utilizar las Tecnologías de la Información y la Comunicación (TICs).
Competencias o Capacidades
Capacitación científico- técnica para el ejercicio de la profesión de Ingeniero Técnico de Obras Públicas y conocimiento de las funciones de asesoría, análisis, diseño, cálculo, proyecto, construcción, mantenimiento, conservación y explotación.
Capacidad para la resolución de los problemas matemáticos que puedan plantearse en la ingeniería. Aptitud para aplicar los conocimientos sobre: álgebra lineal; geometría; geometría diferencial; cálculo diferencial e integral; ecuaciones diferenciales y en derivadas parciales; métodos numéricos; algorítmica numérica; estadística y optimización.
Capacidad de recurrir y aplicar el pensamiento lógico y crítico en su análisis de problemas y toma de decisiones.
Conocimiento de la historia de la ingeniería civil y capacitación para analizar y valorar las obras públicas en particular y la construcción en general.
Capacidad para desarrollar una motivación orientada al logro y automotivación

4. OBJETIVOS

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 Modelling: To explore the potential of calculus as a modelling 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 behaviour, 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.

5. ACTIVIDADES ACADÉMICAS	
ACTIVIDADES	HORAS DE LA ASIGNATURA
ACTIVIDADES PRESENCIALES	
HORAS DE CLASE (A)	
- Teoría (TE)	30
- Prácticas en Aula (PA)	24
- Prácticas de Laboratorio Experimental (PLE)	
- Prácticas de Laboratorio en Ordenador (PLO)	6
- Prácticas Clínicas (CL)	
Subtotal horas de clase	60
ACTIVIDADES DE SEGUIMIENTO (B)	
- Tutorías (TU)	8
- Evaluación (EV)	8
Subtotal actividades de seguimiento	16
Total actividades presenciales (A+B)	76
ACTIVIDADES NO PRESENCIALES	
Trabajo en grupo (TG)	10
Trabajo autónomo (TA)	64
Tutorías No Presenciales (TU-NP)	
Evaluación No Presencial (EV-NP)	
Total actividades no presenciales	74
HORAS TOTALES	150

6. PROGRAMA DE LA ASIGNATURA													
CONTENIDOS		TE	PA	PLE	PLO	CL	TU	EV	TG	TA	TU- NP	EV- NP	Semana
1	<p>BLOCK I: REAL AND COMPLEX NUMBERS, SEQUENCES, AND NUMERICAL SERIES. REAL UNIVARIATE FUNCTIONS.</p> <p>UNIT 1: REAL AND COMPLEX NUMBERS, NUMERICAL SEQUENCES, SERIES, AND POWER SERIES.</p> <p>1.1. Real numbers: Axiomatics of real numbers.</p> <p>1.2. Geometric representation and key concepts of the real line.</p> <p>1.3. Complex numbers: Definition.</p> <p>1.4. Geometric representation of complex numbers.</p> <p>1.5. Operations with complex numbers.</p> <p>1.6. Numerical sequences and series: Definitions.</p> <p>1.7. Convergence criteria for numerical series.</p> <p>UNIT 2: REAL UNIVARIATE FUNCTIONS.</p> <p>2.1. Concept and definitions of functions. Operations with functions.</p> <p>2.2. Elementary functions.</p> <p>2.3. Properties of even and odd functions, periodicity, symmetry, and dimension.</p> <p>2.4. Limit of a function at a point: Definition and properties.</p> <p>2.5. Indeterminate forms.</p> <p>2.6. Continuous function at a point and within an interval: Types of discontinuities.</p> <p>2.7. Theorems about continuous functions.</p> <p>2.8. Properties of differentiable functions at a point and within an interval.</p> <p>2.9. Rolle's and Mean Value Theorems.</p> <p>2.10. Application of the derivative to the calculation of limits: L'Hôpital's rule.</p> <p>2.11. Representation of functions as power series: Taylor and Mac-Laurin formulas. Local approximation of functions.</p>	14,00	12,00	0,00	2,00	0,00	2,00	3,00	2,00	18,00	0,00	0,00	1-6
2	<p>BLOCK II: INTEGRAL CALCULUS OF FUNCTIONS OF ONE VARIABLE</p> <p>UNIT 3: INTEGRAL CALCULUS</p> <p>3.1. Calculation of primitives: Definitions and properties.</p> <p>3.2. Integration methods.</p> <p>3.3. Riemann integral: Interpretation and properties.</p> <p>3.4. Mean value theorem, Fundamental Theorem of Calculus, and Barrow's rule.</p> <p>3.5. Improper integrals.</p> <p>3.6. Parameterization of curves and polar coordinates.</p> <p>3.7. Applications of integrals: Calculation of planar areas, volumes of revolution, surfaces of revolution, and lengths of curves in Cartesian, parametric, and polar coordinates.</p>	8,00	6,00	0,00	2,00	0,00	3,00	3,00	4,00	22,00	0,00	0,00	7-10

3	BLOCK III. MULTIVARIATE REAL FUNCTIONS	8,00	6,00	0,00	2,00	0,00	3,00	2,00	4,00	24,00	0,00	0,00	11-15
	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.												
TOTAL DE HORAS		30,00	24,00	0,00	6,00	0,00	8,00	8,00	10,00	64,00	0,00	0,00	
Esta organización tiene carácter orientativo.													

TE	Horas de teoría
PA	Horas de prácticas en aula
PLE	Horas de prácticas de laboratorio experimental
PLO	Horas de prácticas de laboratorio en ordenador
CL	Horas de prácticas clínicas
TU	Horas de tutoría
EV	Horas de evaluación
TG	Horas de trabajo en grupo
TA	Horas de trabajo autónomo
TU-NP	Tutorías No Presenciales
EV-NP	Evaluación No Presencial

7. SISTEMAS DE EVALUACIÓN DEL APRENDIZAJE				
Descripción	Tipología	Eval. Final	Recuper.	%
Lab practice reports	Trabajo	No	No	12,00
Calif. mínima	0,00			
Duración	2 hours x 2 sessions			
Fecha realización	To be determined throughout the course			
Condiciones recuperación				
Observaciones	The evaluation will be conducted through lab reports completed in pairs or small groups during the lab sessions. Students will work independently, following the provided practice script for each session. Prior preparation using the available examples on Moodle is necessary. The lab session will involve problem-solving related to theory using specific software and the development of a report presenting and discussing the results. The reports will adhere to a template provided by the instructor. Attendance at the sessions is mandatory for evaluation. The final grade for this activity will be the average of the individual marks obtained in each lab session throughout the course.			
Continuous assessment	Trabajo	No	No	28,00
Calif. mínima	0,00			
Duración	Exercises and activities of variable duration			
Fecha realización	To be determined, regularly throughout the course			
Condiciones recuperación				
Observaciones	Brief exercises or assessment activities, lasting approximately 15-20 minutes, will be assigned on a regular basis throughout the semester. These exercises can be completed individually or in small groups and aim to review or further explore previously taught content. Around 6-8 exercises will be assigned in total. The final grade for this activity will be the average of all the grades obtained from these exercises throughout the course.			
Partial examination of Block I	Examen escrito	No	Sí	15,00
Calif. mínima	0,00			
Duración	90 minutes			
Fecha realización	Around week 7			
Condiciones recuperación	Opportunity to resit during the Final Exam			
Observaciones	Individual assessment of contents of Block 1			
Partial examination of Block II	Examen escrito	No	Sí	15,00
Calif. mínima	0,00			
Duración	90 minutes			
Fecha realización	Around week 14			
Condiciones recuperación	Opportunity to resit during the Final Exam			
Observaciones	Individual assessment of contents of Block 2			
Partial Examination of Block III	Examen escrito	Sí	Sí	30,00
Calif. mínima	3,00			
Duración	90 minutes			
Fecha realización	According to official schedule			
Condiciones recuperación	Resit opportunity during the extraordinary call			

Observaciones	The individual written test will assess the skills acquired during Block III. Additionally, it will provide an opportunity to resit previous partial examinations 1 and 2 in case of failure. If the previous partial examinations have been passed, only the last part of the test will be required, covering the contents after the second partial examination and avoiding any repetition of topics.
TOTAL	100,00
Observaciones	
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 passing 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:	
<ul style="list-style-type: none"> 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.	
Criterios de evaluación para estudiantes a tiempo parcial	
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 single exam carries a weight of 60% towards the final grade and will be administered on the scheduled final exam date.	

8. BIBLIOGRAFÍA Y MATERIALES DIDÁCTICOS

BÁSICA

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.)

Complementaria

Marsden, J.E & Tromba, A.J. Cálculo Vectorial. Quinta edición. Pearson, Addison - Wesley, 2004. ISBN: 84-7829-069-9 /

978-84-7829-069-7. <http://catalogo.unican.es/cgi-bin/abnetopac/?TITN=220433>

Apostol, T., Calculus. Vols. 1, 2 Ed. Reverté, 1991. ISBN: 84-291-5001-3.

<http://catalogo.unican.es/cgi-bin/abnetopac/?TITN=7199>

9. SOFTWARE				
PROGRAMA / APLICACIÓN	CENTRO	PLANTA	SALA	HORARIO
Maxima (https://maxima.sourceforge.io/)	ETSI Caminos Canales y Puertos			
Octave (https://octave.org/)	ETSI Caminos Canales y Puertos			

10. COMPETENCIAS LINGÜÍSTICAS	
<input checked="" type="checkbox"/> Comprensión escrita	<input checked="" type="checkbox"/> Comprensión oral
<input checked="" type="checkbox"/> Expresión escrita	<input checked="" type="checkbox"/> Expresión oral
<input checked="" type="checkbox"/> Asignatura íntegramente desarrollada en inglés	
Observaciones	