Teaching Guide					
Identifying Data					2023/24
Subject (*)	Cálculo infinitesimal II			Code	632G02002
Study programme	Grao en Tecnoloxía da Enxeñaría Civil				
Descriptors					
Cycle	Period	Year		Type	Credits
Graduate	2nd four-month period	First		Basic training	6
Language	Spanish				
Teaching method	Face-to-face				
Prerequisites					
Department	Matemáticas				
Coordinador	Fe Marques, Jaime		E-mail	jaime.fe@udc.es	
Lecturers	Couceiro Aguiar, Iván		E-mail	ivan.couceiro.aguiar@udc.es	
	Fe Marques, Jaime			jaime.fe@udc.es	
	Nogueira Garea, Xesus Anton			xesus.nogueira@udc.es	
Web	caminos.udc.es/info/asignaturas/grado_tecic/102/CII/				
General description					

Study programme competences / results	
Code	Study programme competences / results
A1	Capacidad para plantear y resolver los problemas matemáticos que puedan plantearse en el ejercicio de la profesión. En particular, conocer, entender y utilizar la notación matemática, así como los conceptos y técnicas del álgebra y del cálculo infinitesimal, los métodos analíticos que permiten la resolución de ecuaciones diferenciales ordinarias y en derivadas parciales, la geometría diferencial clásica y la teoría de campos, para su aplicación en la resolución de problemas de Ingeniería Civil.
B1	Que los estudiantes hayan demostrado poseer y comprender conocimientos en un área de estudio que parte de la base de la educación secundaria general, y se suele encontrar a un nivel que, si bien se apoya en libros de texto avanzados, incluye también algunos aspectos que implican conocimientos procedentes de la vanguardia de su campo de estudio
B2	Que los estudiantes sepan aplicar sus conocimientos a su trabajo o vocación de una forma profesional y posean las competencias que suelen demostrarse por medio de la elaboración y defensa de argumentos y la resolución de problemas dentro de su área de estudio
B3	Que los estudiantes tengan la capacidad de reunir e interpretar datos relevantes (normalmente dentro de su área de estudio) para emitir juicios que incluyan una reflexión sobre temas relevantes de índole social, científica o ética
B4	Que los estudiantes puedan transmitir información, ideas, problemas y soluciones a un público tanto especializado como no especializado
B5	Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía
B6	Resolver problemas de forma efectiva.
B7	Aplicar un pensamiento crítico, lógico y creativo.
B10	Comunicarse de manera efectiva en un entorno de trabajo.
B15	Claridad en la formulación de hipótesis.
B16	Capacidad de autoaprendizaje mediante la inquietud por buscar y adquirir nuevos conocimientos, potenciando el uso de las nuevas tecnologías de la información y así poder enfrentarse adecuadamente a situaciones nuevas.
B18	Capacidad para aplicar conocimientos básicos en el aprendizaje de conocimientos tecnológicos y en su puesta en práctica.
B19	Capacidad de realizar pruebas, ensayos y experimentos, analizando, sintetizando e interpretando los resultados.
C1	Expresarse correctamente, tanto de forma oral como por escrito, en las lenguas oficiales de la comunidad autónoma.
C2	Dominar la expresión y la comprensión de forma oral e escrita de un idioma extranjero.
C3	Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de la vida.
C4	Desarrollarse para el ejercicio de una ciudadanía abierta, culta, crítica, comprometida, democrática y solidaria, capaz de analizar la realidad, diagnosticar problemas, formular e implantar soluciones basadas en el conocimiento y orientadas al bien común.
C6	Valorar críticamente el conocimiento, la tecnología y la información disponible para resolver los problemas con que deben enfrentarse.

Learning outcomes			
Learning outcomes	Study programme competences / results		
To know and understand the theory of Infinitesimal Calculus.	A1	B1	C3
To know, understand and use mathematical notation.	A1	B1	C3
To improve mathematical reasoning ability by acquiring or developing different skills: to operate, simplify, clear, relate, distinguish, deduce, demonstrate.	A1	B2 B3 B6 B7 B15	C6
To solve mathematical problems applying the theory of Infinitesimal Calculus.	A1	B2 B3 B6 B7 B15 B16 B18	C6
To acquire an analytical attitude towards the different problems that arise, both in the current studies and in the future exercise of the profession.		B3 B6 B7 B19	C3 C4 C6
To learn to make decisions, studying and reflecting previously.		B2 B3 B5	C4 C6
To improve the oral and written expression, to be able to transmit information clearly and rigorously.		B4 B7 B10	C1 C2

Contents	
Topic	Sub-topic
I. INTEGRATION.	1. Primitive of a function: definition and necessary condition of existence. 2. Riemann Integral: Darboux Sums; integrability conditions; properties. 3. Theorem of the mean. 4. First Fundamental Theorem of Calculus. Barrow's rule. 5. Second Fundamental Theorem of Calculus. 6. Improper integrals. 7. Applications of the definite integral: areas, volumes, arcs and surfaces of revolution.

II. VECTOR FUNCTIONS.	1. Types of functions. 2. Euclidean space: ordinary scalar product; euclidean norm and distance. 3. Vector functions of real variable: limit; continuity; differentiability. 4. Real functions of vector variable: functional and directional limit; continuity; differentiability; directional derivative and partial derivative; differential; gradient. 5. Vector functions of a vector variable: limit; continuity; differentiability. 6. Composition of functions: continuity and differentiability of the composite function; chain rule. 7. Higher order derivatives and differentials. 8. Taylor expansion: general expression; matrix expression. 9. Relative extremes: extreme conditions; determination of the type of quadratic form. 10 Implicit function: definition; existence and differentiability theorem for two variables; generalization. 11. Extremes of functions with constraints: method of Lagrange multipliers.
III. NUMERICAL SERIES.	1. Definition. 2. Geometric series. 3. Necessary condition of convergence. 4. Properties of the series. 5. Cauchy convergence criterion. 6. Series of positive terms. Convergence criteria: majorant and minorant; Riemann series; series comparison; root; quotient; Raabe; logarithmic; condensation. 7. Series of positive and negative terms: absolute and unconditional convergence and divergence; Riemann, Dirichlet and Leibnitz theorems. 8. Methods of addition of series: by decomposition; from the the harmonic; from the exponential of x expansion; hypergeometric series.
IV. FUNCTIONAL SEQUENCES AND SERIES.	1. Functional sequences: definition; simple and uniform convergence; sequences of continuous functions. 2. Functional series: definition; simple and uniform convergence; majorant criterion; continuity; integration; derivation. 3. Power series: definition; Cauchy-Hadamard theorem; continuity, derivation and integration; Abel's theorems; power series expansion of a function, Taylor series.
V. COMPLEX NUMBERS.	1. Introduction. 2. Definition, binomial form and basic operations. 3. Trigonometric form; graphic representation. 4. Conjugate, additive and multiplicative inverse; division. 5. Exponential of a complex; Euler's formula. 6. Natural power of a complex; Moivre's formula. 7. Root of a complex. 8. Fundamental Theorem of Algebra.

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Laboratory practice	A1 B10 B15 B1 B2 B3 B4 B6 B7 B18 B19 C1 C2 C6	28	28	56
Objective test	A1 B1 B2 B3 B7 C1	1	0	1
Mixed objective/subjective test	A1 B15 B1 B2 B3 B6 B7 C1 C2	3	0	3

Guest lecture / keynote speech	A1 B10 B15 B1 B2 B3 B4 B7 C1 C2 C4 C6	27	27	54
Problem solving	A1 B15 B1 B2 B3 B6 B7 B16 B19 C1 C4 C6	0	15	15
Workbook	A1 B1 B3 B5 B16 B18 C3	0	20	20
Personalized attention		1	0	1
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	**Description**
Laboratory practice	The Practice lessons are participatory problem-solving sessions. The problems to be solved are published in advance on the web page of the subject.
Objective test	The Control Exercises are brief exercises with theoretical and/or practical content. They are carried out in the classroom without prior notice or fixed frequency, in order to check the assimilation of concepts. These exercises can be true/false or multiple choice, questions or short problems. They are marked by the lecturer.
Mixed objective/subjective test	The Final Examination of the subject has the form of a mixed test: it is made up of some (or all) of the following parts: a test, short theoretical-practical questions, integration exercises, problem solving.
Guest lecture / keynote speech	In the Theory Classes, the theoretical contents of the subject are exposed, accompanied by examples. They are followed by a time dedicated to clarifying doubts, individually or in groups.
Problem solving	During the development of each unit, or after finishing it, it is proposed to carry out various activities (Voluntary Exercises). These exercises are solved individually outside the classroom and are collected on dates announced in advance. Some of these exercises may consist of the presentation in public of a section of the syllabus or the resolution of a mathematical problem in public. The delivery of these exercises is not an essential requirement to pass the subject, but it is recommended for its usefulness to assimilate its contents. It can mean an increase in the final grade, as it is clarified in the Evaluation section.
Workbook	During the development of each of the 5 units that make up the subject, it is necessary to study the complementary material that appears in the Support Documents section of the website.

Personalized attention	
Methodologies	**Description**
Guest lecture / keynote speech Problem solving Laboratory practice	For the correct assimilation of the contents developed in the theory classes (lectures) and in the problem classes (laboratory practices) it is highly recommended to consult with the lecturer any doubts that arise, either during said classes or during the personal study of the subject. Doubts that arise during the personal resolution of voluntary surrender problems can also be consulted in the personalized attention interviews. These consultations will preferably take place at two times: a) In the classroom, during the 10 minutes after each class. b) In the lecturer's office during the hours established for this activity. It is also possible to make inquiries at any time via email, although this means may not be suitable for resolving certain types of doubts, due to its complexity.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**

Problem solving	A1 B15 B1 B2 B3 B6 B7 B16 B19 C1 C4 C6	Carrying out the Voluntary Exercises is valued up to a maximum of 5 points. Both in the June and July opportunities, these points are added to the overall mark, as long as a minimum score of 45 out of 100 is achieved between the Control Exercises and the Final Exam.	0
Objective test	A1 B1 B2 B3 B7 C1	The Control Exercises have a weight of 20% of the overall mark, both in the June and July opportunities.	20
Mixed objective/subjective test	A1 B15 B1 B2 B3 B6 B7 C1 C2	The Final Exam has a weight of 80% of the overall grade, both in the June and July opportunities.	80
Others		Dos parciales compensatorios.	

Assessment comments
Both in June and July, the subject can be passed in one of the following ways:a) Obtaining 50 points or more as the sum of the Final Exam mark (out of 80) plus the average mark of the Control Exercises (out of 20) and -if applicable- the mark of the Voluntary Exercises (out of 5).b) Obtaining a grade of 40 out of 80 in the Final Exam. Voluntary Exercises are not taken into account in this option.Fraudulent performance of tests or evaluation activities, once verified, will directly result in a fail grade in the call in which it is committed: the student will be graded with "fail" (numerical grade 0) in the corresponding call for the academic year , whether the offense is committed on the first opportunity or on the second. To do this, the grade will be modified in the first opportunity report, if necessary. ?

Sources of information	
Basic	- Franco, J.R. (2003). Introducción al Cálculo. Problemas y ejercicios resueltos. Prentice Hall, Madrid - Estela, M.R.; Sáa, J. (2008). Cálculo con soporte interactivo en Moodle. Pearson-Prentice Hall, Madrid - García, A. y otros (1998). Cálculo I. Teoría y problemas de Análisis Matemático en una variable. CLAGSA, Madrid - García, A. y otros (2002). Cálculo II. Teoría y problemas de funciones de varias variables. CLAGSA, Madrid - Granero, F. (2001). Cálculo Integral y aplicaciones. Prentice Hall; Madrid - Estela, M.R.; Serra, A.M. (2008). Cálculo. Problemas resueltos. Pearson-Prentice Hall, Madrid Para cursar satisfactoriamente esta materia é preciso ter ben asimilados os contidos principais da materia Cálculo Infinitesimal I.Para a preparación da materia, ademais dos apuntamentos de clase, é importante dispoñer do seguinte material, que está dispoñible na páxina web:1. Precurso de Matemáticas.2. Programa detallado.3. Apuntamentos de todos os temas, que inclúen tests e cuestións de autoavaliación, e outros documentos de apoio.4. Boletíns de prácticas e integrais.Ademais do anterior, segundo as necesidades, será útil consultar algún dos textos da bibliografía, básica ou complementaria, que poden obterse na Biblioteca da Escola.
Complementary	- Marsden, J.; Tromba, A. (2004). Cálculo Vectorial. Madrid, Pearson-Addison Wesley - Granero, F. (1991). Ejercicios y problemas de Cálculo (2 tomos) . Tébar Flores, Albacete - Burgos, J (2006). Cálculo Infinitesimal de una variable. Madrid, Mc Graw-Hill - Granero, F. (1995). Cálculo Infinitesimal. Una y varias variables. Mc Graw-Hill, Madrid - Besada, M. y otros (2001). Cálculo de varias variables. Problemas y ejercicios resueltos . Prentice Hall; Madrid - Tébar, E. y Tébar M.A. (1991). 909 problemas de Cálculo Integral (2 tomos) . Tébar Flores, Madrid

Recommendations
Subjects that it is recommended to have taken before
Cálculo infinitesimal I/632G02001
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus

Fundamentos de mecánica computacional/632G02015 Ecuacións diferenciais/632G02017
Other comments
When teaching this subject, it is assumed that students have taken Infinitesimal Calculus I and have some command of its contents, since many of the contents of Infinitesimal Calculus I are starting points for Infinitesimal Calculus II.