



## Teaching Guide

Identifying Data				2022/23
Subject (*)	Cálculo infinitesimal I	Code	632G02001	
Study programme	Grao en Tecnoloxía da Enxeñaría Civil			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	First	Basic training	6
Language	English			
Teaching method	Face-to-face			
Prerequisites				
Department	Matemáticas			
Coordinador	Fe Marques, Jaime	E-mail	jaime.fe@udc.es	
Lecturers	Colominas Ezponda, Ignasi Couceiro Aguiar, Iván Fe Marques, Jaime Nogueira Garea, Xesus Anton	E-mail	ignacio.colominas@udc.es ivan.couceiro.aguiar@udc.es jaime.fe@udc.es xesus.nogueira@udc.es	
Web	caminos.udc.es/info/assignaturas/grado_tecic/102/CI/			
General description				

## Study programme competences

Code	Study programme competences
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		
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. THE REAL NUMBER.	<ol style="list-style-type: none"> <li>1. Introduction. Necessary and sufficient condition.</li> <li>2. Successive extensions of the concept of number.</li> <li>3. Field structure. Ordered field.</li> <li>4. Sequences in <math>\mathbb{Q}</math>.</li> <li>5. Properties of <math>\mathbb{Q}</math>.</li> <li>6. Extension of <math>\mathbb{Q}</math>. The real numbers.</li> <li>7. Properties of <math>\mathbb{R}</math>.</li> <li>8. Operations in <math>\mathbb{R}</math>.</li> </ol>
II. METRIC SPACES.	<ol style="list-style-type: none"> <li>1. Distance.</li> <li>2. Balls and neighborhoods</li> <li>3. Notable points in a metric space.</li> <li>4. Notable sets in a metric space.</li> <li>5. Closed, open and compact sets.</li> <li>6. The metric space <math>(\mathbb{R},   )</math>.</li> </ol>



III. NUMERICAL SEQUENCES.	<ol style="list-style-type: none"><li>1. Definition; limit concept; types of successions.</li><li>2. Properties of limits.</li><li>3. Monotone sequences.</li><li>4. Operations with limits. Types of indeterminacy.</li><li>5. Convergence criteria.</li><li>6. Infinites and infinitesimals.</li><li>7. Equivalent sequences.</li><li>8. Substitution by equivalent sequences.</li><li>9. Calculation of limits.</li></ol>
IV. FUNCTIONS IN $\mathbb{R}$ .	<p>A. GENERAL NOTIONS</p> <ol style="list-style-type: none"><li>1. Concept of function.</li><li>2. Operations with functions.</li><li>3. Types of functions.</li></ol> <p>B. FUNCTION LIMITS</p> <ol style="list-style-type: none"><li>1. Limit of a function.</li><li>2. One-side limits.</li><li>3. Extension of the concept of limit.</li><li>4. Sequential limit.</li><li>5. Properties of limits.</li><li>6. Operations with limits.</li><li>7. Infinites and infinitesimals.</li><li>8. Equivalent functions at a point.</li><li>9. Substitution by equivalent functions.</li></ol> <p>C. CONTINUITY OF FUNCTIONS</p> <ol style="list-style-type: none"><li>1. Continuous function.</li><li>2. One-sided continuity.</li><li>3. Discontinuities.</li><li>4. Operations with continuous functions.</li><li>5. Continuity of the elementary functions.</li><li>6. Composition of continuous functions.</li><li>7. Theorems of the continuous functions.</li><li>8. Uniform continuity.</li></ol> <p>D. DIFFERENTIABILITY OF FUNCTIONS</p> <ol style="list-style-type: none"><li>1. Derivability and differentiability.</li><li>2. The chain rule. Applications.</li><li>3. Derivative of the inverse function.</li><li>4. Mean value theorems: Rolle, Cauchy, Lagrange.</li><li>5. The derivative as a limit of derivatives.</li><li>6. L'Hôpital rules.</li><li>7. Successive derivatives.</li><li>8. Taylor and McLaurin polynomials.</li><li>9. Representation of curves.</li></ol>
V. CALCULUS OF PRIMITIVES.	<ol style="list-style-type: none"><li>1. Logarithms and hyperbolic functions.</li><li>2. Primitive of a function. immediate integrals.</li><li>3. Primitive calculation methods: semi-immediate; change of variables; parts; reduction formulas; rational; trigonometric; irrational.</li></ol>



Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Laboratory practice	A1 B10 B15 B1 B2 B3 B4 B6 B7 B18 B19 C1 C2 C6	31	31	62
Objective test	A1 B1 B2 B3 B7 C1	1	0	1
Mixed objective/subjective test	A1 B15 B1 B2 B3 B6 B7 C1 C2	2.5	0	2.5
Guest lecture / keynote speech	A1 B10 B15 B1 B2 B3 B4 B7 C1 C2 C4 C6	26	26	52
Problem solving	A1 B15 B1 B2 B3 B6 B7 B16 B19 C1 C4 C6	0	12.5	12.5
Introductory activities	A1 B1 B2 B6 B7 C3	0	4	4
Workbook	A1 B1 B3 B5 B16 B18 C3	0	15	15
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.
Introductory activities	During the first two weeks of the course, students must solve Practice 0, that can be obtained on the web page of the subject. The solution can be consulted later on the same web page.
Workbook	Before beginning the study of each of the units of the subject, it is recommended to access the Mathematics Precourse. This Precourse is made up of some theory notes, solved and proposed problems and contains basic knowledge to study the subject, which is assumed to have been acquired in previous courses. It has been prepared by various first-year Mathematics professors of this university, from the High School programs.  The basic material provided must be studied, personally solving the proposed exercises, as a guarantee that the knowledge required for the new subject is possessed.  Likewise, 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
Problem solving Laboratory practice Guest lecture / keynote speech	<p>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.</p> <p>These consultations will preferably take place at two times:</p> <p>a) In the classroom, during the 10 minutes after each class.</p> <p>b) In the lecturer's office during the hours established for this activity.</p> <p>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.</p>

Assessment			
Methodologies	Competencies	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 January 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 January opportunity and in the July one.	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 January and July opportunities.	80
Others		Dos parciales compensatorios.	

Assessment comments
<p>Both in January and July, the subject can be passed in one of the following ways:</p> <p>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).</p> <p>b) Obtaining a grade of 40 out of 80 in the Final Exam. Voluntary Exercises are not taken into account in this option.</p>

Sources of information	
<b>Basic</b>	<ul style="list-style-type: none"> <li>- Franco, J.R. (2003). Introducción al Cálculo. Problemas y ejercicios resueltos. Prentice Hall, Madrid</li> <li>- Estela, M.R.; Sáa, J. (2008). Cálculo con soporte interactivo en Moodle. Pearson-Prentice Hall, Madrid</li> <li>- García, A. y otros (1998). Cálculo I. Teoría y problemas de Análisis Matemático en una variable. CLAGSA, Madrid</li> <li>- Granero, F. (2001). Cálculo Integral y aplicaciones. Prentice Hall; Madrid</li> <li>- Estela, M.R.; Serra, A.M. (2008). Cálculo. Problemas resueltos. Pearson-Prentice Hall, Madrid</li> </ul> <p>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 e outros documentos de apoio, que inclúen tests e cuestións de autoavaliación.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.</p>
<b>Complementary</b>	<ul style="list-style-type: none"> <li>- Granero, F. (1991). Ejercicios y problemas de Cálculo (2 tomos). Tébar Flores, Albacete</li> <li>- Burgos, J (2006). Cálculo Infinitesimal de una variable. Madrid, Mc Graw-Hill</li> <li>- Granero, F. (1995). Cálculo Infinitesimal. Una y varias variables. Mc Graw-Hill, Madrid</li> <li>- Tébar, E. y Tébar M.A. (1991). 909 problemas de Cálculo Integral (2 tomos). Tébar Flores, Madrid</li> </ul>



Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Cálculo infinitesimal II/632G02002 Ecuacións diferenciais/632G02017
Other comments

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.