



## Teaching Guide

Identifying Data					2024/25
Subject (*)	Fundamentals of Mathematics		Code	610G04001	
Study programme	Grao en Nanociencia e Nanotecnoloxía				
Descriptors					
Cycle	Period	Year	Type	Credits	
Graduate	1st four-month period	First	Basic training	6	
Language	SpanishGalicianEnglish				
Teaching method	Face-to-face				
Prerequisites					
Department	Matemáticas				
Coordinador	Ferreiro Ferreiro, Ana María	E-mail	ana.ferreiro@udc.es		
Lecturers	Ferreiro Ferreiro, Ana María García Rodríguez, José Antonio Pérez Villarino, Joel Suarez Taboada, Maria	E-mail	ana.ferreiro@udc.es jose.garcia.rodriguez@udc.es joel.perez.villarino@udc.es maria.suarez3@udc.es		
Web	<a href="https://campusvirtual.udc.gal/course/view.php?id=15393">https://campusvirtual.udc.gal/course/view.php?id=15393</a>				
General description	This course aims to develop skills providing the student the ability to develop a critical knowledge of: differential calculus, integral calculus, numerical and functional series, Fourier series and a short introduction to linear algebra.				

## Study programme competences / results

Code	Study programme competences / results
A3	CE3 - Reconocer y analizar problemas físicos, químicos, matemáticos, biológicos en el ámbito de la Nanociencia y Nanotecnología, así como plantear respuestas o trabajos adecuados para su resolución, incluyendo el uso de fuentes bibliográficas.
A7	CE7 - Interpretar los datos obtenidos mediante medidas experimentales y simulaciones, incluyendo el uso de herramientas informáticas, identificar su significado y relacionarlos con las teorías químicas, físicas o biológicas apropiadas.
B2	CB2 - 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
B4	CB4 - Que los estudiantes puedan transmitir información, ideas, problemas y soluciones a un público tanto especializado como no especializado
B5	CB5 - Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía
B6	CG1 - Aprender a aprender
B7	CG2 - Resolver problemas de forma efectiva.
B8	CG3 - Aplicar un pensamiento crítico, lógico y creativo.
B9	CG4 - Trabajar de forma autónoma con iniciativa.
B10	CG5 - Trabajar de forma colaborativa.
B11	CG6 - Comportarse con ética y responsabilidad social como ciudadano/a y como profesional.
B12	CG7 - Comunicarse de manera efectiva en un entorno de trabajo.
C3	CT3 - 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 su vida
C7	CT7 - Desarrollar la capacidad de trabajar en equipos interdisciplinarios o transdisciplinarios, para ofrecer propuestas que contribuyan a un desarrollo sostenible ambiental, económico, político y social.
C8	CT8 - Valorar la importancia que tiene la investigación, la innovación y el desarrollo tecnológico en el avance socioeconómico y cultural de la sociedad
C9	CT9 - Tener la capacidad de gestionar tiempos y recursos: desarrollar planes, priorizar actividades, identificar las críticas, establecer plazos y cumplirlos

## Learning outcomes



Learning outcomes	Study programme competences / results		
Remember sets of numbers and especially handle complex numbers. Know and handle with ease the differential calculus in a variable: successive derivatives, chain's rule, Taylor expansion, calculation of extremes and local study of functions. Know how to apply knowledge to real problems	A3 A7	B2 B4 B5 B6 B7 B8 B9 B10 B11 B12	C3 C7 C8 C9
Know and acquire fluency in the techniques of integration of functions of a variable. Improper integrals. Know how to apply knowledge to real problems.	A3 A7	B2 B4 B5 B6 B7 B8 B9 B10 B11 B12	C3 C7 C8 C9
Know the numerical and functional sequences and series, determine their convergence and acquire fluency in the calculation of limits. Know and handle the Fourier series. Know how to apply knowledge to real problems.	A3 A7	B2 B5 B6 B7 B8 B9 B10 B11 B12	C3 C7 C8 C9
Know and handle matrix calculus, systems of linear equations and vector spaces with ease. Know how to apply knowledge to real problems.	A3 A7	B2 B5 B6 B7 B8 B9 B10 B11 B12	C3 C8 C9



Manage software tools that implement the methodologies studied and know how to analyze the results.	A3	B2	C3
	A7	B4	C7
		B5	C8
		B6	C9
		B7	
		B8	
		B9	
		B10	
		B11	
		B12	

Contents	
Topic	Sub-topic
Unit 0: Sets of numbers.	Real numbers. Complex numbers.
Unit 1: Differential calculus of one variable.	Differentiable functions. Chain's rule. Increasing and decreasing functions. Local extrema. Concavity and convexity. Inflection points. Graph representation of functions. Newton's method. Taylor's polynomial. Applications.
Unit 2: Integral calculus of one variable.	Definite integral. Fundamental theorem of Calculus. Integration rules. Computation of flat areas and volumes. Numerical integration: trapezoid's method. Improper integrals. Applications.
Unit 3: Vector spaces. Linear algebra.	Matrix algebra. Solving linear system equations. Gauss' method. Vector spaces. Diagonalization. Eigenvalues and eigenvectors. Applications.
Unit 4: Sequences and series.	Numerical sequences. Numerical series. Function sequences. Function series. Series of Taylor. Series of Fourier. Applications.

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A3 A7 B6 B7 B8 C3	28	56	84
ICT practicals	B2 B4 B5 B6 B7 B9 B10 B11 B12 C7 C8 C9	12	25	37



Mixed objective/subjective test	A3 B2 B4 B7	3	0	3
Problem solving	A3 A7 B6 B7 C3	8	16	24
Personalized attention		2	0	2

(\*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	Exhibition of the contents specified in the program of the subject, for this, audiovisual media or blackboard will be used.
ICT practicals	Interactive practices in which relevant problems in the field of Science and Engineering will be solved, for this the Python programming language will be used
Mixed objective/subjective test	Development of issues and problems of the subject.
Problem solving	Sessions where relevant problems in the field of Sciences and Engineering will be presented, which will be solved both analytically and numerically. The student must be able to reach the solution of any problem by hand or alternatively using computer tools, and compare the results.

Personalized attention	
Methodologies	Description
Problem solving ICT practicals	<p>a) During practical and solving problems lessons, professors will help students to develop purposed problems as well as applications to problems outside the scope of Science and Engineering.</p> <p>b) The specific personalized attention measures for "Students with recognition of part-time dedication and academic waiver of attendance exemption" for the study of the subject, the continuous evaluation of the practices through ITC and the resolution of problems carried out attending, as far as possible, to your particular circumstances.</p>

Assessment			
Methodologies	Competencies / Results	Description	Qualification
Mixed objective/subjective test	A3 B2 B4 B7	Proba que inclúe a resolución de cuestións e problemas da materia	60
Problem solving	A3 A7 B6 B7 C3	Resolución de problemas de carácter práctico.	20
ICT practicals	B2 B4 B5 B6 B7 B9 B10 B11 B12 C7 C8 C9	Resolución de problemas de carácter práctico empregando o linguaxe de programación Python	20

Assessment comments



The final qualification of the subject consists of three parts:

Qualification of internships through ICT (CP): between 0 and 2 points Problem Solving Qualification (CR): between 0 and 2 points Mixed test qualification (CE): If CP+CR is equal or greater to 2 points, the qualification of the mixed test (CE) will be  $E=10-(CP+CR)$ . If CP+CR is smaller than 2 points, the qualification of the mixed test (CE) will be  $CE=8-(CP+CR)$ . The final qualification will be the sum of three parts:  $Final\_Note= CP + CR + CE$ , if the qualification of the mixed test (CE) is greater than 2 (over 10 points). In other case, the final qualification will be the mark obtained on the mixed test, CE. The qualification of the practices through ICT (CP) + the resolution of problems (CR), constitute the note of Continuous Evaluation (EV),  $EV = CP + CR$ . The qualifications of practices through ICT (CR) and problem solving (CP) will be kept on the second opportunity of the evaluation, that is, the EV note will be kept for the second opportunity.

The evaluation of CP + CR will be carried out by solving four small mixed tests, in which the student will have to solve problems of the subject by hand and with Python.

The qualifications of practices through ICT (CR) and problem solving (CP) will be retained in the second opportunity of the evaluation.

Students who do not show up for the final mixed test will be considered as "Not presented".

All previous observations are applicable to students who request the early December call.

All aspects related to "academic dispensation", "dedication to study", "permanence" and "academic fraud" are governed in accordance with the current academic regulations of the UDC.

### Sources of information

<b>Basic</b>	<ul style="list-style-type: none"> <li>- Ron Larson, Bruce Edwards (Edición 10ª.2018.). Cálculo. Tomo I. Cengage Learning</li> <li>- Denis G. Zill, Warren S. Wright (2013). Ecuaciones Diferenciales con problemas con valores en la frontera (capítulo 11). Brooks/Cole Cengage Learning</li> <li>- Robert G. Mortimer (2013). Mathematics for Physical Chemistry. Pearson</li> <li>- Edward Jen Herman, Gilbert Strang (). Calculus. Volumen 1. <a href="https://openstax.org/details/books/calculus-volume-1">https://openstax.org/details/books/calculus-volume-1</a></li> <li>- Edward Jen Herman, Gilbert Strang (). Calculus. Volumen 2. <a href="https://openstax.org/details/books/calculus-volume-2">https://openstax.org/details/books/calculus-volume-2</a></li> <li>- W. Keith Nicholson (). Linear Algebra with Applications. <a href="https://lyryx.com/linear-algebra-applications/">https://lyryx.com/linear-algebra-applications/</a></li> <li>- Svein Linde, Hans P. Langtangen (2017). Programming for Computations - Python. A Gentle Introduction to Numerical Simulations with Python. Springer. Texts in Computational Science and Engineering</li> <li>- Jeffrey J. Heys (2017). Chemical and Biomedical Engineering Calculations using Python. Wiley</li> </ul>
<b>Complementary</b>	<ul style="list-style-type: none"> <li>- Jay Abramson (). Precalculus. <a href="https://openstax.org/details/books/prec calculus">https://openstax.org/details/books/prec calculus</a></li> <li>- Stanley Grossman (). Álgebra Lineal (Ed 7ª). McGraw-Hill.</li> <li>- Robert Johansson (2018). Numerical Python: Scientific Computing and Data Science Applications with Numpy, Scipy and Matplotlib. Apress</li> <li>- Rubin H. Landau, Manuel J. Paez, Christian C. Bordeiany (2007). Computational Physics: Problem Solving with Computers. Wiley VCH Verlag GmbH</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

Advanced Calculus /610G04009

Other comments



It is recommended to have knowledge of the second year of high school. In particular, differential and integral calculus. Daily study of the contents treated in the classroom, complementing them with the recommended bibliography. Gender perspective: as stated in the transversal competences of the title (C4), the development of a critical, open and respectful citizenship with diversity in our society will be promoted, highlighting the equal rights of students without discrimination based on gender or sexual condition. An inclusive language will be used in the material and during the development of the lessons. Work will be done to identify and modify prejudices and sexist attitudes and influence the environment to modify them and promote values of respect and equality.

Green Campus Program of the Faculty of Science

In order to achieve an immediate and sustainable and to fulfill the point 6 of the "Declaración

Ambiental da Facultade de Ciencias (2020)", the work carried out in this subject will be requested in virtual format or computer support.

**(\*)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.**