



Teaching Guide				
Identifying Data				2021/22
Subject (*)	Advanced Calculus	Code	610G04009	
Study programme	Grao en Nanociencia e Nanotecnoloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	First	Basic training	6
Language	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department	Matemáticas			
Coordinador	Suarez Taboada, María	E-mail	maria.suarez3@udc.es	
Lecturers	Ferreiro Ferreiro, Ana María Suarez Taboada, Maria Varela Rodríguez, Hiram	E-mail	ana.fferreiro@udc.es maria.suarez3@udc.es hram.varela@udc.es	
Web	<a href="https://campusvirtual.udc.gal/course/view.php?id=15383">https://campusvirtual.udc.gal/course/view.php?id=15383</a>			
General description	Nesta asignatura preténdese o desenvolvemento de competencias que permitan ao alumnado desenvolver un coñecemento crítico do calculo diferencial e integral de varias variables.			
Contingency plan	<ol style="list-style-type: none"> <li>1. Modifications to the contents</li> <li>2. Methodologies <ul style="list-style-type: none"> <li>*Teaching methodologies that are maintained</li> <li>*Teaching methodologies that are modified</li> </ul> </li> <li>3. Mechanisms for personalized attention to students</li> <li>4. Modifications in the evaluation <ul style="list-style-type: none"> <li>*Evaluation observations:</li> </ul> </li> <li>5. Modifications to the bibliography or webgraphy</li> </ol>			

Study programme competences	
Code	Study programme competences
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 interdisciplinares o transdisciplinares, 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		
Conocer y manejar con soltura las funciones en varias variables escalares y vectoriales: su representación espacial, su necesidad en el modelado de problemas reales, el cálculo de límites y la continuidad	A3 A7	B2 B4 B5 B6 B7 B8 B9 B10 B11 B12	C3 C7 C8 C9
Conocer y manejar con soltura el cálculo diferencial en varias variables: derivadas parciales y direccionales, operadores diferenciales, desarrollo de Taylor y cálculo de extremos y extremos condicionados. Saber aplicar los conocimientos a problemas reales, especialmente relacionados con la titulación.	A3 A7	B2 B4 B5 B6 B7 B8 B9 B10 B11 B12	C3 C7 C8 C9
Conocer y adquirir soltura en las técnicas de integración en varias variables, aplicándolo a problemas reales.	A3 A7	B2 B4 B5 B6 B7 B8 B9 B10 B11 B12	C3 C7 C8 C9



<p>Conocer y adquirir soltura en la integración sobre curvas y superficies. Saber aplicar las fórmulas de Green y Stokes, aplicándolo a problemas relacionados con la titulación</p>	<p>A3 A7</p>	<p>B2 B4 B5 B6 B7 B8 B9 B10 B11 B12</p>	<p>C3 C7 C8 C9</p>
<p>Manejar herramientas de software que implementen las metodologías estudiadas y saber analizar los resultados.</p>	<p>A3 A7</p>	<p>B2 B4 B5 B6 B7 B8 B9 B10 B11 B12</p>	<p>C3 C7 C8 C9</p>

Contents	
Topic	Sub-topic
<p>Unit 1: Topology in <math>\mathbb{R}^n</math></p>	<p>Scalar product, norm and distance. Classification of points and sets. Topology in <math>\mathbb{R}</math>: bounded sets, supreme, infimo, maximum and minimum. Polar, cylindrical and spherical oordinates. Applications.</p>
<p>Unit 2: Functions of more than one variable</p>	<p>Scalar and vector functions. Level sets. Continuity. Applications.</p>
<p>Unit 3: Differentiation of functions of more than one variables and applications</p>	<p>Directional derivative. Partial derivatives: properties and practical computations. Difererential of a function. Relationship between the differential and the partial derivatives. Gradient vector, relationship with the directional derivatives. Jacobian matrix. Higher order partial derivatives. Introduction to vector calculus. Taylor's theorem for scalar functions. Critical points, classification. Hessian matrix. Extremos condicionados: reducción de la dimensión, método de los multiplicadores de Lagrange. Aplicaciones.</p>
<p>Unit 4: Integration of functions of one and more variables</p>	<p>Double integrals. Triples integrals. Change of variables in double and triple integrals. Applications of integrals.</p>



Unit 5: Integration in curves and surfaces	<p>Parameterized curves.</p> <p>Integral line.</p> <p>Gradient function and conservative field.</p> <p>Green's theorem.</p> <p>Parameterized surfaces.</p> <p>Integral of surface. Stokes theorem. Divergence's theorem.</p> <p>Applications.</p>
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Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student's personal work hours	Total hours
Guest lecture / keynote speech	A3 A7 B6 B11 C8	28	56	84
ICT practicals	B2 B4 B5 B7 B12 C3 C7 C8	12	25	37
Mixed objective/subjective test	A3 B2 B6 B7 B9	3	0	3
Problem solving	B2 B4 B5 B7 B8 B9 B10 B12 C3 C7 C9	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) As specific personalized attention measures for "Students with partial time dedication recognition and academic exemption from attendance exemption" for the study of the subject, the continuous assessment of practical lessons through ICT and problem solving will be carried out through online tests.</p> <p>b)As medidas de atención personalizada específicas para o ?Alumnado con recoñecemento de dedicación a tempo parcial e dispensa académica de exención de asistencia? para o estudo da materia, a avaliación continua das prácticas a través de TIC e da resolución de problemas realizarase mediante probas parciais online.</p>

Assessment
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Methodologies	Competencies	Description	Qualification
Problem solving	B2 B4 B5 B7 B8 B9 B10 B12 C3 C7 C9	Resolución de problemas de carácter práctico.	20
ICT practicals	B2 B4 B5 B7 B12 C3 C7 C8	Resolución de problemas de carácter práctico empregando o linguaxe de programación Python	20
Mixed objective/subjective test	A3 B2 B6 B7 B9	Proba que inclúe a resolución de cuestións e problemas da materia	60

### Assessment comments

The final qualification of the subject consists of three parts:

Practical qualifications by ITC (CP): between 0 and 2 points  
Solving problems qualifications (CR): between 0 and 2 points

Objective test qualification (CE): between 0 and 6 points.

The

final qualification will be the sum of the three parts CP + CR + CE, if

the qualification of the objective test is greater than 2 (over 10

points). In other situation, the final qualification will be the

qualification of the objective test, CE.

The qualifications of the

practical lessons by ITC (CR) and solving problems (CP) will be kept

for the second opportunity of the assessment.

The qualifications

of the practical lessons by ITC (CR) and solving problems (CP) of the

academic year 20/21 will be automatically kept for the academic year

21/22. The participation in the continuous assessment of 21/22 will mean

the rejection to the qualifications of CR and CP of the previous year.

In the proceedings, the students who do not attend the final test will be considered as "Not presented".

### Sources of information

<b>Basic</b>	<p>Bibliografía: Jerrold Marsden. "Cálculo Vectorial". Pearson. Edición 6ª. 2018. Ron Larson, Bruce Edwards. "Cálculo. Tomo II". Cengage Learning, Edición 10ª. 2018. Claudia Neuhauser, "Calculus for Biology and Medicine", Prentice Hall. Edición 2ª. 2004. Robert G. Mortimer. "Mathematics for Physical Chemistry". Pearson. Edición 4ª. 2013. Saturnino L. Salas, Finar Hille, Garret J. Etgen. "Calculus II. Una y varias variables" (Vol. nº 2). Reverté. Edición 4ª. 2018. Edward Jen Herman, Gilbert Strang. "Calculus. Volumen 3". OpenStax. Rice University. Disponible gratuitamente en : <a href="https://openstax.org/details/books/calculus-volume-3">https://openstax.org/details/books/calculus-volume-3</a></p> <p>Bibliografía para prácticas a través de TIC: Jeffrey J. Heys. "Chemical and Biomedical Engineering Calculations using Python". Wiley. 2017. Svein Linge, Hans P. Langtangen. "Programming for Computations - Python. A Gentle Introduction to Numerical Simulations with Python". Springer. Texts in Computational Science and Engineering. Edición 1ª. 2017. Anders Mathe-Sorensen. "Elementary Mechanics Using Python: A Modern Course Combining Analytical and Numerical Techniques (Undergraduate Lecture Notes in Physics)". Springer. 2015. Robert Johansson. "Numerical Python: Scientific Computing and Data Science Applications with Numpy, Scipy and Matplotlib". Apress. . Edición: 2ª. 2018. Rubin H. Landau, Manuel J. Paez, Christian C. Bordeiany. "Computational Physics: Problem Solving with Computers". Wiley VCH Verlag GmbH. Edición 2ª. 2007.</p>
<b>Complementary</b>	

### Recommendations

Subjects that it is recommended to have taken before



Fundamentals of Mathematics/610G04001

Physics: Mechanics and Waves/610G04002

**Subjects that are recommended to be taken simultaneously**

Fundamentals of Computing Science/610G04010

**Subjects that continue the syllabus**

Numerical and Statistical Methods/610G04013

Differential Equations/610G04016

**Other comments**

It is recommended to have knowledge of the second year of high school. 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.

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.**