



## Teaching Guide

| Teaching Guide      |                                                                                                                                                                                                                                                |        |                                              |           |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------------------------------------------|-----------|
| Identifying Data    |                                                                                                                                                                                                                                                |        |                                              | 2022/23   |
| 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         | Suarez Taboada, María                                                                                                                                                                                                                          | E-mail | maria.suarez3@udc.es                         |           |
| Lecturers           | Ferreiro Ferreiro, Ana María<br>Suarez Taboada, María                                                                                                                                                                                          | E-mail | ana.fferreiro@udc.es<br>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

| 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 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 |
|-------------------|-----------------------------|
|-------------------|-----------------------------|



|                                                                                                                                                                                                                                                                                               |          |                                                             |                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------------------------------------------------------|----------------------|
| 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<br>A7 | B2<br>B4<br>B5<br>B6<br>B7<br>B8<br>B9<br>B10<br>B11<br>B12 | C3<br>C7<br>C8<br>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<br>A7 | B2<br>B4<br>B5<br>B6<br>B7<br>B8<br>B9<br>B10<br>B11<br>B12 | C3<br>C7<br>C8<br>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<br>A7 | B2<br>B5<br>B6<br>B7<br>B8<br>B9<br>B10<br>B11<br>B12       | C3<br>C7<br>C8<br>C9 |
| Know and handle matrix calculus, systems of linear equations and vector spaces with ease. Know how to apply knowledge to real problems.                                                                                                                                                       | A3<br>A7 | B2<br>B5<br>B6<br>B7<br>B8<br>B9<br>B10<br>B11<br>B12       | C3<br>C8<br>C9       |
| Manage software tools that implement the methodologies studied and know how to analyze the results.                                                                                                                                                                                           | A3<br>A7 | B2<br>B4<br>B5<br>B6<br>B7<br>B8<br>B9<br>B10<br>B11<br>B12 | C3<br>C7<br>C8<br>C9 |



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

| Planning                                                                                                                        |                                              |                      |                               |             |
|---------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------|-------------------------------|-------------|
| Methodologies / tests                                                                                                           | Competencies                                 | Ordinary class hours | 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<br>B10 B11 B12 C7 C8<br>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<br>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                      |                                              |                                                                                           |               |
|---------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------|---------------|
| Methodologies                   | Competencies                                 | 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<br>B10 B11 B12 C7 C8<br>C9 | Resolución de problemas de carácter práctico empregando o linguaxe de programación Python | 20            |

| Assessment comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The final qualification of the subject consists of three parts:</p> <p>Practical qualifications by ITC (CP): between 0 and 2 points<br/>Solving problems qualifications (CR): between 0 and 2 points<br/>Objective test qualification (CE): between 0 and 6 points.</p> <p>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.</p> <p>The qualifications of the practical lessons by ITC (CR) and solving problems (CP) will be kept for the second opportunity of the assessment.</p> <p>In the proceedings, the students who do not attend the final test will be considered as "Not presented".</p> |

| Sources of information |
|------------------------|
|------------------------|



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|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic         | <p>Bibliografía: Ron Larson, Bruce Edwards. "Cálculo. Tomo I". Cengage Learning, Edición 10ª. 2018. Denis G. Zill, Warren S. Wright. "Ecuaciones Diferenciales con problemas con valores en la frontera". Brooks/Cole Cengage Learning. 2013; (Capítulo 11) Claudia Neuhauser, "Calculus for Biology and Medicine", Prentice Hall. Edición 2ª. 2004. Robert G. Mortimer. "Mathematics for Physical Chemistry". Pearson. Edición 4ª. 2013. Edward Jen Herman, Gilbert Strang. "Calculus. Volumen 1". OpenStax. Rice University. Disponible gratuitamente en <a href="https://openstax.org/details/books/calculus-volume-1">https://openstax.org/details/books/calculus-volume-1</a> Edward Jen Herman, Gilbert Strang. "Calculus. Volumen 2". OpenStax. Rice University. Disponible gratuitamente en <a href="https://openstax.org/details/books/calculus-volume-2">https://openstax.org/details/books/calculus-volume-2</a> W. Keith Nicholson. "Linear Algebra with Applications". Disponible gratuitamente en <a href="https://lyryx.com/linear-algebra-applications/">https://lyryx.com/linear-algebra-applications/</a> Saturnino L. Salas, Finar Hille, Garret J. Etgen. "Calculus I. Una y varias variables" (Vol. nº 1). Reverté. Edición 4ª. 2018. Claudia Neuhauser. "Matemáticas para Ciencias". Pearson-Prentice Hall. Edición 2ª. 2020. Bernard Kolman, David R. Hill. "Álgebra Lineal". México: Pearson Educación. Edición 8ª. 2006. Stanley Grossman. "Álgebra Lineal". McGraw-Hill. Edición 7ª. 2012. Jay Abramson. "Precalculus". Disponible gratuitamente en <a href="https://openstax.org/details/books/precalculus">https://openstax.org/details/books/precalculus</a></p> <p>Bibliografía para prácticas a través de TIC: Jeffrey J. Heys. "Chemical and Biomedical Engineering Calculations using Python". Wiley. 2017. Anders Malthe-Sørensen. "Elementary Mechanics Using Python". Springer. 2015. 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 Malthe-Sørensen. "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. Bordeianu. "Computational Physics: Problem Solving with Computers". Wiley VCH Verlag GmbH. Edición 2ª. 2007.</p> |
| Complementary |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## 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.

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.