



## Teaching Guide

| Teaching Guide      |                                                                                                                                                                                                                                                                                                                                                          |        |                      |           |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------------------|-----------|
| Identifying Data    |                                                                                                                                                                                                                                                                                                                                                          |        |                      | 2020/21   |
| Subject (*)         | Numerical Methods for Computing                                                                                                                                                                                                                                                                                                                          |        | Code                 | 614G01064 |
| Study programme     | Grao en Enxeñaría Informática                                                                                                                                                                                                                                                                                                                            |        |                      |           |
| Descriptors         |                                                                                                                                                                                                                                                                                                                                                          |        |                      |           |
| Cycle               | Period                                                                                                                                                                                                                                                                                                                                                   | Year   | Type                 | Credits   |
| Graduate            | 1st four-month period                                                                                                                                                                                                                                                                                                                                    | Fourth | Optional             | 6         |
| Language            | Spanish                                                                                                                                                                                                                                                                                                                                                  |        |                      |           |
| Teaching method     | Hybrid                                                                                                                                                                                                                                                                                                                                                   |        |                      |           |
| Prerequisites       |                                                                                                                                                                                                                                                                                                                                                          |        |                      |           |
| Department          | Matemáticas                                                                                                                                                                                                                                                                                                                                              |        |                      |           |
| Coordinador         | Arregui Alvarez, Iñigo                                                                                                                                                                                                                                                                                                                                   | E-mail | inigo.arregui@udc.es |           |
| Lecturers           | Arregui Alvarez, Iñigo                                                                                                                                                                                                                                                                                                                                   | E-mail | inigo.arregui@udc.es |           |
| Web                 |                                                                                                                                                                                                                                                                                                                                                          |        |                      |           |
| General description |                                                                                                                                                                                                                                                                                                                                                          |        |                      |           |
| Contingency plan    | 1. Modifications to the contents<br><br>2. Methodologies<br>*Teaching methodologies that are maintained<br><br>*Teaching methodologies that are modified<br><br>3. Mechanisms for personalized attention to students<br><br>4. Modifications in the evaluation<br><br>*Evaluation observations:<br><br>5. Modifications to the bibliography or webgraphy |        |                      |           |

## Study programme competences

| Code | Study programme competences                                                                                                                                                                                                                                    |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A1   | Capacidade para a resolución dos problemas matemáticos que se poden presentar na enxeñaría. Aptitude para aplicar os coñecementos sobre: álgebra linear; cálculo diferencial e integral; métodos numéricos; algorítmica numérica; estatística e optimización.  |
| A33  | Capacidade de analizar e avaliar arquitecturas de computadores, incluíndo plataformas paralelas e distribuídas, así como desenvolver e optimizar software para elas                                                                                            |
| A41  | Capacidade para avaliar a complexidade computacional dun problema, coñecer estratexias algorítmicas que poidan conducir á súa resolución e recomendar, desenvolver e implementar aquela que garanta o mellor rendemento de acordo cos requisitos establecidos. |
| B3   | Capacidade de análise e síntese                                                                                                                                                                                                                                |

## Learning outcomes

| Learning outcomes                                                                                                                                                 | Study programme competences |    |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----|--|
| Knowledge of the most representative models in science and engineering, specially in computing, formulated by mathematical models and that need numerical methods | A1                          |    |  |
| Knowledge and comprehension of the numerical techniques better adapted for each one of the formulated models                                                      | A1<br>A33<br>A41            | B3 |  |



|                                                                                                                                                                              |           |    |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|----|--|
| Implementation of software that develops the numerical techniques, or the use of software tools that develop them                                                            | A1<br>A41 | B3 |  |
| Abord of problems that arise in the fields of computational science, covering from the understanding of the models to the practical and efficient implementation in computer | A1<br>A41 | B3 |  |

| Contents                                                             |                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                                                | Sub-topic                                                                                                                                                                                                                                                                        |
| Matrix numerical methods and applications                            | <ul style="list-style-type: none"> <li>- Numerical resolution of large linear systems. Direct and iterative methods. Sparse matrices. Applications</li> <li>- Least-square problems. Applications</li> <li>- Power method for eigenvalues. Google page rank algorithm</li> </ul> |
| Numerical methods for computer graphics                              | <ul style="list-style-type: none"> <li>- Interpolation and piecewise interpolation</li> <li>- Spline interpolation</li> <li>- Introduction to B-splines and Bezier curves</li> <li>- Applications in computer graphics</li> </ul>                                                |
| Numerical resolution of partial differential equations. Applications | <ul style="list-style-type: none"> <li>- Introduction to partial differential equations</li> <li>- Finite difference methods</li> <li>- Applications in image processing</li> </ul>                                                                                              |
| Numerical methods implementation                                     | <ul style="list-style-type: none"> <li>- Some MatLab and Python commands</li> </ul>                                                                                                                                                                                              |

| Planning                        |               |                      |                               |             |
|---------------------------------|---------------|----------------------|-------------------------------|-------------|
| Methodologies / tests           | Competencies  | Ordinary class hours | Student's personal work hours | Total hours |
| Laboratory practice             | A1 A33 A41 B3 | 14                   | 28                            | 42          |
| Problem solving                 | A1 A41 B3     | 4                    | 14                            | 18          |
| Mixed objective/subjective test | A1 B3         | 3                    | 0                             | 3           |
| Guest lecture / keynote speech  | A1 B3         | 21                   | 60                            | 81          |
| Personalized attention          |               | 6                    | 0                             | 6           |

(\*)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             | Some applied problems will be posed, different techniques will be discussed and the chosen one will be implemented. In 2020/21, it will be transmitted by streaming; nevertheless, the attendance at the classroom will be suggested.                                                                                                                              |
| Problem solving                 | Applied problems will be posed and solved by the teacher in order to understand the different methods and techniques explained in the theoretical courses. In 2020/21, it will be transmitted by streaming; nevertheless, the attendance at the classroom will be suggested.                                                                                       |
| Mixed objective/subjective test | The student will have to solve some theoretical questions and applied problems. If allowed by the normative, it will take place in the classroom. Only in case of confinement the students will do it by means of telematic tools (Teams, Moodle).                                                                                                                 |
| Guest lecture / keynote speech  | In the session magistral the professor will expose the theoretical and practical contents. The contents will be issued from real problems, the concepts and methods will be developed and some applied examples and exercises will be presented. In 2020/21, it will be transmitted by streaming; nevertheless, the attendance at the classroom will be suggested. |

| Personalized attention |             |
|------------------------|-------------|
| Methodologies          | Description |



|                     |                                                                                                                                                                                                                                                                                                                        |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Laboratory practice | - The teacher will supervise and discuss with the students their progress in their respective tasks.                                                                                                                                                                                                                   |
| Problem solving     | - The teacher will expose the goals of the supervised project, and will discuss and overview the progress and the final results.<br>- The teacher will attend the students in all their doubts about the theoretical concepts and practical application.<br>- In 2020/21, it will be done by means of telematic tools. |

| Assessment                      |               |                                                                                                             |               |
|---------------------------------|---------------|-------------------------------------------------------------------------------------------------------------|---------------|
| Methodologies                   | Competencies  | Description                                                                                                 | Qualification |
| Laboratory practice             | A1 A33 A41 B3 | The student will implement the adequate numerical methods in order to solve some proposed applied problems. | 50            |
| Mixed objective/subjective test | A1 B3         | Theoretical-practical control about the contents of the subject.                                            | 50            |

| Assessment comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>To surpass the matter, the student will have to:</p> <ul style="list-style-type: none"><li>- do at least the 75% of the proposed laboratory practices</li><li>- obtain at least a qualification of 4 in the mixed objective/subjective proof.</li></ul> <p>In the case of presencial activities, facilities will be given to part-time students.</p> <p>The final exam will be -whenever the sanitary conditions allow it and following the indications of the authorities- face-to-face. Only in case of confinement it will be done by means of telematic tools.</p> |

| Sources of information |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic                  | <ul style="list-style-type: none"><li>- R.L. Burden, J.D. Faires (2011). Análisis Numérico. Cengage Learning</li><li>- D. Kincaid, W. Cheney (1994). Análisis numérico: las matemáticas del cálculo científico. Addison Wesley</li><li>- J.H. Mathews, K.D. Fink. (2000). Métodos numéricos con MATLAB. Prentice-Hall</li><li>- J. Kiusalaas (2005). Numerical Methods in Engineering with Python. Cambridge U.P.</li><li>- (1996). Matlab, the language of scientific computing. Mathworks</li><li>- (1996). Matlab, Partial differential equations toolbox. Mathworks</li></ul> |
| Complementary          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

| Recommendations                                                                                |
|------------------------------------------------------------------------------------------------|
| Subjects that it is recommended to have taken before                                           |
| Programming I/614G01001<br>Calculus/614G01003<br>Programming II/614G01006<br>Algebra/614G01010 |
| Subjects that are recommended to be taken simultaneously                                       |
|                                                                                                |
| Subjects that continue the syllabus                                                            |
|                                                                                                |
| 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.