



## Teaching Guide

| Teaching Guide      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                   |           |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------------------|-----------|
| Identifying Data    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                   | 2020/21   |
| Subject (*)         | Mathematics II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        | Code              | 631G01106 |
| Study programme     | Grao en Náutica e Transporte Marítimo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |        |                   |           |
| Descriptors         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                   |           |
| Cycle               | Period                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Year   | Type              | Credits   |
| Graduate            | 2nd four-month period                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | First  | Basic training    | 6         |
| Language            | Spanish                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        |                   |           |
| Teaching method     | Hybrid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |                   |           |
| Prerequisites       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                   |           |
| Department          | Matemáticas                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |                   |           |
| Coordinador         | Rodriguez Aros, Angel Daniel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | E-mail | angel.aros@udc.es |           |
| Lecturers           | Cao Rial, María Teresa                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | E-mail | teresa.cao@udc.es |           |
|                     | Rodriguez Aros, Angel Daniel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        | angel.aros@udc.es |           |
| Web                 | www.nauticaymaquinas.es/                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |        |                   |           |
| General description | <p>This course is devoted to the study o basic concepts of Planar and Spherical Trigonometry, two-dimensional and three-dimensional loci (in particular conic sections and quatric surfaces), Differential and Integral Calculus in several variables and Statistics.</p> <p>The studenst will learn to use these specific mathematical tools, but also they will improve their skills in developing new methods and acquiring new technlolgies, to consult bibliographic references and online resources, to elaborate a memory in a rigourous and sistematic manner, to give lectures to others and collaborate with other colleagues, etc. In general they will develop a sense of scientific and rational thinking, capable to adapt to unexpected situations which may arise in their future practice as an engineer.</p> |        |                   |           |
| Contingency plan    | <p>1. Modifications to the contents</p> <p>2. Methodologies</p> <p>*Teaching methodologies that are maintained</p> <p>*Teaching methodologies that are modified</p> <p>3. Mechanisms for personalized attention to students</p> <p>4. Modifications in the evaluation</p> <p>*Evaluation observations:</p> <p>5. Modifications to the bibliography or webgraphy</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |                   |           |

## Study programme competences

| Code | Study programme competences                                                                                                                               |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| A2   | Interpretar e representar correctamente o espazo tridimensional, coñecendo os obxectivos e o emprego de representación gráfica.                           |
| A8   | Modelizar situacións e resolver problemas con técnicas ou ferramentas físico-matemáticas.                                                                 |
| A9   | Avaliación cualitativa e cuantitativa de datos e resultados, así como representación e interpretación matemática de resultados obtidos experimentalmente. |
| B1   | Aprender a aprender.                                                                                                                                      |
| B2   | Resolver problemas de xeito efectivo.                                                                                                                     |
| B3   | Aplicar un pensamento crítico, lóxico e creativo.                                                                                                         |
| B4   | Comunicarse de xeito efectivo nun ámbito de traballo.                                                                                                     |



|     |                                                                                                                                                                                                                                             |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| B5  | Traballar de forma autónoma con iniciativa.                                                                                                                                                                                                 |
| B6  | Traballar de forma colaboradora.                                                                                                                                                                                                            |
| B7  | Comportarse con ética e responsabilidade social como cidadán e como profesional.                                                                                                                                                            |
| B9  | Capacidade para interpretar, seleccionar e valorar conceptos adquiridos noutras disciplinas do ámbito marítimo, mediante fundamentos físico-matemáticos.                                                                                    |
| B10 | Versatilidade.                                                                                                                                                                                                                              |
| B11 | Capacidade de adaptación a novas situacións.                                                                                                                                                                                                |
| B12 | Uso das novas tecnoloxías TIC, e de Internet como medio de comunicación e como fonte de información.                                                                                                                                        |
| B13 | Comunicar por escrito e oralmente os coñecementos procedentes da linguaxe científica.                                                                                                                                                       |
| B14 | Capacidade de análise e síntese.                                                                                                                                                                                                            |
| B15 | Capacidade para adquirir e aplicar coñecementos.                                                                                                                                                                                            |
| B16 | Organizar, planificar e resolver problemas.                                                                                                                                                                                                 |
| B17 | Expresarse correctamente, tanto de forma oral coma escrita, nas linguas oficiais da comunidade autónoma                                                                                                                                     |
| B19 | Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.                                                             |
| B22 | Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.                                                                                                           |
| B23 | Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.                                                                                                                                                            |
| B24 | Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.                                                                                               |
| C9  | Posuír e comprender coñecementos que aporten unha base ou oportunidade de ser orixinais no desenvolvemento e/ou aplicación de ideas, a miúdo nun contexto de investigación                                                                  |
| C10 | Que os estudantes saiban aplicar os coñecementos adquiridos e a súa capacidade de resolución de problemas en contornas novas ou pouco coñecidas dentro de contextos máis amplas (ou multidisciplinares) relacionados coa súa área de estudo |

| Learning outcomes                        |  |                             |     |
|------------------------------------------|--|-----------------------------|-----|
| Learning outcomes                        |  | Study programme competences |     |
| Do listado de competencias da titulación |  | A2                          | B11 |
|                                          |  | A8                          | B17 |
|                                          |  | A9                          | B19 |
|                                          |  |                             | B22 |
|                                          |  |                             | B23 |
| Do listado de competencias da titulación |  |                             | B24 |
|                                          |  |                             | B1  |
|                                          |  |                             | B2  |
|                                          |  |                             | B3  |
|                                          |  |                             | B4  |
|                                          |  |                             | B5  |
|                                          |  |                             | B6  |
|                                          |  |                             | B7  |
|                                          |  |                             | B9  |
|                                          |  |                             | B10 |
|                                          |  |                             | B12 |
|                                          |  |                             | B13 |
| Do listado de competencias da titulación |  |                             | B14 |
|                                          |  |                             | B15 |
|                                          |  |                             | B16 |
|                                          |  |                             | C9  |
|                                          |  |                             | C10 |



| Contents                                                             |                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                                                | Sub-topic                                                                                                                                                                                                                                       |
| Lesson 1.- Circular Functions. Formulas                              | 1.1. Basic definitions and relationships<br>1.2. Graphical representations<br>1.3. Usual formulas<br>1.4. Inverse functions<br>1.5. Circular equations                                                                                          |
| Lesson 2.- Planar Trigonometry. Solving Triangles. Applications.     | 2.1 Definitions<br>2.2. Laws of sines and cosines. other formulas<br>2.3. Solving Oblique Triangles<br>2.4. Complements and applications                                                                                                        |
| Lesson 3.- Spherical triangles. General Properties.                  | 3.1. Dihedral angles. The supplementary rectilinear<br>3.2. Trihedron. Polar trihedron<br>3.3. Spherical surface. Definitions<br>3.4. Spherical Triangle. Associated trihedron<br>3.5. Polar Spherical triangle. Properties<br>3.6. Accessories |
| Lesson 4.-Groups of Bessel's formulas. Delambre and Neper analogies. | 4.1. Bessel's formulas<br>4.2. Briggs' formulas<br>4.3. Delambre-Gauss' analogies<br>4.4. Neper's analogies                                                                                                                                     |
| Tema 5.- Resolución de Triángulos Esféricos Oblicuángulos.           | 5.1. Análise de Casos<br>5.2. Complementos                                                                                                                                                                                                      |
| Lesson 6.- Solving Oblique Spherical Triangles.                      | 6.1. Definitions<br>6.2. General case: navigating a maximum circumference<br>6.3. Navegating a parallel<br>6.4. Navegating a plane<br>6.5. Estima (estimate position)                                                                           |
| Lesson 5.- Solving Right-angled Spherical Triangles.                 | 5.1. Definitions<br>5.2. Particular formulas. Napier's nifty Rules<br>5.3. Particular properties of the right triangles.<br>5.4. Solving right triangles.<br>5.5. Decomposition into right triangles. Perpendicular method.                     |
| Lesson 7.- Loci in the Plane. Conic sections.                        | 7.1. Locus in the plane<br>7.2. Conic sections<br>7.2.1. Circle<br>7.2.2. Elipse<br>7.2.3. Hyperbola<br>7.2.4. Parabola                                                                                                                         |



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lesson 9.-Loci in the space. Quadric surfaces.                                                                                                                                                                                                                                                                                                                                                                                                                     | 9.1. Loci in the space<br>9.1.1. Quadric surfaces of revolution<br>9.1.3. Ruled surfaces<br>9.2. Particular estudy of Quadric surfaces<br>9.2.1. Sphere<br>9.2.2. Ellipsoid<br>9.2.3. Hyperboloids<br>9.2.4. Paraboloids<br>9.2.5. Degenerate quadric surfaces<br>9.3. General equation of Quadric surfaces<br>9.3.1. General equation<br>9.3.2. Invariantes métricos<br>9.3.3. Clasification<br>9.4.4. Reduction to Canonical form |
| Lesson 10.- Functions of several real variables. Limits and Continuity.                                                                                                                                                                                                                                                                                                                                                                                            | 10.1.- General definitions<br>10.2.- Limits<br>10.3.- Continuity                                                                                                                                                                                                                                                                                                                                                                    |
| Lesson 11. Partial and Directional Derivatives. Taylor?s formula. Extrema.                                                                                                                                                                                                                                                                                                                                                                                         | 11.1.- Partial derivatives. Tangent plane<br>11.2.- Directional Derivatives.<br>11.3.- Higher order Derivatives<br>11.4.- Taylor?s polinomyal and theorem<br>11.5.- Relative extrema and conditioned extrema.                                                                                                                                                                                                                       |
| Lesson 12.- Double integrals. Calculus and applications                                                                                                                                                                                                                                                                                                                                                                                                            | 12.1.- General definitions<br>12.2.- Properties<br>12.3.- Iterated Integrals. Fubini?s Theorem.<br>12.4.- Change of Variables<br>12.5.- Applications                                                                                                                                                                                                                                                                                |
| Lesson 13.- Triple Integrals. Calculus and applications.                                                                                                                                                                                                                                                                                                                                                                                                           | 13.1.- General definitions<br>13.2.- Properties<br>13.3.- Iterated Integrals. Fubini?s Theorem<br>13.4.- Change of Variables<br>13.5.- Applications                                                                                                                                                                                                                                                                                 |
| Lesson 14.- First order Differential Equations.                                                                                                                                                                                                                                                                                                                                                                                                                    | 14.1.- General definitions<br>14.2.- First order Differential Equations.<br>14.3.- Special cases of first order ODEs                                                                                                                                                                                                                                                                                                                |
| Lesson 15.- High order Differential Equations.                                                                                                                                                                                                                                                                                                                                                                                                                     | 15.1.- Homogeneous and Nonhomogeneous Second Order EDO?s<br>15.2.- Higher order linear equations with constant coefficients<br>15.3.- Higher order Nonhomogeneous equations                                                                                                                                                                                                                                                         |
| Lesson 16.- Systems of Differential Equations.                                                                                                                                                                                                                                                                                                                                                                                                                     | 16.1.- Systems of Ordinary Differential Equations.<br>16.2.- Systems of Linear Differential Equations with constant coefficients.                                                                                                                                                                                                                                                                                                   |
| The development and overcoming of these contents, together with those corresponding to other subjects that include the acquisition of specific competencies of the degree, guarantees the knowledge, comprehension and sufficiency of the competencies contained in Table AII / 2, of the STCW Convention, related to the level of management of chief mates of the Merchant Navy, on ships without gross tonnage limitation and Master up to a maximum of 500 GT. | Table A-II / 2 of the STCW Convention.<br><br>Mandatory minimum requirements for certification of masters and chief mates on chief on ships of 500 gross tonnage or more.                                                                                                                                                                                                                                                           |



| Methodologies / tests                                                                                                           | Competencies                                                                                            | Ordinary class hours | Student's personal work hours | Total hours |
|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------------------|-------------------------------|-------------|
| Objective test                                                                                                                  | A2 A8 A9 B2 B4 B5<br>B11 B12 B13 B14<br>B16 B17 B19 B22 C1<br>C3 C10                                    | 4                    | 0                             | 4           |
| Guest lecture / keynote speech                                                                                                  | A2 A8 B1 B2 B3 B4<br>B15 B22 C10                                                                        | 27                   | 27                            | 54          |
| Supervised projects                                                                                                             | A2 A8 A9 B1 B2 B3<br>B4 B5 B6 B8 B9 B12<br>B13 B14 B15 B16<br>B17 B19 B22 B23<br>B24 C1 C3 C6 C7<br>C10 | 4                    | 20                            | 24          |
| Problem solving                                                                                                                 | A2 A8 A9 B5 B6 B10<br>B11 B12 B13 B15<br>B16 B17 B19 C1 C3<br>C10                                       | 9                    | 27                            | 36          |
| Collaborative learning                                                                                                          | A9 B1 B3 B4 B6 B7<br>B23 B24 C9 C10                                                                     | 6                    | 6                             | 12          |
| Document analysis                                                                                                               | B1 B2 B4 B5 B6 B7<br>B8 B10 B11 B12 B14<br>B15 B16 B17 B19 C3<br>C8                                     | 0                    | 2                             | 2           |
| Online discussion                                                                                                               | A8 A9 B2 B3 B4 B6<br>B8 B9 B10 B12 B13<br>B14 B15 B19 B22<br>B24 C3 C6 C8 C10                           | 0                    | 6                             | 6           |
| Directed discussion                                                                                                             | A2 A8 A9 B1 B2 B3<br>B4 B5 B6 B7 B8 B9<br>B10 B12 B14 B15<br>B19 B22 B24 C1 C3<br>C6 C7 C8 C9 C10       | 2                    | 0                             | 2           |
| Diagramming                                                                                                                     | A8 A9 B1 B2 B4 B5<br>B8 B9 B11 B12 B13<br>B14 B16 C1 C3                                                 | 2                    | 4                             | 6           |
| Personalized attention                                                                                                          |                                                                                                         | 4                    | 0                             | 4           |
| (*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. |                                                                                                         |                      |                               |             |

| Methodologies                  |                                                                                                                                                                                           |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies                  | Description                                                                                                                                                                               |
| Objective test                 | Resolver de forma individual un test de coñecementos teóricos e prácticos.                                                                                                                |
| Guest lecture / keynote speech | Exposición na aula dos conceptos fundamentais. Para os estudantes que non poidan seguir as clases de modo presencial, éstas retransmitíranse e gravaranse mediante a plataforma MS Teams. |
| Supervised projects            | Seguimento e corrección de traballos propostos.                                                                                                                                           |
| Problem solving                | Resolución de exercicios tipo e proposta de outros a resolver por os estudantes.                                                                                                          |
| Collaborative learning         | Resolver cuestións propostas en grupo e plantexar dudas.                                                                                                                                  |
| Document analysis              | Seleccionar libros e páxinas web a utilizar                                                                                                                                               |
| Online discussion              | Plantexar e resolver dudas en Moodle                                                                                                                                                      |
| Directed discussion            | Discusión na aula do plantexado previamente en Moodle.                                                                                                                                    |



|             |                                                                    |
|-------------|--------------------------------------------------------------------|
| Diagramming | Rematar cada tema con un esquema dos conceptos básicos aprendidos. |
|-------------|--------------------------------------------------------------------|

## Personalized attention

| Methodologies                                                                                         | Description                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Guest lecture /<br>keynote speech<br>Supervised projects<br>Problem solving<br>Collaborative learning | The students are encouraged to attend in small groups or individually to the professors' office to solve questions that may arise, thus obtaining a more specific guidance, according to their specific difficulties. |

## Assessment

| Methodologies          | Competencies                                                                                            | Description                                      | Qualification |
|------------------------|---------------------------------------------------------------------------------------------------------|--------------------------------------------------|---------------|
| Objective test         | A2 A8 A9 B2 B4 B5<br>B11 B12 B13 B14<br>B16 B17 B19 B22 C1<br>C3 C10                                    | Proba individual de asimilación de coñecementos. | 50            |
| Supervised projects    | A2 A8 A9 B1 B2 B3<br>B4 B5 B6 B8 B9 B12<br>B13 B14 B15 B16<br>B17 B19 B22 B23<br>B24 C1 C3 C6 C7<br>C10 | Realización dos traballos propostos.             | 20            |
| Problem solving        | A2 A8 A9 B5 B6 B10<br>B11 B12 B13 B15<br>B16 B17 B19 C1 C3<br>C10                                       | Capacidade para resolver problemas.              | 20            |
| Collaborative learning | A9 B1 B3 B4 B6 B7<br>B23 B24 C9 C10                                                                     | Participación en traballos grupais.              | 5             |
| Directed discussion    | A2 A8 A9 B1 B2 B3<br>B4 B5 B6 B7 B8 B9<br>B10 B12 B14 B15<br>B19 B22 B24 C1 C3<br>C6 C7 C8 C9 C10       | Participación nos debates na aula.               | 5             |
| Others                 |                                                                                                         |                                                  |               |

## Assessment comments

The course is divided into two parts: Part 1 (lessons 1-9) and part 2 (lessons 10-16). To pass it, it will be necessary to reach in each part a minimum of 3,5 points and afterwards obtain an average of, at least, 5 points following the formula  $(2 \times \text{part 1} + \text{part 2})/3$ .

In the unlikely case of reaching an arithmetic average of 5 but not having, at least, 3,5 points in each one of the parts, the result of the evaluation will be of fail and the final qualification will be calculated with a suitable geometric average.

The students that do not participate in the EHEA will be evaluated through a written test that will constitute 100% of the evaluation. For those who participate in the EHEA, the written tests will constitute 70% of the final marks. In order to add the qualification of the continuous assessment to the qualification of the written test, the latter must be at least 2,4 points (approximately 35% of 7) for each part, otherwise the final mark will only account for the written test.

Those students with recognition of part-time dedication and academic exemption of attendance, as established by the norm that regulates the regime of dedication to the study of undergraduate students in the UDC (Arts 2.3, 3.b, 4.3 e 7.5) (04/05/2017), and want to benefit from continuous assessment, must attend at least 50% of the course, exempting them from attending the theoretical classes, if they can not attend them. In case of not being able to attend the practical tests, they should attend tutorials at the professor office, where they will perform equivalent tests.



## Sources of information

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Basic</b>         | <ul style="list-style-type: none"><li>- García García-López Pellicer (). ÁLGEBRA LINEAL Y GEOMETRÍA. Marfil</li><li>- Granero, F. (). ÁLGEBRA Y GEOMETRÍA ANALÍTICA. Mac Graw Hill</li><li>- Fernández Viña, J.A. (). ANÁLISIS MATEMÁTICO II . Tecnos</li><li>- Larson-Hostetler-Edwards (). CÁLCULO (2) . Mac Graw Hill</li><li>- James Stewart (). CALCULO MULTIVARIABLE . Thomson Editores</li><li>- Vila Mitjá, A. (). ELEMENTOS DE TRIGONOMETRÍA ESFÉRICA. U.P.C.</li><li>- Gutiérrez Gómez-García Castro (). GEOMETRÍA. Pirámide</li><li>- Villa, A. de la (). PROBLEMAS DE ÁLGEBRA LINEAL. Glagsa</li><li>- Swokowski-Kole (). TRIGONOMETRÍA. Thomson</li><li>- Ayres, F. (). TRIGONOMETRÍA PLANA Y ESFÉRICA. Mac Graw Hill</li><li>- A. R. Arós, F. Blanco, M.J. Muiños (). TRIGONOMETRÍA PLANA Y ESFÉRICA CON APLICACIONES A LA NAVEGACIÓN. Paraninfo</li><li>- D.G. Zill, W.S. Wright (). Cálculo de Varias Variables. McGraw Hill</li></ul> |
| <b>Complementary</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## Recommendations

### Subjects that it is recommended to have taken before

Mathematics I/631G01101

### Subjects that are recommended to be taken simultaneously

### Subjects that continue the syllabus

Ship Manoeuvring I/631G01207

Ship's Theory I/631G01208

### 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.