



## Teaching Guide

| Identifying Data         |   |        |  |           | 2015/16 |
|--------------------------|---|--------|--|-----------|---------|
| Subject (*)              | Ampliación de matemáticas   |        | Code   | 730496015 |         |
| Study programme          | Mestrado Universitario en Enxeñaría Naval e Oceánica (plan 2012)  |        |  |           |         |
| Descriptors              |   |        |  |           |         |
| Cycle                    | Period  | Year   | Type   | Credits   |         |
| Official Master's Degree | 1st four-month period   | First  | Optativa   | 4.5       |         |
| Language                 | SpanishGalicianEnglish  |        |  |           |         |
| Teaching method          | Face-to-face  |        |  |           |         |
| Prerequisites            |   |        |  |           |         |
| Department               | Matemáticas   |        |  |           |         |
| Coordinador              | Brozos Vázquez, Miguel  | E-mail | miguel.brozos.vazquez@udc.es                                 |           |         |
| Lecturers                | Brozos Vázquez, Miguel<br>García Rodríguez, José Antonio  | E-mail | miguel.brozos.vazquez@udc.es<br>jose.garcia.rodriguez@udc.es |           |         |
| Web                      | campusvirtual.udc.es/moodle   |        |  |           |         |
| General description      | Nesta asignatura ampliaranse os conceptos matemáticos estudados nos graos de enxeñaría. Así, traballárase con curvas e superficies, comprendendo a súa xeometría e os elementos que a describen xunto coas ferramentas que usamos habitualmente para estudialas. Introdúcirose conceptos básicos de cálculo tensorial e a súa aplicación na formulación e estudo de ecuacións en derivadas parciais que aparecen na física e na enxeñaría |        |  |           |         |

## Study programme competences / results

| Code | Study programme competences / results   |
|------|---|
| B1   | Posuír e comprender coñecementos que acheguen unha base ou oportunidade de ser orixinais no desenvolvemento e/ou aplicación de ideas, a miúdo nun contexto de investigación   |
| B2   | Que os estudantes saiban aplicar os coñecementos adquiridos e a súa capacidade de resolución de problemas en ámbitos novos ou pouco coñecidos dentro de contextos máis amplos (ou multidisciplinares) relacionados coa súa área de estudo   |
| B3   | Que os estudantes sexan capaces de integrar coñecementos e enfrontarse á complexidade de formular xuízos a partir dunha información que, sendo incompleta ou limitada, inclúa reflexións sobre as responsabilidades sociais e éticas vinculadas á aplicación dos seus coñecementos e xuízos |
| B4   | Que os estudantes saiban comunicar as súas conclusións e os coñecementos e razóns últimas que as sustentan a públicos especializados e non especializados dun modo claro e sen ambigüidades.  |
| B5   | Que os estudantes posúan as habilidades de aprendizaxe que lles permitan continuar estudando dun modo que haberá de ser en boa medida autodirixido ou autónomo.   |
| B6   | Ser capaz de realizar unha análise crítica, avaliación e síntese de ideas novas e complexas.  |

## Learning outcomes

| Learning outcomes  | Study programme competences / results  |
|--|--|
| Knowledge of elementary tensor calculus  | BC1<br>BC2<br>BC3<br>BC4               |
| Ability to work with curves and surfaces and study their geometric properties: curvature, geodesics, ... | BC1<br>BC2<br>BC3<br>BC4<br>BC5<br>BC6 |



|   |                          |
|---|--------------------------|
| Application of tensor calculus to the formulation of partial differential equations from Physics.                                 | BC1<br>BC2<br>BC3<br>BC4 |
| Capability to face typical problems in the context of naval engineering using basic differential geometry of curves and surfaces. | BC1<br>BC2<br>BC5<br>BC6 |

| Contents   |   |
|--|---|
| Topic  | Sub-topic   |
| Curves   | Parametrized curves.<br>Regular curves. Arc length.<br>Curvature. Torsion. Frenet trihedron.<br>Famous curves.  |
| Surfaces   | Parametrized surfaces.<br>Regular surfaces. Tangent plane.<br>First fundamental form. Surface area.<br>Tensor fields. The metric tensor.<br>Second fundamental form.<br>Christoffel symbols.<br>Gauss curvature and mean curvature.<br>Ruled surfaces and minimal surfaces.<br><br>Appendix 1: Einstein notation.<br>Appendix 2: bilinear forms and quadratic forms.  |
| Mathematics of continuum mechanics. Conservations laws | <ul style="list-style-type: none"> <li>- Continuum cinematics</li> <li>- Gradient of strain tensor. Green-Saint Venant Strain tensor</li> <li>- Transformation of areas and volumes</li> <li>- Reynolds theorem of transport.</li> <li>- Mass conservation law.</li> <li>- Law of conservation of momentum</li> <li>- Thermodynamics. Law of conservation of energy</li> <li>- Control volumens and conservation laws</li> </ul>                                      |
| Partial differential equations                         | <ul style="list-style-type: none"> <li>- Partial differential equations. Boundary conditions.</li> <li>- Constitutive laws</li> <li>- Fluid mechanics. Derivation of some important equations in fluid mechanics.</li> <li>Equations for incompressible fluids.</li> <li>- Elastic solids. Cauchy Theorem. Stress and strain tensors. Principal components.</li> <li>Eigenvalues and eigenvectors. Partial differential equations para for elastic solids.</li> </ul> |

| Planning                       |                        |                                      |                               |             |
|--------------------------------|------------------------|--------------------------------------|-------------------------------|-------------|
| Methodologies / tests          | Competencies / Results | Teaching hours (in-person & virtual) | Student?s personal work hours | Total hours |
| Seminar                        | B2 B3 B4 B5 B6         | 15                                   | 15                            | 30          |
| Supervised projects            | B1 B2 B3 B4 B5 B6      | 0                                    | 3                             | 3           |
| Objective test                 | B1 B2 B3 B4 B5 B6      | 3.5                                  | 0                             | 3.5         |
| Guest lecture / keynote speech | B1 B2 B3 B6            | 30                                   | 45                            | 75          |



|   |  |   |   |   |
|---|--|---|---|---|
| Personalized attention  |  | 1 | 0 | 1 |
| (*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. |  |   |   |   |

| Methodologies                  |  |
|--------------------------------|--|
| Methodologies                  | Description  |
| Seminar                        | Technique of group work which purpose is the in-depth study of a subject. It involves discussion, participation, edocuments elaboration and the conclusion reached by all the components of the seminar.   |
| Supervised projects            | Methodology designed to promote autonomous learning of the students, always under the teacher's guide. It is a technique based on the assumption by the students of the responsibility of their learning.<br>This learning technique is based in two basic elements: the autonomous learning and the continuous monitoring of this learning by the teachers. |
| Objective test                 | Written test to assess the obtained competencies. It is an instruments of measure, rigorously developed, that allows to evaluate knowledges, capacities, skills, performances, aptitudes, attitudes, etc.  |
| Guest lecture / keynote speech | Oral presentation complemented with the use of audiovisual media and the introduction of some questions to the students, in order to transmit knowledge and provide learning   |

| Personalized attention |   |
|------------------------|---|
| Methodologies          | Description   |
| Supervised projects    | Along the course several works will be proposed to the students, and that will allow them, in case of obtaining a positive evaluation, to pass the subject. |

| Assessment          |                        |  |               |
|---------------------|------------------------|--|---------------|
| Methodologies       | Competencies / Results | Description  | Qualification |
| Supervised projects | B1 B2 B3 B4 B5 B6      | Students who wish to, can choose a topic from among those proposed by the teachers of the subject. They will do a work on this subject to deepen their concepts and techniques, and that they will have to expose later. This work will be qualified and will allow to pass the subject. | 50            |
| Objective test      | B1 B2 B3 B4 B5 B6      | At the end of the course, these students that have not done the proposed works or that want to obtain a better qualification, will do a written exam in the data fixed by the school.  | 50            |

| Assessment comments  |
|--|
| The works will be corrected and attending to this corrections students will be qualified. If a student does not present the proposed work or if he/she wants to obtain a better qualifications, he/she will be able to give up the obtained qualification and do the final exam. |

| Sources of information |   |
|------------------------|---|
| Basic                  | <ul style="list-style-type: none"> <li>- Manfredo P. do Carmo (1995). Geometría diferencial de curvas y superficies. Alianza Universidad Textos</li> <li>- Rutherford Aris (1962). Vectors, tensors, and the basic equations of fluid mechanics.. Prentice-Hall</li> <li>- José A. Pastor González, M<sup>a</sup> Ángeles Fernández Cifre (2010). Un curso de geometría diferencial. Consejo Superior de Investigaciones Científicas</li> <li>- Alexandre J. Chorin, Jerrold E. Marsden. (2000). A Mathematical Introduction to Fluid Mechanics. Texts in Applied Mathematic, Springer</li> <li>- M. Gurtin (1981). An introduction to continuum mechanics. Academic Press</li> <li>- M. Gurtin, Eliot Fried, Lallit Anand (2010). The mechanics and thermodynamics of continua. Cambridge</li> </ul> |
| Complementary          |   |

| Recommendations                                      |
|--|
| Subjects that it is recommended to have taken before |



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| 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.