



## Teaching Guide

Identifying Data				2016/17
Subject (*)	Matemáticas 1	Code	631G02151	
Study programme	Grao en Tecnoloxías Mariñas			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	First	FB	6
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Métodos Matemáticos e de Representación			
Coordinador	Rodríguez Aros, Angel Daniel	E-mail	angel.aros@udc.es	
Lecturers	Rodríguez Aros, Angel Daniel	E-mail	angel.aros@udc.es	
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General description	<p>This course is devoted to the study of the basic results and applications of classical subjects in mathematics: Linear Algebra, Euclidean Geometry, Functional Analysis and Complex Variable. The student will learn to use these specific mathematical tools, but also they will improve their skills in developing new methods and acquiring new technologies, to consult bibliographic references and online resources, to elaborate a memory in a rigorous and systematic 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>			

## Study programme competences / results

Code	Study programme competences / results
A12	CE12 - Interpretar e representar correctamente o espazo tridimensional, coñecendo os obxectivos e o emprego dos sistemas de representación gráfica.
A14	CE14 - Avaliación cualitativa e cuantitativa de datos e resultados, así como a representación e interpretación matemáticas de resultados obtidos experimentalmente.
A17	CE17 - Modelizar situacións e resolver problemas con técnicas ou ferramentas físico-matemáticas.
B1	CT1 - Capacidad para gestionar los propios conocimientos y utilizar de forma eficiente técnicas de trabajo intelectual
B2	CT2 - Resolver problemas de forma efectiva.
B3	CT3 - Comunicarse de xeito efectivo nun ámbito de traballo.
B4	CT4 - Traballar de forma autónoma con iniciativa.
B5	CT5 - Traballar de forma colaboradora.
B6	CT6 - Comportarse con ética e responsabilidade social como cidadán e como profesional.
B7	CT7 - Capacidade para interpretar, seleccionar e valorar conceptos adquiridos noutras disciplinas do ámbito marítimo, mediante fundamentos físico-matemáticos.
B8	CT8 - Versatilidade.
B9	CT9 - Capacidade para a aprendizaxe de novos métodos e teorías, que lle doten dunha gran versatilidade para adaptarse a novas situacións.
B10	CT10 - Comunicar por escrito e oralmente os coñecementos procedentes da linguaxe científica.
B11	CT11 - Capacidade para resolver problemas con iniciativa, toma de decisións, creatividade, razoamento crítico e de comunicar e transmitir coñecementos habilidades e destrezas.
C1	C1 - Expresarse correctamente, tanto de forma oral coma escrita, nas linguas oficiais da comunidade autónoma.
C3	C3 - 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.
C5	C5 - Entender a importancia da cultura emprendedora e coñecer os medios ao alcance das persoas emprendedoras.
C6	C6 - Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C7	C7 - Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.
C8	C8 - Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.



C9	CB1 - Demostrar que posúen e comprenden coñecementos na área de estudo que parte da base da educación secundaria xeneral, e que inclúe coñecementos procedentes da vangardia do seu campo de estudo
C10	CB2 - Aplicar os coñecementos no seu traballo ou vocación dunha forma profesional e poseer competencias demostrables por medio da elaboración e defensa de argumentos e resolución de problemas dentro da área dos seus estudos
C11	CB3 - Ter a capacidade de reunir e interpretar datos relevantes para emitir xuícios que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética
C12	CB4 - Poder transmitir información, ideas, problemas e solucións a un público tanto especializado como non especializado.
C13	CB5 - Ter desenvolvido aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores con un alto grao de autonomía.

Learning outcomes			
Learning outcomes	Study programme competences / results		
		A12 A14 A17	
		B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11	
			C1 C3 C5 C6 C7 C8 C9 C10 C11 C12 C13

Contents	
Topic	Sub-topic



Lesson 1.- Vector Space	<ul style="list-style-type: none"><li>1.1.- Vector space. Definition. Examples and Properties</li><li>1.2.- Vector subspace.</li><li>1.3.- System of Generators of a Subspace</li><li>1.4.- Linear Independence</li><li>1.5.- Basis of a Vector Space. Finite Dimensional Spaces.</li><li>1.6.- Change of Basis in a Vector Space</li><li>1.7.- Union and Intersection of Subspaces</li><li>1.8.- Sum of Subspaces. Direct sum. Supplementary Subspaces.</li><li>1.9.- Product of Vectorial Spaces</li></ul>
Lesson 2.- Linear Functions. Matrices.	<ul style="list-style-type: none"><li>2.1.- Linear Function: Definition, Examples, Properties and Types of Linear Functions.</li><li>2.2.- Kernel and Image of a Linear Function.</li><li>2.3.- Existence and obtention of an Associated Matrix to a Linear Function.</li><li>2.4.- Addition of Linear Functions. Product by a Scalar. Associated Matrices.</li><li>2.5.- Vector Spaces of Matrices</li><li>2.6.- Composition of Linear Functions. Associated Matrix.</li><li>2.7.- Product of Matrices. Ring of Square Matrices</li><li>2.8.- Some Particular Types of Matrices</li><li>2.9.- Transpose Matrix. Symmetric, Antisymmetric and Orthogonal Matrices.</li><li>2.10.- Matrices of Complex Elements.</li></ul>
Lesson 3.- Determinants.	<ul style="list-style-type: none"><li>3.0.- Permutations. Class of a Permutation.</li><li>3.1.- Determinant of a Square Matrix. Sarrus Rule.</li><li>3.2.- Properties of Determinants.</li><li>3.3.- Methods for Calculation of Determinants. Cofactor Matrix.</li><li>3.4.- Product of Determinants.</li><li>3.5.- Some Particular Examples of Determinants.</li><li>3.6.- Reverse Matrix.</li><li>3.7.- Rank of a Matrix.</li><li>3.8.- Rank of a System of Vectors</li><li>3.9.- Expression of the Change of Base of a Vectorial Space in shape Matrix</li></ul>
Lesson 4.- Systems of Linear Equations.	<ul style="list-style-type: none"><li>4.1.- Definitions. Classification. Matrix notation.</li><li>4.2.- Equivalent systems.</li><li>4.3.- System of Cramer. Rule of Cramer</li><li>4.4.- General System of Linear Equations. Theorem of Rouché-Frobenius</li><li>4.5.- Homogeneous Systems.</li><li>4.6.- Methods of Resolution by Reduction. Gauss' Method.</li></ul>
Lesson 5.- Matrix Diagonalization.	<ul style="list-style-type: none"><li>5.1.- Eigenvectors and Eigenvalues. Properties.</li><li>5.2.- Characteristic polynomial. Properties.</li><li>5.3.- Diagonalizable Matrices. Diagonalization.</li><li>5.4.- Diagonalization Of Symmetric Matrices.</li></ul>
Lesson 6.- Affine Space E3. Problems of Incidence and Parallelism.	<ul style="list-style-type: none"><li>6.1.- Affine Space Associated to a Vector Space. System of Reference. Coordinates.</li><li>6.2.- Equations of Straight Lines.</li><li>6.3.- Relative positions of Straight Lines.</li><li>6.4.- Equations of a Plane.</li><li>6.5.- Relative positions of Planes. Bundles of Planes.</li><li>6.6.- Relative positions of Straight Lines and Planes.</li></ul>



Lesson 7.- Euclidean Vector Spaces. Scalar product, Vector product. Mixed Product.	<p>7.1.- Scalar product</p> <p>7.2.- Determination of a Scalar Product. Gram Matrix.</p> <p>7.3.- Euclidean Vector Space. Definition.</p> <p>7.4.- Norm of a Vector. Relevant Equalities and Inequalities.</p> <p>7.5.- Angle of two Vectors. Orthogonality.</p> <p>7.6.- Orthonormal Basis. Expression of the Scalar Product in an Orthonormal Basis.</p> <p>7.7.- Euclidean Space <math>E^3</math>.</p> <p>7.8.- Orientation in <math>E^3</math>.</p> <p>7.9.- Vector product in <math>R^3</math> . Properties. Analytical expression.</p> <p>7.10.- Mixed product. Analytical expression. Geometrical interpretation.</p> <p>7.11.- Combined Products.</p>
Lesson 8.- Metric Problems in Euclidean Spaces.	<p>8.1.- Normal equation of a Plane.</p> <p>8.2.- Angles between Linear Manifolds in <math>R^3</math>: Angle of Two Planes, Angle of Two Straight Lines, Angle of Straight Line and Plane.</p> <p>8.3.- Distance between Linear Manifolds in <math>R^3</math>: Distance of a Point to a Plane, Distance of a Point to a Straight Line. Distance between two Planes, Distance between Straight Line and Plane. Distance between two Straight Lines. Common Perpendicular to two Straight Lines.</p> <p>8.4.- Cylindrical coordinates and Spherical coordinates in <math>R^3</math>.</p>
Lesson 9.-Real valued functions of a Real Variable. Continuity.	<p>9.1.- Basic definitions.</p> <p>9.2.- Functional limits.</p> <p>9.3.- Continuity. Types of Discontinuity.</p> <p>9.4.- Properties and Theorems on Continuous Functions.</p>
Lesson 10.- Differentiability and Applications of the Derivatives.	<p>10.1.- Derivative and Differential of a Function in a Point. Geometrical meaning.</p> <p>10.2.- Properties and Calculation of Derivatives.</p> <p>10.3.- Derivative function. Successive derivatives.</p> <p>10.4.- Applications of the Derivatives to the Local Study of a Function: Growth and Decreasing. Maxima and Minima. Concavity and Convexity. Inflection points.</p> <p>10.5.- Theorems of Rolle and Mean Value Theorem.</p> <p>10.6.- Rules of L'Hôpital</p>
Lesson 11.- Theorem of Taylor. Applications.	<p>11.1.- Expression of a Polynomial by means of his Derivatives in a Point.</p> <p>11.2.- Polynomial and Theorem of Taylor. Formulae of Taylor and Mac Laurin.</p> <p>11.3.- Expression of Lagrange for the Residual. Bounds for the residual.</p> <p>11.4.- Applications to the Local Study of a Function: Monotonicity. Extremal values. Concavity and Convexity. Inflection points.</p>
Lesson 12.- Graphic representation of Real Valued Functions.	<p>12.1.- Domain and Continuity</p> <p>12.2.- Symmetries</p> <p>12.3.- Periodicity.</p> <p>12.4.- Intersection with the coordinates axis.</p> <p>12.5.- Use of successive derivatives and applications: Monotonicity. Extremal values. Concavity and Convexity. Inflection points.</p> <p>12.6.- Asymptotes and Parabolic Branches</p>
Lesson 13.- Sequences and Series.	<p>13.1.- General definitions. Types of Sequences.</p> <p>13.2.- Practical calculation of Limits</p> <p>13.3.- General definitions. Main Types of Numerical Series.</p> <p>13.4.- Properties of the Numerical Series. Criteria of Convergence for Series of Positive Terms.</p> <p>13.5.- Series of Positive and Negative Terms. Alternated Series.</p>



Lesson 14.- Functional Sequences and Series. Series of powers.	14.1.- General definitions. 14.2.- Series of Powers. Convergence. 14.3.- Series expansions. 14.4.- Series of Taylor and Mac Laurin. 14.5.- Binomial Series. 14.6.- Method of the Undetermined Coefficients.
Lesson 15.- Indefinite integration of Functions of a Real Variable	15.1.- General definitions. Table of Primitives. 15.2.- Immediate integration 15.3.- Integration by Parts 15.4.- Integration of Rational Functions 15.5.- Integration by Replacement or Change of Variable
Lesson 16.- Definite Integration. Applications.	16.1.- General definitions 16.2.- Properties 16.3.- Mean Value Theorem. Barrow's Rule. 16.4.- Evaluation of Definite Integrals. 16.5.- Improper Integral. 16.6.- Applications of the Definite Integral
Lesson 17.- Complex Numbers	17.1.- General definitions 17.2.- Fundamental operations 17.3.- Powers and Roots 17.4.- Exponential form of a Complex 17.5.- Logarithms And Complex Powers.

Planning

Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Problem solving	A12 A14 A17 B1 B2 B3 B4 B5 B7 B8 B9 B10 B11 C3 C6 C7 C8 C9 C10 C11 C12 C13	6	24	30
Guest lecture / keynote speech	A12 A14 A17 B1 B2 B3 B4 B5 B6 B7 B9 C1 C3 C5 C7 C8	24	24	48
Objective test	A12 A14 A17 B1 B2 B3 B4 B6 B7 B8 B10 B11 C1 C3 C5 C6 C8	4	0	4
Document analysis	A12 A17 B1 B3 B4 B5 B7 B8 B9 B11 C3	0	2	2
Collaborative learning	A12 A14 A17 B1 B2 B3 B5 B6 B7 B8 B9 B10 B11 C1 C3 C5 C6 C7 C8	9	9	18
Supervised projects	A12 A14 A17 B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 C1 C3 C5 C6 C7 C8	4	20	24



Online discussion	A12 A14 A17 B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 C1 C3 C5 C6 C7 C8	0	6	6
Directed discussion	A12 A14 A17 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 C1 C5 C6 C7 C8	2	0	2
Diagramming	A14 A17 B1 B2 B4 B5 B7 B8 B9 B10 C9 C11 C12	2	4	6
Introductory activities	A12 A14 A17 B1 B4 B6 B7 B9 B10 C1 C3 C5 C6 C7	3	3	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
Problem solving	En cada tema, vanse propoñer exercicios para resolver.
Guest lecture / keynote speech	Exposición na aula dos conceptos fundamentais.
Objective test	Proba de coñecementos.
Document analysis	Seleccionar libros e páxinas web a utilizar
Collaborative learning	Traballo en grupo con exposición dos resultados no seu caso
Supervised projects	Traballos propostos individuais e grupais
Online discussion	Plantexar e resolver dudas en Moodle
Directed discussion	Discusión na aula do plantexado previamente en Moodle ou en clase.
Diagramming	Facer esquemas
Introductory activities	Tema 0: Conceptos básicos que se deben recordar

Personalized attention	
Methodologies	Description
Supervised projects Collaborative learning Guest lecture / keynote speech Problem solving	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 / Results	Description	Qualification
Directed discussion	A12 A14 A17 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 C1 C5 C6 C7 C8	Participación nos debates na aula. Se avaliarán as competencias A12, A14, A17, B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, C1, C3, C5, C6, C7 y C8.	5



Supervised projects	A12 A14 A17 B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 C1 C3 C5 C6 C7 C8	Traballos propostos. Se avaliarán as competencias A12, A14, A17, B1, B2, B4, B6, B7, B8, B9, B10, B11, C1, C5, C6, C7 y C8.	10
Collaborative learning	A12 A14 A17 B1 B2 B3 B5 B6 B7 B8 B9 B10 B11 C1 C3 C5 C6 C7 C8	Participación en traballos grupais. Se avaliarán as competencias A12, A14, A17, B1, B2, B5, B6, B7, B8, B9, B10, B11, C1, C6, C7 y C8.	5
Objective test	A12 A14 A17 B1 B2 B3 B4 B6 B7 B8 B10 B11 C1 C3 C5 C6 C8	Comprobación dos coñecementos e capacidade de resolución de problemas. Se avaliarán as competencias A12, A14, A17, B1, B2, B5, B6, B7, B8, B9, B10, B11, C1, C6, C7 y C8.	70
Problem solving	A12 A14 A17 B1 B2 B3 B4 B5 B7 B8 B9 B10 B11 C3 C6 C7 C8 C9 C10 C11 C12 C13	Resolver problemas. Se avaliarán as competencias A12, A14, A17, B1, B2, B4, B5, B6, B8, B9, B10, B11, C1, C3, C6, C7 y C8.	10

### Assessment comments

The students that do not participate in the EEES will be evaluated through an Objective Proof that will constitute 100% of the evaluation.

The course is divided in two parts: Part 1 (lessons 1-8) and part 2 (lessons 9-17). 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.

In the unlikely case to reach 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 criteria of evaluation contemplated in the framewor A-III/1 and A-III/2 of the Code STCW and his amendments related with this matter have been taken into account for the design of this qualification methodology.

### Sources of information

<b>Basic</b>	<ul style="list-style-type: none"> <li>- García Gómez - Gutiérrez Castro (). ALGEBRA LINEAL. Pirámide</li> <li>- Granero, F (). ALGEBRA Y GEOMETRÍA ANALÍTICA . Mac Graw-Hill</li> <li>- Fernández Viña, J.A (). ANÁLISIS MATEMÁTICO I . Tecnos</li> <li>- Granero, F. (). CÁLCULO . Mac Graw-Hill</li> <li>- García , A.y otros. (). CÁLCULO I (Teoría y Problemas) . Librería I.C.A.I</li> <li>- Fernández Viña, J.A (). EJERCICIOS Y COMPLEMENTOS DE ANÁLISIS MATEMÁTICO I. Tecnos</li> <li>- Granero, F. (). EJERCICIOS Y PROBLEMAS DE CÁLCULO (I y II) . Tébar Flores</li> <li>- García Gómez - Gutiérrez Castro. (). GEOMETRÍA . Pirámide</li> <li>- Villa, A. de la (). PROBLEMAS DE ALGEBRA LINEAL. GLAGSA</li> </ul>
<b>Complementary</b>	

### Recommendations

Subjects that it is recommended to have taken before

Subjects that are recommended to be taken simultaneously

Subjects that continue the syllabus

Other comments



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