UNIVERSIDADE DA CORUÑA

Teaching Guide					
Identifying Data					2021/22
Subject (*)	Álxebra lineal II			Code	632G02008
Study programme	Grao en Tecnoloxía da Enxeñaría Civil				
Descriptors					
Cycle	Period	Year		Type	Credits
Graduate	2nd four-month period	First		Basic training	6
Language	Spanish				
Teaching method	Face-to-face				
Prerequisites					
Department	Matemáticas				
Coordinador	Fuentes Garcia, Luis		E-mail	luis.fuentes@udc.es	
Lecturers	Colominas Ezponda, Ignasi Fuentes Garcia, Luis Taboada Vazquez, Raquel		E-mail	ignacio.colominas@udc.es luis.fuentes@udc.es raquel.taboada@udc.es	
Web	caminos.udc.es/info/asignaturas/grado_tecic/101/AL2/index.html				
General description	The aim of the course is to provide a solid background in linear algebra and mathematical foundation engineering. This second part of the course focuses on studying the geometrical applications of the theory of vectorial spaces.				

Contingency plan	1. Modifications to the contents: No changes. 2. Methodologies. *Teaching methodologies that are maintained: The same methodologies are maintained, with a slight difference in two of them indicated in the next point. *Teaching methodologies that are modified: The master sessions and problem solving seminars will be held online through the Microsoft Teams platform. In addition, 13 hours of master sessions will be replaced by problem solving seminars. Moreover, these will be complemented with the publication of explanatory videos. 3. Mechanisms for personalized attention to students: Teams and e-mail. Every day at the student's request. 4. Modifications in the evaluation: Written test (synchronous). (75%). Exam where concepts are methods of the subjet are evaluated. Problem solving (asynchronous). (25%). A set of problems and works are proposed to practice the contents of each topic. The student has a period of several days to solve them. *Evaluation observations: The written test will be done through Moodle. The development of it will be monitored through Teams. In the case that a student has unsolvable connection problems during the test, an alternative date will be agreed individually with the affected person. 5. Modifications to the bibliography or webgraphy: No changes.

Study programme competences	
Code	Study programme competences
A1	Capacidad para plantear y resolver los problemas matemáticos que puedan plantearse en el ejercicio de la profesión. En particular, conocer, entender y utilizar la notación matemática, así como los conceptos y técnicas del álgebra y del cálculo infinitesimal, los métodos analíticos que permiten la resolución de ecuaciones diferenciales ordinarias y en derivadas parciales, la geometría diferencial clásica y la teoría de campos, para su aplicación en la resolución de problemas de Ingeniería Civil.
B1	Que los estudiantes hayan demostrado poseer y comprender conocimientos en un área de estudio que parte de la base de la educación secundaria general, y se suele encontrar a un nivel que, si bien se apoya en libros de texto avanzados, incluye también algunos aspectos que implican conocimientos procedentes de la vanguardia de su campo de estudio
B2	Que los estudiantes sepan aplicar sus conocimientos a su trabajo o vocación de una forma profesional y posean las competencias que suelen demostrarse por medio de la elaboración y defensa de argumentos y la resolución de problemas dentro de su área de estudio
B3	Que los estudiantes tengan la capacidad de reunir e interpretar datos relevantes (normalmente dentro de su área de estudio) para emitir juicios que incluyan una reflexión sobre temas relevantes de índole social, científica o ética
B4	Que los estudiantes puedan transmitir información, ideas, problemas y soluciones a un público tanto especializado como no especializado
B5	Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía

B6	Resolver problemas de forma efectiva.
B7	Aplicar un pensamiento crítico, lógico y creativo.
B8	Trabajar de forma colaborativa.
B10	Comunicarse de manera efectiva en un entorno de trabajo.
B15	Claridad en la formulación de hipótesis.
B16	Capacidad de autoaprendizaje mediante la inquietud por buscar y adquirir nuevos conocimientos, potenciando el uso de las nuevas tecnologías de la información y así poder enfrentarse adecuadamente a situaciones nuevas.
B17	Capacidad para aumentar la calidad en el diseño gráfico de las presentaciones de trabajos.
B18	Capacidad para aplicar conocimientos básicos en el aprendizaje de conocimientos tecnológicos y en su puesta en práctica.
B19	Capacidad de realizar pruebas, ensayos y experimentos, analizando, sintetizando e interpretando los resultados.
C1	Expresarse correctamente, tanto de forma oral como por escrito, en las lenguas oficiales de la comunidad autónoma.
C2	Dominar la expresión y la comprensión de forma oral e escrita de un idioma extranjero.
C3	Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de la vida.
C4	Desarrollarse para el ejercicio de una ciudadanía abierta, culta, crítica, comprometida, democrática y solidaria, capaz de analizar la realidad, diagnosticar problemas, formular e implantar soluciones basadas en el conocimiento y orientadas al bien común.
C6	Valorar críticamente el conocimiento, la tecnología y la información disponible para resolver los problemas con que deben enfrentarse.
C7	Asumir como profesional y ciudadano la importancia del aprendizaje a lo largo de la vida.
C8	Valorar la importancia que tiene la investigación, la innovación y el desarrollo tecnológico en el avance socioeconómico y cultural de la sociedad.

Learning outcomes			
Learning outcomes	Study programme competences		
To know and to understand the basic theory of linear algebra required in civil engineering , especially the geometric applications of vector spaces.	A1	B1 B6 B7 B8 B15	C3 C7
Know, understand and manage elementary mathematical notation.	A1	B1 B3 B5 B6 B7 B18	C1 C3 C6
Learn to express with precision and rigor.	A1	B4 B7 B10 B17	C1 C2
Learn to use the basic techniques of mathematical reasoning.	A1	B2 B3 B6 B7	C1
Understanding the importance of justifying the thesis and results in science	A1	B1 B3 B16 B19	C4 C6
Develop critical thinking and analytical skills .	A1	B2 B3 B7	C1 C4 C8

Learn to pose and solve mathematical problems of Linear Algebra.	A1	B2 B3 B6 B7 B8 B10 B15	C1

Contents	
Topic	**Sub-topic**
Bilinear maps and homogenous tensors.	1. Bilinear maps and quadratic forms. 1.1 Bilinear maps. 1.2 Bilinear forms. 1.3 Quadratic forms. 1.4 Real quadratic forms. 2. Homogenous tensors and duality. 2.1 Duality. 2.2 Homogenous tensor. 2.3 Operations with homogenous tensors. 2.4 Simmetry and skewsimmetry.
Euclidean vectorial spaces.	1. Introduction to euclidean spaces. 1.1 Scalar product. 1.2 Norm of a vector. Properties. 1.3 Angle between two vectors. 2. Orthogonality. 2.1 Orthogonal vectors. 2.2 Orthogonal systems. Gram-Schmidt method. 2.3 Singularties of orthonormal basis. 2.4 Orthogonal projection. 2.5 Symmetric endomorphisms. 3. Orthogonal maps. 3.1 Definition. 3.2 Properties. 3.3 Eigenvalues and eigenvectors of an orthogonal map. 3.4 Orientation of a basis 3.5 Inverse and direct orthogonal maps. 3.6 Classiication of orthogonal maps in two and three dimensions. 4. Vectorial product and triple product. 4.1 Definition. 4.2 Properties.

Affine geometry.	1. Affine space. 1.1 Definition and properties. 1.2 System of reference. 1.3 Affine varieties. 1.4 Pencils of affine varietes. 1.5 Distances and angles between affine varieties. 1.6 Affine transformations. 2. Projective space. 2.1 Introduction. 2.2 Homogeneous coordinates. 2.3 Proper points and points at infinity. 2.4 Reference change in homogeneous coordinates. 2.5 Equations of affine varieties in homogeneous coordinates.
Conics and quadric surfaces.	1. Conics. 1.1 Definition and equations. 1.2 Intersections of a conic and a line. 1.3 Polarity. 1.4 Important potins and lines of a conic. 1.5 Description of nondegenerated conics: ellipse, parabola e hyperbola. 1.6 Change of reference. 1.7 Classification of conics. Reduced equation. 1.8. Pencils of conics. 2. Quadric surfaces. 2.1 Definition and equations. 2.2 Intersections of a quadric surface and a line. 2.3 Polarity. 2.4 Change of reference. 2.5 Important potins, lines and planes of a quadric surface. 2.6 Classification of quadric surfaces. Reduced equation. 2.7 Description of quadric surfaces of rank 3 and 4.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 B2 B3 C1	27	32	59
Seminar	A1 B2 B3	27	33	60
Mixed objective/subjective test	A1 B2 B3	3	3	6
Workbook	A1 B2 B3	0	10	10
Problem solving	A1 B2 B3	0	10	10
Personalized attention		5	0	5
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description

Guest lecture / keynote speech	New mathematic concepts will be developed from examples familiar for the students, or explaining the questions are wished to be solved with them; from this their common caracthers will be abstracted causing its more accuracy deffinition. The theory which allows to solve the questions described at the beginning will be developed after. Students participation is desirable, sharing their doubts or comments as the class progresses.
Seminar	Simultaneously to the theoretical development of the matter collections of exercics are given. The goal is allowing students to practise the knowledge adquierd at theorical classes. At seminars the most important problems will be discussed.
Mixed objective/subjective test	Exam where concepts are methods of the subjets are evaluated.
Workbook	Before the beginning of each item, some notes about the contents are avaiable for the students. The notes are intended as a complement of teacher's explanations. A previous reading of students familiarize them with an outline of what they will study.
Problem solving	Each student must solve individually some of the proposed problems.

Personalized attention	
Methodologies	**Description**
Problem solving Guest lecture / keynote speech Seminar	We recommend using tutorials to ask any question regarding the subject, both theoretical and practical aspects.

Assessment			
Methodologies	**Competencies**	**Description**	**Qualification**
Problem solving	A1 B2 B3	Each student must solve individually some of the proposed problems.	20
Mixed objective/subjective test	A1 B2 B3	Exam where concepts are methods of the subjets are evaluated.	80
Others			

Assessment comments

Sources of information	
Basic	- Juan de Burgos (2000). Álgebra Lineal. McGraw-Hill - Fuentes, Salete y Cruces (1980). Álgebra vectorial y Tensorial. ETSICCP Madrid - F. Granero (1992). Álgebra y Geometría Analítica. McGraw-Hill - Luis Fuentes García (2005-). Apuntes y ejemplos (http://caminos.udc.es/info/asignaturas/101/index.html). A Coruña - A. de la Villa (1994). Problemas de Álgebra. CLAGSA - Anzola, Caruncho y Pérez-Canales (1981). Problemas de Álgebra (Tomos 6,7). Madrid Â

Complementary	- S.I. Grossman (1995). Álgebra lineal. McGraw-Hill - J. Rojo (2001). Álgebra lineal. McGraw-Hill - M. Castellet e I. Llerena (1991). Álgebra lineal y geometría. Reverté - J. Rojo e I. Martín (1994). Ejercicios y problemas de álgebra. McGraw-Hill - M. García Galludo y otros (1984). Problemas de álgebra y analítica. Madrid - F. González Posada (1971). Problemas de estructuras algebraicas tensoriales. Madrid

Recommendations
Subjects that it is recommended to have taken before
Cálculo infinitesimal I/632G02001 Álxebra lineal I/632G02007
Subjects that are recommended to be taken simultaneously
Cálculo infinitesimal II/632G02002
Subjects that continue the syllabus
Fundamentos de mecánica computacional/632G02015 Ecuacións diferenciais/632G02017
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.