IDENTIFYING DATA
Mathematics: Algebra and statistics

Subject	Mathematics: Algebra and statistics
Code	P52G382V01104
Study programme	Grado en Ingeniería Mecánica

Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Basic education	1st	2nd

Teaching language	Spanish
Department	
Coordinator	González Coma, José Pablo
Lecturers	Álvarez Hernández, María Cores Carrera, Débora González Coma, José Pablo González-Cela Echevarría, Gerardo
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General description	The objective of this subject is that the student acquires knowledge of the basic techniques of Linear Algebra and Statistics that are required in other subjects that must be taken later in the degree.

Training and Learning Results

Code	
B3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
C1	Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial differential equations, numerical methods, numerical algorithms, statistics and optimization.
D2	Problems resolution.
D5	Information Management.
D6	Application of computer science in the field of study.
D9	Apply knowledge.

Expected results from this subject

Expected results from this subject	Training and Learning Results		
Acquire the basic knowledge of matrices, vectorial spaces, and linear applications.	B3	C1	
Manage matrix calculus operations and, using this knowledge, solve problems related to linear equations systems.	B3	C1	D2
Understand the basics of eigenvectors and eigenvalues, vector spaces with a scalar product and quadratic forms used in other subjects, and solve basic problems related to these topics.	B3	C1	D2 D9
Acquire knowledge of database handling and exploratory analysis.	B3	C1	D5
Being able to model uncertainty scenarios through the calculation of probabilities.	B3	C1	D2
Knowing the basic statistical techniques and models in their application to the industrial field and performing inferences from data samples.	B3	C1	D2 D5 D9
Using software tools to solve problems related to the contents of the subject.	B3		D2 D6
ENAEE learning outcome: KNOWLEDGE AND UNDERSTANDING: LO1.1- Knowledge and understanding of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes [Intermediate (2)].	B3	C1	

ENAEE learning outcome: ENGINEERING ANALYSIS: LO2.2.- Ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical - societal, health and safety, environmental, economic and industrial - constraints [Intermediate (2)].	C1	D2 D9
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.2.- Practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study [Basic (1)].		D2 D9
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.1.- Ability to effectively communicate information, ideas, problems and solutions in the engineering field and with society in general [Intermediate (2)].		D5
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.2.- Ability to function effectively in a national and international context, as an individual and as a member of a team and to cooperate effectively with engineers and non-engineers [Intermediate (2)].		D5

Contents

Topic	
Topic 1 (Algebra). Matrices and systems of linear equations	Matrices. Operations. Elementary matrices. Echelon and reduced echelon forms. Rank of a matrix. Invertible matrices. Calculation of the inverse matrix. Determinant of a square matrix. Properties and calculation. Homogeneous and non-homogeneous systems. Existence of solutions.
Topic 2 (Algebra). Vectorial spaces and linear applications	Vector space and subspace. Generator systems. Linear independence. Basis and dimension. Systems of coordinates. Change of basis. Linear applications. Associated matrix. Kernel and rank of a linear application.
Topic 3 (Algebra). Eigenvalues and eigenvectors	Eigenvalues and eigenvectors. Characteristic equation. Diagonalizable matrices. Characteristic polynomial. Cayley-Hamilton theorem. Matrix functions. Exponential matrix of a square matrix.
Topic 4 (Algebra). Vectorial spaces with scalar product. Quadratic forms	Vector spaces with scalar product. Orthogonality. Orthonormal basis. Gram-Schmidt orthogonalization procedure. Orthogonal diagonalization of symmetric matrices. Real quadratic forms. Classification. Sylvester criterion.
Topic 1 (Statistics). Descriptive statistic and regression	Concept and uses of statistics. Variables and attributes. Types of variables. Representations and charts. Measures of location or position. Measures of dispersion. Analysis of bivariant data. Linear regression. Correlation.
Topic 2 (Statistics). Probability	Concept and properties. Conditioned probability and independence of events. Bayes Theorem.
Topic 3 (Statistics). Discrete and continuous random variables	Concept. Types. Probability distribution function of a random variable. Discrete and continuous random variables. Characteristics of a random variable. Remarkable distributions: Binomial, geometric, Poisson, hypergeometric, uniform, exponential, normal. Central limit theorem
Topic 4 (Statistics). Statistical inference	General concepts. Sampling distributions. Estimation. Confidence interval estimate. Hypothesis testing.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	42	42	84
Problem solving	18	14	32
Practices through ICT	4	4	8
Project based learning	4	4	8
Mentored work	14	0	14
Seminars	25	20	45
Problem and/or exercise solving	4	4	8
Essay questions exam	12	14	26

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	The lecturer will present the contents of the subject in the theoretical sessions. The students will be able to consult bibliographical references for the development of the course as well as the notes of the course.
Problem solving	In the problem sessions, the lecturer will solve problems and model exercises. The student will have a copy of the solutions of all the exercises that are realized or proposed in these lessons.
Practices through ICT	In the laboratory sessions, the software tools Matlab and Excel will be used to apply the concepts presented in the theory sessions to practical scenarios. The student will be provided with notes and practice guides.
Project based learning	This Matlab laboratory practices are about developing a realistic project that solves a practical problem. A predefined guide will be used and a product that responds to the requirements will be obtained.
Mentored work	In the group tutorials (internally called seminars), the student will have the possibility to raise doubts about the subject that will be solved by the lecturer. Additionally, these sessions can be used to solve doubts related to the laboratory practices.
Seminars	An intensive course of 25 hours is organized for those students who have failed the subject at the first call, prior to the exam in the second call.

Personalized assistance

Methodologies	Description
Lecturing	In the lecture sessions, the faculty members will resolve any doubts raised by the students regarding the theoretical concepts presented at that time.
Problem solving	In the sessions for the resolution of exercises and problems, the lecturer will answer in a personalized way the doubts raised by the students.
Practices through ICT	In the sessions devoted to the realization of computer practices, the lecturer will answer in a personalized way the doubts raised by the students.
Seminars	In the intensive course, the lecturer will answer the doubts of the students in a personalized way, suggesting complementary exercises or other types of activities that will help the students to make the best use of the sessions.
Mentored work	In the mentored work sessions, the lecturer will answer in a personalized way the doubts of the students, proposing complementary exercises or any other kind of activities that will result in the best use of the classes of the students. These sessions are organized according to the schedule that will be published on the web page of the center, and through telematic means (e-mail, videoconference, Moovi forums, etc.) by appointment.
Project based learning	In the project based learning sessions, the lecturer will address any doubts that may arise regarding the objectives of the project, the application of the theoretical foundations for the proposed scenario, or in relation to the use of the tool. These questions will be addressed in a personalized way for each student.

Assessment

	Description	Qualification	Training and Learning Results		
Problem and/or exercise solving	Algebra Block. Two partial exams of Topics 1 and 2 will be done (30%). Algebra practice exam with Matlab (15%). Complementary activities of Algebra exercises (15%). Statistics Block. Two partial exams of Topics 1 and 2 will be done (30%). Statistics practice exam with Excel (15%). Complementary activities of Statistics exercises (15%).	60	B3	C1	D2 D5 D6 D9
Essay questions exam	There will be a final exam of continuous evaluation of the Algebra part and the Statistics part. The final exam of continuous evaluation is mandatory and marked out of 10 points.	40	B3	C1	D2 D5 D9

Other comments on the Evaluation

It is necessary to reach 50% of the mark in order to pass the course.

A continuous evaluation mechanism will be used, which it is intended to monitor the student's progress throughout the course, assessing their effort globally. Denoted as EV_CON, the continuous evaluation mark is calculated as follows:

EV_CON = 0.2*T1 + 0.1*P1 + 0.2*T2 + 0.1*P2 + 0.4*PE.

In case the student fails to pass the course in the ordinary call, he/she will have the right to a second evaluation opportunity (extraordinary call) that will take place in the distance mode on the dates established for that purpose by the Master's

Academic Committee. The evaluation will consist in that case in a single written test that will account for 100% of the grade, being necessary to obtain at least 50% to pass the subject.

ACADEMIC INTEGRITY: Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo , as well as point 6 of the fifth rule of Order DEF/711/2022, of July 18th, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces, **any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity**, regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.

In case of any difference between the guides in Galician/Spanish/English related to the evaluation, what is indicated in the teaching guide in Spanish will always prevail.

Sources of information

Basic Bibliography

Lay, David C., **Álgebra lineal y sus aplicaciones**, 4ª, Pearson, 2012

De la Villa, A., **Problemas de Álgebra**, 4ª, CLAGSA, 2010

Cao, Ricardo et al., **Introducción a la Estadística y sus aplicaciones**, 1ª, Pirámide, 2001

Devore, Jay L., **Probabilidad y estadística para ingeniería y ciencias.**, 7ª, Cengage, 2008

Complementary Bibliography

Strang, G., **Álgebra lineal y sus aplicaciones**, 3ª, Addison-Wesley Iber., 2007

Arvesú, J., **Problemas resueltos de Álgebra Lineal**, 1ª, Paraninfo, 2005

Pérez, C., **Estadística aplicada a través de Excel**, 1ª, Pearson, 2002

Canavos, G., **Probabilidad y Estadística. Aplicaciones y Métodos**, 1ª, McGraw-Hill, 2001

Recommendations

Other comments

It is recommended that students of the Algebra and Statistics subject have completed the subject Calculus I and review the properties of trigonometric functions, operations with polynomials, operations with complex numbers and the basic knowledge of statistics corresponding to Bachillerato (equivalent to high school or A levels).