Universidad Rey Juan Carlos

TEACHING GUIDE

Mathematics II

GRADO EN INGENIERÍA BIOMÉDICA (INGLÉS) (1º y 2º curso)

ACADEMIC YEAR 2026-27

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I.-Subject Identification	
Type	FORMACIÓN BÁSICA
Teaching period	1 course, 1Q semester
Nº of credits	6
Language in wich the subject is taught	English

II.-Presentation

Linear algebra is the study of the basic algebraic structure; the vector space. Vector spaces encompass many natural concepts arising in algebra and geometry, and their transformation maps, called linear transformations, allow for the mathematical formulation of a wide variety of models arising in different areas of science and engineering. This course is intended as an introduction to linear algebra. The student will become competent in solving linear equations, performing matrix algebra, calculating determinants, and finding eigenvalues and eigenvectors. On the theoretical side, the student will understand a matrix as a linear transformations relative to a basis of a vector space. The student will become comfortable with the vector space R^n and be exposed to a variety of commonly used vector spaces by working on examples. The student will understand the concept of inner product and orthogonality, and learn how to solve over constrained systems using the method of least squares. Thus, throughout this course, students will gain a solid base of understanding in elementary linear algebra as required for further undergraduate work.

III.-Learning outcomes

COM16. 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. (EURACE 2.2)
CON18. Understand the basic concepts of: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial differen-tial equations, numerical methods, numerical algorithms, statistics, and optimization.
CON20. Knowledge and understanding of the mathematics, computation and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes. (EURACE 1.1)
HAB03. Ability to solve mathematical problems that may arise in engineering. Proficiency in applying knowledge of linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial differential equations, numerical methods, numerical algorithms, statistics, and optimization.
HAB17. Ability to analyse complex engineering products, processes and systems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to correctly interpret the outcomes of such analyses. (EU-RACE 2.1)

- Key for degrees not adapted to RD 822/21: **CB** - basic competences, **CG** - generic competences, **CE** - specific competences, **CT** - transversal competences.
- Key for degrees adapted to RD 822/21: **CON** - knowledge, **COM** - competences, **HAB** - skills.

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IV.-Contents

IV.A.-Syllabus

Chapter 1. Matrices and linear equations Matrices.
Gaussian elimination. Rank. Inverse of a matrix. Determinants
Chapter 2. Vector spaces Linear independence.
Basis. Dimension. Subspaces.
Chapter 3. Linear mappings. Eigenvectors and eigenvalues.
Kernel and image of a linear mapping. Associated matrices of a linear mapping. Diagonalization.
Chapter 4. Scalar products and orthogonality.
Scalar products, orthogonal projection and least squares method. Orthogonal diagonalization of symmetric matrices.

IV.B.-Training activities

Type	Title
Theoretical sessions	Lectures of the contents
Resolution of exercises, problems, case studies	Problem-solving sessions
Realización de Pruebas	Written exams

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V.-Student workload	
Theoretical sessions	32
Resolution of exercises, problems, case studies, etc.	22
Practical sessions in experimental, technological and clinical laboratories, fieldwork, etc.	0
Tests and/or exams	6
Academic tutorials	18
Related activities: conferences, seminars, etc.	30
Preparation of theoretical sessions and self-study	60
Preparation of practical tasks, exercises, case studies, projects, etc.	6
Preparation for tests and/or exams	6
Total student workload	180

VI.-Methodology and academic programme

Type	Period	Content
Theoretical sessions	Week 1 to Week 15	Lectures of the contents
Resolution of exercises, problems, case studies	Week 1 to Week 15	Problem-solving sessions
Tests and/or exams	Week 7 to Week 7	Midterm I
Tests and/or exams	Week 12 to Week 12	Midterm II
Tests and/or exams	Week 15 to Week 15	Final exam
Academic tutorials	Week 1 to Week 15	Individual or group tutoring sessions

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VII.-Assessment methods

The general assessment method is continuous as established in the *Regulation for the Assessment of Learning Outcomes* of Rey Juan Carlos University.
All the assessment systems established in the degree report must be employed, except for those that have a minimum weight of 0%, which can be used by professors in the academic years they consider relevant. Each assessment system may be applied through one or more assessment activities, consistent with the system. No assessment activity can exceed individually 60% of the overall grade for the subject.
The sum of non re-evaluable activities cannot exceed 40% of the overall grade for the subject and, in general, should not have an established minimum grade (except for practical activities in which, strictly speaking, the conditions of the ordinary call cannot be reproduced in the extraordinary call).
Those students who do not manage to pass the subject in the ordinary call, or do not attend this first call, may attend the extraordinary call only for failed re-evaluable assessment activities.
The distribution and characteristics of the assessment activities are described below.

VII.A.-Description and weight of the assessment activities

Evaluation System	Reassessable	Weight	Activity	Minimum Score	Contents	Timing
SE2	Yes	20%	Midterm I	0.5	Chapters 1 and 2	Around week 7
SE2	Yes	20%	Midterm II	0.5	Chapters 1, 2, 3	Around week 12
SE2	Yes	60%	Final Exam	4	Chapters 1, 2, 3, 4	Official date of the ordinary call

Regular Evaluation:
The regular evaluation will consist of three written tests, which together will account for 100% of the final grade.
- After the first third (1/3) and second third (2/3) of the course, there will be a partial exam (P1 and P2, respectively) covering the material studied up to that point. The date and scope of each exam will be announced well in advance.
- During the official regular exam period, a final exam (FE) will be administered, covering the entire content of the course.

To pass the course, students must obtain a final grade of 5 or higher (on a 10-point scale) and meet the minimum required score on each individual test.
Extraordinary Evaluation:
Students who do not pass the regular evaluation, or who did not take it, will have the opportunity to take an extraordinary evaluation. This is intended to assess whether they have acquired the competencies specified in the course guide, and will only cover the components of the evaluation that are eligible for reassessment. The extraordinary evaluation will consist of a single exam covering the entire content of the course.
Early Evaluation Session:
Students who apply for the early evaluation session will take a single exam that will account for 100% of their final grade. This exam will assess all course content.

VII.B. Assessment of students with academic exemption from class attendance

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Having Academic Exemption from Class Attendance (DAAC) does not imply that students are automatically exempt from participating in the continuous assessment activities or in the training activities of compulsory attendance as established in the teaching guide. Once the exemption has been granted, students must contact the subject's teaching staff, who will propose the adaptations he/she may consider relevant, as long as they guarantee the acquisition and adequate assessment of the learning goals established. Students must maintain adequate communication with the teaching staff so that they may provide information on the dates for training and assessment activities, if these are not established in the programme and available for students at the time of achieving the exemption.
Subject with possibility of academic exemption: Yes.

VII.C. Review of assessment activities

In accordance with the Regulation for the Assessment of Learning Outcomes of Rey Juan Carlos University.

VII.D.-Students with a disability or special educational needs

In order to guarantee equal opportunities, non-discrimination, universal accessibility and academic success, students with disabilities or especial education needs may request curricular adaptations to follow their studies. These adaptations will be provided by the Unit of Attention to People with Disabilities of Rey Juan Carlos University, in accordance with the regulation which regulates the service for the Attention of People with Disabilities at the University. This Unit will issue a report for curricular adaptations, so that students with disabilities or special education needs must contact the service (at e-mail discapacidad.programa@urjc.es) in order to provide relevant information for different educational alternatives.

VII.E.-Academic behaviour, academic integrity and honesty

Rey Juan Carlos University is fully committed to the highest standards of academic integrity and honesty, so studying at the URJC means assuming and subscribing to the values of integrity and academic honesty set out in the University's Ethical Code. To support this process, the University has Rey Juan Carlos University's Academic Conduct Regulation as well as different tools (anti-plagiarism, supervision...) that offer a collective guarantee for the full development of these essential values.

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VIII.-Teaching resources and materials
Basic bibliography
Linear Algebra Done Right, Sheldon Axler, 4th edition. Open Access Textbook. Available at https://doi.org/10.1007/978-3-031-41026-0 **Algebra**, Misael E. Marriaga, Michael Stich, 2025. *Editorial Academia Abierta*. Open Acces Textbook. Available at https://monografias.urjc.es/index.php/omp-urjc/catalog/book/41 **Álgebra lineal con métodos elementales**, Evangelina Santos Aláez and Luis M. Merino González. Paraninfo. **Linear algebra and its applications,** David C. Lay. 4th edition, Pearson, 2012. **Linear Algebra**, Serge Lang. Third edition. Undergraduate Texts in Mathematics, Springer, 1987. **Problems resueltos de álgebra lineal**, Jorge Arvesú Carballo, Francisco Marcellán Español and Jorge Sánchez Ruiz. Paraninfo. **Apuntes de álgebra**, Regino Criado y Alessandra Gallinari. . https://reginocriado.files.wordpress.com/2013/01/alg03.pdf
Consultation bibliography

IX.-Professors	
Name and surname	GUILLERMO VERA DE SALAS
E-mail address	guillermo.vera@urjc.es
Department	Matemática Aplicada, Ciencia e Ingeniería de los Materiales y Tecnología Electrónica
Campus	Fuenlabrada
Category	Profesor/a Ayudante Doctor/a
Academic degree	Doctor
Person responsible for the subject	Yes
Tutorial timetable	Para consultar las tutorias póngase en contacto con el/la profesor/a a través de correo electrónico
Number of quinquennia	1
Number of sexennia	1
No. of positive evaluations by Docentia	2

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