UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: ALGEBRA
Code: 56300
Type: BASIC
ECTS credits: 6
Degree: 352 - UNDERGRADUATE DEGREE PROGRAMME IN MECHANICAL ENGINEERING (AB)
Academic year: 2021-22
Center: 605 - SCHOOL OF INDUSTRIAL ENGINEERS. AB
Group(s): 14 15 16 11 12 13
Year: 1
Duration: First semester
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **ANTONIO MARTINEZ PLAZA** - Group(s): **14 11**

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Lecturer: **JOSE CARLOS VALVERDE FAJARDO** - Group(s): **15 16 12 13**

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2. Pre-Requisites

In order to achieve the learning objectives, the students should have the knowledge and skills that their previous education provides to their access to the University training:

- Knowledge: geometry, basic trigonometry, basic mathematical operations (power, logarithms, fractions, etc.), polinomials, matrices, derivation, integration and graphical

representation of elementary functions.

- Basic skills in the managment of instrumentation: elementary use of computers and mathematical software.

3. Justification in the curriculum, relation to other subjects and to the profession

Industrial engineers are professionals who use knowledge of physical and mathematical sciences and engineering techniques to develop his professional activity in aspects such as control, instrumentation an automation of processes and equipment, as well as design, construction, operation and maintenance of industrial products. This training allows them to participate succesfully in the different branches integrated in industrial engineering, such as mechanics, electricity, electronics, etc. It also make them adopt the changes of technologies in these areas, where appropriate, to respond to the needs that arise in the productive branches and services, so achieving the welfare of society.

Within the mathematical knowledge, the methods developed in the course of Algebra have revealed as the most adequate for the modern treatment of many disciplines including in the curriculum. Such disciplines will allow industrial engineers to face real problems that they can find at work.

Therefore, this subject is an essential part of the basic training of future engineers. Its main purpose is to provide students the algebraic and geometric resources to solve problems concerning maths and engineering. In this sense, this subject will help them to enhance the capacities of abstraction, understanding, analysis, implementation and synthesis that are common in mathematics and neccesary to any other scientific discipline or branch of engineering.

4. Degree competences achieved in this course

Course competences

Code	Description
A01	To understand and have knowledge in an area of study that moves on from the general education attained at secondary level and usually found at a level that, while supported in advanced text books, also includes some aspects that include knowledge found at the cutting edge of the field of study.
A02	To know how to apply knowledge to work or vocation in a professional manner and possess the competences that are usually demonstrated by the formulation and defence of arguments and the resolution of problems in the field of study.
A03	To have the capability to gather and interpret relevant data (normally within the area of study) to make judgements that include a reflection on themes of a social, scientific or ethical nature.
A07	Knowledge of Information Technology and Communication (ITC).
A08	Appropriate level of oral and written communication.
A12	Knowledge of basic materials and technologies that assist the learning of new methods and theories and enable versatility to adapt to new situations.
A13	Ability to take the initiative to solve problems, take decisions, creativity, critical reasoning and ability to communicate and transmit knowledge, skills and abilities in Mechanical Engineering.
A17	Ability to apply principles and methods of quality control.
B01	Ability to solve mathematical problems that occur in engineering. Aptitude to apply knowledge of: linear algebra; geometry; differential geometry; differential and integral calculus; differential and partial differential equations; numerical methods; numerical algorithms;

statistics and optimization.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Be able to express yourself correctly both orally and in writing, and, in particular, to know how to use mathematical language to express with precision quantities and operations that appear in industrial engineering. Become accustomed to working in a team and behaving respectfully.

To know the theory of matrices and determinants and to know how to carry out the corresponding calculations. Know the fundamentals and applications of Lineal Algebra and Euclidean Geometry

To know how to use and carry out elementary operations with complex numbers.

Know the main approaches for resolution through using numerical methods, to use some statistical software packages at user level, data processing, mathematical calculus and vizualization, set out algorithms and program through programming language of a high level, vizualize functions, geometric figures and data, design experiments, analyze data and interpret results

Additional outcomes

6. Units / Contents

Unit 1: COMPLEX NUMBERS

- **Unit 1.1** The complex numbers system.
- **Unit 1.2** Geometric representation of the complex numbers: modulus and arguments
- **Unit 1.3** Trigonometric and polar form of a complex number
- **Unit 1.4** Powers and roots of a complex number

Unit 2: MATRICES AND DETERMINANTS

- **Unit 2.1** Matrices: some related definitions
- **Unit 2.2** Rank of a matrix
- **Unit 2.3** Non-singular matrices. Calculation of the inverse matrix.
- **Unit 2.4** Determinant of a matrix
- **Unit 2.5** Properties of the determinants
- **Unit 2.6** Application to the calculation of the rank and the inverse matrix

Unit 3: SYSTEMS OF LINEAR EQUATIONS

- **Unit 3.1** Systems of linear equations: some related definitions
- **Unit 3.2** Rouché-Frobenius theorem.
- **Unit 3.3** Solving systems of linear equations with algebraic and direct methods
- **Unit 3.4** Numerical algebra
- **Unit 3.5** Iterative methods
- **Unit 3.6** Jacobi method
- **Unit 3.7** Gauss-Seidel method

Unit 4: VECTOR SPACES

- **Unit 4.1** The algebraic structure of a vector space
- **Unit 4.2** Vector subespaces. Subespaces operations
- **Unit 4.3** Linear dependence and independence
- **Unit 4.4** Basis and dimension of a vector space
- **Unit 4.5** Rank of a vector system
- **Unit 4.6** Vector varieties
- **Unit 4.7** Equations of subespaces and varieties
- **Unit 4.8** Equations of a change of basis

Unit 5: LINEAR MAPS

- **Unit 5.1** Linear maps and related concepts
- **Unit 5.2** Linear maps operatiions
- **Unit 5.3** Kernel, Image and character of a linear map
- **Unit 5.4** Rank of a linear map
- **Unit 5.5** Equations and matrices associated with a linear map
- **Unit 5.6** Equations and matrices associated with a change of basis in linear map

Unit 6: DIAGONALIZATION

- **Unit 6.1** Eigenvalues and Eigenvectors
- **Unit 6.2** Characteristic Polinomial
- **Unit 6.3** Diagonalization of an endomorphism
- **Unit 6.4** Digonalization of a square matrix
- **Unit 6.5** Application to the calculation of a power of matrix
- **Unit 6.6** Jordan canonical form

Unit 7: EUCLIDEAN SPACES AND ORTHOGONAL TRANSFORMATIONS

- **Unit 7.1** Inner products and Euclidean spaces
- **Unit 7.2** Euclidean norm
- **Unit 7.3** Euclidean distance
- **Unit 7.4** Orthogonality and orthonormality: orthogonal and orthonormal basis
- **Unit 7.5** Gramm-Schmidt orthogonalization
- **Unit 7.6** Orthogonal projections

Unit 8: GEOMETRY. AFFINE SPACES

- **Unit 8.1** Geomtry in affine spaces
- **Unit 8.2** Geometry in affine and Euclidean spaces

Unit 9: DIFFERENCE EQUATIONS

- **Unit 9.1** Introduction
- **Unit 9.2** Classification

Unit 9.3 Solving difference equations
Unit 9.4 Modeling with difference equations

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	A01 A02 A03 A07 A12 B01	1	25	Y	N	
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	A02 A07 A13 B01	0.6	15	Y	N	
Computer room practice [ON-SITE]	Practical or hands-on activities	A02 A07 B01	0.3	7.5	Y	N	
Progress test [ON-SITE]	Assessment tests	A01 A12 B01	0.1	2.5	Y	N	
Writing of reports or projects [OFF-SITE]	Group Work	A01 A02 A03 A07 A08 A12 A13 A17 B01	0.54	13.5	Y	N	
Study and Exam Preparation [OFF-SITE]	Self-study	A02 A08 A12 A13 A17 B01	3.06	76.5	Y	N	
Group tutoring sessions [ON-SITE]	Group tutoring sessions		0.2	5	Y	N	
Workshops or seminars [ON-SITE]	Workshops and Seminars	A01 A02 A03 A08 A13 A17 B01	0.1	2.5	Y	N	
Final test [ON-SITE]	Assessment tests	A01 A02 A03 A07 A08 A12 A13 A17 B01	0.1	2.5	Y	Y	
		Total:	**6**	**150**			
		Total credits of in-class work: 2.4					**Total class time hours: 60**
		Total credits of out of class work: 3.6					**Total hours of out of class work: 90**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Progress Tests	40.00%	0.00%	
Final test	50.00%	90.00%	
Theoretical papers assessment	10.00%	10.00%	
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	25
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	15
Computer room practice [PRESENCIAL][Practical or hands-on activities]	7.5
Progress test [PRESENCIAL][Assessment tests]	2.5
Writing of reports or projects [AUTÓNOMA][Group Work]	13.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	76.5
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	5
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	2.5
Final test [PRESENCIAL][Assessment tests]	2.5

Global activity

Activities	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	25
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	15
Computer room practice [PRESENCIAL][Practical or hands-on activities]	7.5
Progress test [PRESENCIAL][Assessment tests]	2.5
Writing of reports or projects [AUTÓNOMA][Group Work]	13.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	76.5
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	5
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	2.5
Final test [PRESENCIAL][Assessment tests]	2.5
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
GARCÍA, J.; LOPEZ PELLICER,						

M.	Álgebra Lineal y Geometría	Ed. Marfil		8426802699	1992	
GARCÍA, J.; LOPEZ PELLICER, M.	Álgebra Lineal y Geometría. Ejercicios	Ed. Marfil		8426804047	1991	
HERNÁNDEZ RODRÍGUEZ, E., VÁZQUEZ GALLO, MJ, ZURRO MORO, M.A.	Álgebra lineal y Geometría, 3ed	Pearson Universidad		9788478291298	2012	
KEICH NICHOLSON, K	Álgebra Lineal con aplicaciones	McGraw Hill		84-486-3789-2	2003	
Tai-Ran Hsu	APPLIED ENGINEERING ANALYSIS	JOHN WILEY	Hoboken, NJ	9781119071204	2018	It contains all the topics of the subjects related to Mathematics in the industrial Engineering degree
Fernández, C., Vázquez, F.C. y Vegas, J.M.	Ecuaciones diferenciales y en diferencias	Paraninfo	Madrid		2003	
Larson, R., Edwards, B.H. y Falvo, D.C.,	Algebra Lineal, 5ª edición	Piramide			2004	
Garcia, S.R. y Horn, R.A.	A Second Course in Linear Algebra	Cambridge University Press	Cambridge		2017	
LAY, D. C.	Álgebra Lineal y sus aplicaciones	Prentice Hall		970-26-0080-4	2001	
SERRANO, R. LOZANO, M. VILLAVERDE, J. MARTÍNEZ, A.	Apuntes de álgebra	Popular Libros		84-931937-8-X	2001	
SERRANO, R. LOZANO, M. VILLAVERDE, J. MARTÍNEZ, A.	Apuntes de álgebra : ejercicios	Popular Libros		978-84-932498-7-8	2002	
TORREGROSA, J. R., JORDAN, C.	Teoría y problemas de álgebra lineal y sus aplicaciones	McGraw Hill		9684222149	1991	
ALEDO, J.A., PENABAD, J. VALVERDE, J.C., VILLAVERDE, J.J.	Ejercicios de álgebra y matemática discreta II	Alpeviva		84-931862-1-X (v.II)	2001	
ALEDO, J.A., PENABAD, J. VALVERDE, J.C., VILLAVERDE, J.J.	Álgebra y matemática discreta	Alpeviva		84-931862-2-8	2002	
ANZOLA M., CARUNCHO, J., PÉREZ CANALES, G.	Problemas de Álgebra.Tomo 3. Espacios Vectoriales	Primer Ciclo		843004230X	1981	
ANZOLA M., CARUNCHO, J., PÉREZ CANALES, G.	Problemas de Álgebra.Tomo 6. Geometría Afín y Euclídea	Primer Ciclo		8430052461	1981	
BURGOS, J. de	Álgebra Lineal y Geometría Cartesiana	McGraw Hill		978-84-481-4900-0	2010	
GARCÍA CABELLO, J.	Álgebra lineal: sus aplicaciones en Economía, Ingeniería y otras Ciencias.	Delta Publicaciones		84-96477-12-6	2006	