UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: ALGEBRA
Code: 57704
Type: BASIC
ECTS credits: 6
Degree: 344 - CHEMICAL ENGINEERING
Academic year: 2023-24
Center: 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY
Group(s): 21
Year: 1
Duration: First semester
Main language: Spanish
Second language:
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **HENAR HERRERO SANZ** - Group(s): **21**

Building/Office	Department	Phone number	Email	Office hours
Margarita Salas/341	MATEMÁTICAS	926295412	henar.herrero@uclm.es	Ask for appointment by email

2. Pre-Requisites

To achieve the learning objectives of the subject, knowledge and skills are required that are supposed to be guaranteed in the training prior to access to the University. In particular, it is recommended to have basic knowledge of geometry, algebra and trigonometry, elementary mathematical operations (powers, logarithms, exponentials, fractions...), elementary knowledge of differentiation and integration of real functions of real variables and fundamentals of graphical representation of functions.

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

The mathematical concepts that are studied in this subject provide an essential tool and constitute a precise language that is later used by most of the basic and advanced subjects of Chemical Engineering. Everything related to matrices, algebraic systems of equations and all the methods studied in this subject appear in the study, synthesis, development, design, operation and optimization of industrial processes that produce physical, chemical and/or biochemical changes in materials. dealing with chemical engineering. Algebra is present in the planning and development of all experimental, academic and professional activities in Chemical Engineering.

4. Degree competences achieved in this course

Course competences

Code	Description
CB01	Prove that they have acquired and understood knowledge in a subject area that derives from general secondary education and is appropriate to a level based on advanced course books, and includes updated and cutting-edge aspects of their field of knowledge.
CB02	Apply their knowledge to their job or vocation in a professional manner and show that they have the competences to construct and justify arguments and solve problems within their subject area.
CB03	Be able to gather and process relevant information (usually within their subject area) to give opinions, including reflections on relevant social, scientific or ethical issues.
CB04	Transmit information, ideas, problems and solutions for both specialist and non-specialist audiences.
E01	Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculation; differential equations and partial derivatives; numerical methods; numerical algorithm; statistics and optimization.
G03	Knowledge in basic and technological subjects, which enables them to learn new methods and theories, and give them versatility to adapt to new situations.
G12	Proficiency in a second foreign language at level B1 of the Common European Framework of Reference for Languages
G13	Knowledge of Information and Communication Technologies (ICT).
G14	Proper oral and written communication
G17	Capacity for critical thinking and decision making
G19	Capacity for teamwork
G20	Ability to analyze and solve problems
G22	Ability to apply theoretical knowledge to practice
G26	Obtaining skills in interpersonal relationships.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

To get used to teamwork, express yourself correctly orally and in writing in Spanish and English and behave respectfully.

To know the fundamentals of plane and spatial geometry.

To know the main approaches for resolution using numerical methods, use at the user level some software packages of statistics, data processing, mathematical calculation and visualization, propose algorithms and program using a high-level programming language, visualize functions, geometric figures and data, design experiments, analyze data and interpret results.

To know how to use the language of Mathematics.

To know the theory of arrays and know how to carry out the corresponding calculations.

Additional outcomes

The student will acquire knowledge about the theory of vector spaces, matrices and systems of algebraic equations and will know how to carry out the corresponding calculations. He will also know the fundamentals and applications of optimization. He will know the main approaches for resolution using numerical methods. She will use some mathematical calculation and visualization software packages at the user level, she will propose algorithms and program using a high-level programming language, she will visualize solutions and data and interpret the results. She will know how to apply this knowledge to Chemical Engineering problems. She will acquire the general knowledge of Algebra that will allow her to understand advanced algebraic methods and apply them in chemical engineering situations. She will be able to use, at the user level, some mathematical calculation and visualization software package to visualize solutions, program with a high-level programming language and to perform the necessary numerical calculations and symbolic operations. She will improve her ability to express herself correctly orally and in writing and, in particular, with the language of Algebra to accurately state the relationships, equations and operations that appear in Chemical Engineering, as well as solve and interpret them. She will be able, given a problem, to reason about the model and the mathematical method necessary for its resolution, as well as to interpret the results, which will be a key argument in her decision-making. She will develop her ability to work in a team by solving group problems in practical sessions and in the computer room. You will develop your ability to analyze and solve problems by approaching and solving the problems proposed in the seminar sessions, in the problem sheets, in the evaluations and in the bibliography. You will develop your ability to apply theoretical knowledge to practice by solving problems applied to chemical engineering. Solving problems in groups and with the help of the teacher in the practical and computer sessions by the students will allow them to practice and improve their interpersonal skills.

6. Units / Contents

Unit 1: Algebra foundations

- **Unit 1.1** Complex numbers
- **Unit 1.2** Matrices and determinants
- **Unit 1.3** Systems of linear euqtions
- **Unit 1.4** Computer practice. Scientific and technological applications

Unit 2: Numerical methods in algebra

- **Unit 2.1** Numerical solution of nonlinear equations
- **Unit 2.2** Numerical solution of systems of linear equations
- **Unit 2.3** Numerical solution of systems of nonlinear equations
- **Unit 2.4** Computer practice. Scientific and technological applications

Unit 3: Vector spaces

- **Unit 3.1** Vector space concept
- **Unit 3.2** Vector subspaces
- **Unit 3.3** Linear combination. Generator sets
- **Unit 3.4** Linear dependence and independence
- **Unit 3.5** Base, dimension and coordinates
- **Unit 3.6** Subspace equations. Operations with subspaces
- **Unit 3.7** Base change
- **Unit 3.8** Computer practice. Introduction to programming

Unit 4: Euclidean vector spaces

- **Unit 4.1** Scalar product. Euclidean vector space
- **Unit 4.2** Norms and angles
- **Unit 4.3** Orthogonality. Gram-Schmidt method. Orthogonal projection
- **Unit 4.4** Computer practice. Introduction to programming

Unit 5: Linear maps and matrices

- **Unit 5.1** Linear application
- **Unit 5.2** Kernel and image
- **Unit 5.3** Matrix representation
- **Unit 5.4** Operations
- **Unit 5.5** Base change
- **Unit 5.6** Computer practice. Introduction to programming

Unit 6: Eigenvalues and eigenvectors

- **Unit 6.1** Eigenvalues and eigenvectors of a matrix
- **Unit 6.2** Eigenvector subspaces
- **Unit 6.3** Diagonalization of matrices
- **Unit 6.4** Computer practice. Scientific and technological applications

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	CB02 CB03 CB04 E01 G03	0.72	18	N	-	
Problem solving and/or case studies [ON-SITE]	Guided or supervised work	CB01 CB02 CB03 CB04 E01 G03 G13 G14 G17 G19 G20 G22 G26	0.94	23.5	Y	N	
Computer room practice [ON-SITE]	Practical or hands-on activities	CB01 CB02 CB03 CB04 E01 G03 G13 G14 G17 G19 G20 G22 G26	0.32	8	Y	Y	
Progress test [ON-SITE]	Assessment tests	CB01 CB02 CB03 CB04 E01 G03 G14 G17 G20 G22	0.2	5	Y	N	
Final test [ON-SITE]	Assessment tests	CB01 CB02 CB03 CB04 E01 G03 G13 G14 G17 G20 G22	0.12	3	Y	Y	
Study and Exam Preparation [OFF-SITE]	Self-study	G12	3.6	90	N	-	

Project or Topic Presentations [ON-SITE]		CB01 CB02 CB03 CB04 E01 G03 G14 G17 G19 G20 G22 G26	0.1	2.5	Y	N	
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
Assessment of active participation	1.00%	0.00%	Attendance and active participation in all presential activities of the subject will be valued positively.
Theoretical papers assessment	1.00%	0.00%	Theoretical team work to be presented in class
Final test	0.00%	90.00%	There will be an exam with all the material or the partial failing. It will be valued: 1. Correction of the problem statement 2. Correction of the solution 3. Correction of written expression Concept errors and errors in basic mathematical operations will imply penalties. The subject will be passed if the final grade is equal to or greater than 5. It is necessary to obtain a minimum grade of 4 for the partial exams and the computer test to be considered compensable.
Progress Tests	18.00%	0.00%	It will be valued 1. Correction of the problem statement. 2. Correction of the solution. 3. Correction of written expression. Concept errors and errors in basic mathematical operations will imply penalties.
Test	70.00%	0.00%	It will be valued 1. Correction of the problem statement. 2. Correction of the solution. 3. Correction of written expression. Concept errors and errors in basic mathematical operations will imply penalties. You need to get a note minimum of 4 for the partial exams and the computer test to be considered compensable.
Assessment of activities done in the computer labs	10.00%	10.00%	It will be valued 1. Attendance and active participation. 2. Correction of the approach to the problem/practice. 3. Solution correction and resolution method. You need to get a note minimum of 4 for the partial exams and the computer test to be considered compensable.
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).

Evaluation criteria for the final exam:

Continuous assessment:

There will be two progress tests, two partial exams and a computer test. It will be valued:
1. Correction of the problem statement
2. Correction of the solution
3. Correction of written expression

Concept errors and errors in basic mathematical operations will imply penalties. Midterm exams serve as recovery tests for progress. The subject will be passed if the final grade is equal to or greater than 5. It is necessary to obtain a minimum grade of 4 so that the partial exams and the computer test are considered compensable.

Non-continuous evaluation:

There will be an exam with all the material. The exam will consist of solving a series of exercises, which will constitute 90% of the grade, and a computer test for the remaining 10%. It will be valued:
1. Correction of the problem statement
2. Correction of the solution
3. Correction of written expression

Concept errors and errors in basic mathematical operations will imply penalties. The subject will be passed if the final grade is equal to or greater than 5.

Specifications for the resit/retake exam:

If the student has not passed the subject in the ordinary call, he/she must take the exam in the extraordinary call with all the material or the partial fails. The exam will consist of solving a series of exercises, which will constitute 90% of the grade, and a computer test for the remaining 10%. It will be valued:
1. Correction of the problem statement
2. Correction of the solution
3. Correction of written expression

Concept errors and errors in basic mathematical operations will imply penalties.

The subject will be passed if the final grade is equal to or greater than 5. It is necessary to obtain a minimum grade of 4 so that the partial exams and the computer test are considered compensable.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents	
Hours	**hours**
Final test [PRESENCIAL][Assessment tests]	3
Unit 1 (de 6): Algebra foundations	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Computer room practice [PRESENCIAL][Practical or hands-on activities]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	12
Unit 2 (de 6): Numerical methods in algebra	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Computer room practice [PRESENCIAL][Practical or hands-on activities]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	16
Unit 3 (de 6): Vector spaces	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	6
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	3
Computer room practice [PRESENCIAL][Practical or hands-on activities]	1
Progress test [PRESENCIAL][Assessment tests]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	20
Unit 4 (de 6): Euclidean vector spaces	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Computer room practice [PRESENCIAL][Practical or hands-on activities]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	15
Unit 5 (de 6): Linear maps and matrices	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Computer room practice [PRESENCIAL][Practical or hands-on activities]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	15
Unit 6 (de 6): Eigenvalues and eigenvectors	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Computer room practice [PRESENCIAL][Practical or hands-on activities]	2
Progress test [PRESENCIAL][Assessment tests]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	12
Global activity	
Activities	**hours**
Final test [PRESENCIAL][Assessment tests]	3
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	13
Class Attendance (theory) [PRESENCIAL][Lectures]	27
Computer room practice [PRESENCIAL][Practical or hands-on activities]	11
Progress test [PRESENCIAL][Assessment tests]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	90
Total horas:	146

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
A. de la Villa	Problemas de Álgebra	CLAGSA	Madrid		1998	
García, J.	Álgebra lineal: sus aplicaciones en Economía, Ingeniería y otras Ciencias	Delta Publicaciones	Madrid		2006	
García, J. y López, M.	Álgebra Lineal y Geometría	Marfil	Alcoy		1989	
Hernández, E.	Álgebra y Geometría	Addison-Wesley	Madrid		1994	
Herrero, H. y Díaz-Cano, A.	Informática aplicada a las Ciencias y a la Ingeniería con Matlab	ETSII-Ñ	Ciudad Real		2000	
Lay, D.C.	Álgebra lineal y sus aplicaciones	Prentice-Hall	Madrid		2001	
Mathews, J.H. y Fink, K.D.	Métodos Numéricos con Matlab	Prentice-Hall	Madrid		1999	
Quarteroni, A. y Saleri, F.	Cálculo Científico con Matlab y Octave	Springer	Milán		2006	

http://matematicas.uclm.es/qui-cr
http://matematicas.uclm.es/qui-cr
http://www.gnu.org/software/octave
http://www.gnu.org/software/octave