

**1. General information**

**Course:** MATHEMATICS  
**Type:** BASIC  
**Degree:** 409 - CHEMISTRY  
**Center:** 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY  
**Year:** 1  
**Main language:** Spanish  
**Use of additional languages:**  
**Web site:**

**Code:** 57301  
**ECTS credits:** 12  
**Academic year:** 2023-24  
**Group(s):** 20 23  
**Duration:** AN  
**Second language:** English  
**English Friendly:** Y  
**Bilingual:** N

**2. Pre-Requisites**

To achieve the learning objectives is necessary knowledge and skills that are supposed to be guaranteed in the training prior to entering the university. In particular, basic knowledge of geometry, algebra and trigonometry, elementary mathematical operations (pow

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

As in any scientific discipline, in Chemistry, Mathematics is an indispensable tool for the understanding and development of any of its branches. Mathematics is the foundation and origin of modern theories of atomic and molecular structure, they allow to deal with pr  
The mathematical concepts studied in the Mathematics course provide an essential tool and constitute a precise language that is used by most of the basic subjects. The subject of Mathematics helps to enhance the abstraction, rigor, analysis and synthesis capacite

**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.
E17	Develop the ability to relate to each other the different specialties of Chemistry, as well as this one with other disciplines (interdisciplinary character)
G01	Know the principles and theories of Chemistry, as well as the methodologies and applications characteristic of analytical chemistry, physical chemistry, inorganic chemistry and organic chemistry, understanding the physical and mathematical bases that require
T02	Domain of Information and Communication Technologies (ICT)
T03	Proper oral and written communication
T05	Organization and planning capacity
T07	Ability to work as a team and, where appropriate, exercise leadership functions, fostering the entrepreneurial character
T08	Skills in interpersonal relationships

**5. Objectives or Learning Outcomes****Course learning outcomes****Description**

Know the matrix theory and know how to carry out the corresponding calculations.  
Get used to teamwork, express yourself orally and in writing, and behave respectfully.  
Knowing how to derive, integrate and represent functions of one and several variables, as well as the meaning and applications of the derivative and the integral.  
Know how to model chemical processes through differential equations, solve them and interpret results.  
Know how to use the language of Mathematics.

**6. Units / Contents****Unit 1: Linear Algebra**

- Unit 1.1** Matrix and determinants
- Unit 1.2** Linear equations systems
- Unit 1.3** Solving linear equations systems with MatLab

**Unit 2: Vector Spaces**

- Unit 2.1** Definition of vector space
- Unit 2.2** Vector subspaces
- Unit 2.3** Linear combination. Generator systems
- Unit 2.4** Linear independence and dependence
- Unit 2.5** Basis. Dimension
- Unit 2.6** Subspaces equations
- Unit 2.7** Change of basis

**Unit 3: Euclidean vector spaces**

- Unit 3.1** Scalar product. Euclidean vector space
- Unit 3.2** Norm and angle
- Unit 3.3** Orthogonality. Gram-Schmidt method

**Unit 4: Linear transformations**

- Unit 4.1** Linear transformation
- Unit 4.2** Kernel and image
- Unit 4.3** Matrix representation
- Unit 4.4** Operations
- Unit 4.5** Change of basis

**Unit 5: Eigenvalues and eigenvectors**

- Unit 5.1** Eigenvalues and eigenvectors
- Unit 5.2** Proper subspaces
- Unit 5.3** Diagonalizing a matrix
- Unit 5.4** Diagonalizing a matrix with Matlab

**Unit 6: One variable Integral and differential calculus**

- Unit 6.1** Limits and continuity
- Unit 6.2** Derivative
- Unit 6.3** Maximum and minimum. Convexity
- Unit 6.4** Taylor polynomial
- Unit 6.5** Definite and indefinite integrals
- Unit 6.6** Improper integrals
- Unit 6.7** Graphics, derivation and integrals with Matlab

**Unit 7: Multivariable differential calculus**

- Unit 7.1** Multivariable functions
- Unit 7.2** Global and directional limits. Continuity
- Unit 7.3** Partial derivatives. Gradient
- Unit 7.4** Chain rule
- Unit 7.5** Taylor polynomial
- Unit 7.6** Critical points. Maximum and minimum.
- Unit 7.7** Lagrange multiplier method
- Unit 7.8** Graphics, derivation and optimization with Matlab

**Unit 8: Multiple integrals**

- Unit 8.1** Double integrals
- Unit 8.2** Triple integrals
- Unit 8.3** Linear integral
- Unit 8.4** Surface integral
- Unit 8.5** Integration with Matlab

**Unit 9: Ordinary differential equations**

- Unit 9.1** Introduction to differential equations
- Unit 9.2** Solving first order differential equations
- Unit 9.3** Solving second order differential equations
- Unit 9.4** Qualitative properties of differential equations of differential equations
- Unit 9.5** Solving ordinary differential equations with Matlab

**Unit 10: Systems of Ordinary differential equations**

- Unit 10.1** Solving systems of first order ordinary differential equation
- Unit 10.2** Qualitative properties of systems of first order ordinary differential equations
- Unit 10.3** Solving systems of ordinary differential equations with Matlab

**ADDITIONAL COMMENTS, REMARKS**

The contents are divided into 3 parts:

I. Linear Algebra (Unit 1 to Unit 5)

II. Integral and Differential Calculus (Unit 6 to Unit 8)

III. Ordinary Differential Equations (Unit 9 and Unit 10).

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	CB01 E17 G01	2.68	67	N	-	
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	CB01 E17 G01	0.88	22	N	-	
Computer room practice [ON-SITE]	Practical or hands-on activities	CB01 E17 G01 T02	0.44	11	Y	Y	
Progress test [ON-SITE]	Assessment tests	CB01 E17 G01	0.08	2	Y	N	
Progress test [ON-SITE]	Assessment tests	CB01 E17 G01	0.16	4	Y	Y	
Final test [ON-SITE]	Assessment tests	CB01 E17 G01	0.08	2	Y	Y	
Study and Exam Preparation [OFF-SITE]	Self-study	T03 T05 T07 T08	7.68	192	N	-	
<b>Total:</b>			<b>12</b>	<b>300</b>			
<b>Total credits of in-class work: 4.32</b>			<b>Total class time hours: 108</b>				
<b>Total credits of out of class work: 7.68</b>			<b>Total hours of out of class work: 192</b>				

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	20.00%	0.00%	Two progress test: one in the first semester and other one in the second semester.
Test	70.00%	90.00%	One test each semester.
Assessment of activities done in the computer labs	10.00%	10.00%	Test using the software MATLAB.
<b>Total:</b>	<b>100.00%</b>	<b>100.00%</b>	

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:**

Continuous evaluation involves the realization of:

- two progress tests whose average grade weighs 20% in the final grade.
- two midterm exams whose average grade weighs 70% in the final grade, if each midterm has been passed or has obtained a grade equal or higher than 4.0.
- two computer tests with the Matlab software whose average grade weighs 10% of the final grade.

The course is passed if the final grade is equal or higher than 5.0. If the final grade of the course is lower than 5.0, the student has failed the course and must take the exam in the ordinary exam session.

**Non-continuous evaluation:**

The non-continuous evaluation involves the realization of:

- a final exam of the entire syllabus in the ordinary call whose grade weighs 90% in the final grade.
- a computer test with the Matlab software in the ordinary exam, which grade weighs 10% in the final grade.

The course is passed if the final grade is equal or higher than 5.0. If the final grade of the course is lower than 5.0, the student has failed the course and must take the exam in the extraordinary convocation.

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
<b>Hours</b>	<b>hours</b>
Progress test [PRESENCIAL][Assessment tests]	2
Progress test [PRESENCIAL][Assessment tests]	4
Final test [PRESENCIAL][Assessment tests]	2
<b>Unit 1 (de 10): Linear Algebra</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Computer room practice [PRESENCIAL][Practical or hands-on activities]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	10
<b>Unit 2 (de 10): Vector Spaces</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	11
<b>Unit 3 (de 10): Euclidean vector spaces</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	10
<b>Unit 4 (de 10): Linear transformations</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	11
<b>Unit 5 (de 10): Eigenvalues and eigenvectors</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	1
Computer room practice [PRESENCIAL][Practical or hands-on activities]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	11
<b>Unit 6 (de 10): One variable Integral and differential calculus</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	10
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	3
Computer room practice [PRESENCIAL][Practical or hands-on activities]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	28
<b>Unit 7 (de 10): Multivariable differential calculus</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	10
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Computer room practice [PRESENCIAL][Practical or hands-on activities]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	28
<b>Unit 8 (de 10): Multiple integrals</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	9
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Computer room practice [PRESENCIAL][Practical or hands-on activities]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	28
<b>Unit 9 (de 10): Ordinary differential equations</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	8
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Computer room practice [PRESENCIAL][Practical or hands-on activities]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	28
<b>Unit 10 (de 10): Systems of Ordinary differential equations</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	11
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	3
Computer room practice [PRESENCIAL][Practical or hands-on activities]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	27
<b>Global activity</b>	
<b>Activities</b>	<b>hours</b>

Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	22
Class Attendance (theory) [PRESENCIAL][Lectures]	67
Computer room practice [PRESENCIAL][Practical or hands-on activities]	11
Progress test [PRESENCIAL][Assessment tests]	2
Progress test [PRESENCIAL][Assessment tests]	4
Final test [PRESENCIAL][Assessment tests]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	192
Total horas: 300	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	City	ISBN	Year	Description
Zill, D. G.	Ecuaciones diferenciales con problemas de valor en la frontera	Cengage Learning,			2018	
Zill, D. G.; Wright, W. S.	Matemáticas V. Ecuaciones Diferenciales	Cengage Learning,			2018	
Larson, R.; Edwards, B.	Cálculo 2 de varias variables	McGraw Hill		9789701071342	2009	
Larson, R.; Edwards, B.; Falvo, D.	Álgebra Lineal	Grupo Anaya Comercial		9788436820607		
Stewart, J.	Cálculo de una variable	Thomson Learning		9789706860699	2001	
Stewart, J.	Cálculo multivariable	Thomson Learning		9789706861238	2002	
Thomas, G.	Cálculo de una variable	Pearson		9702606438	2005	
Thomas, G.	Cálculo de varias variables	Pearson		9789702606444	2006	
Zill, D.	Ecuaciones diferenciales con aplicaciones de modelado	Thomson		9687529210	2007	
Larson, R., Edwards, B. H.	Calculus	Cengage Learning,		978-1337275347	2017	
Quarteroni, A., Saleri, F., Gervasio, P.	Scientific Computing with Matlab and Octave	Springer		978-3-642-45366-3	2014	
Lay	Linear Algebra and its applications	Pearson International		978-1292092232	2015	
Zill, D. G.	First course in Differential equations with modeling applications	Cengage Learning,			2018	
Larson, R.	Elementary Linear Algebra	Wadsworth Publishing Co		978-1133110873		
Larson, Ron (1941-)	Cálculo 1 : de una variable /	McGraw-Hill,		978-607-15-0273-5	2010	
Quarteroni, Alfio	Cálculo científico con MATLAB y Octave /	Springer-Verlag Italia,		88-470-0503-5	2006	
Stewart, James (1941-)	Multivariable calculus /	Cengage Learning,		978-1-305-26673-5	2016	
Zill, D. G.	Differential Equations with Boundary-Value Problems	Cengage Learning,			2018	