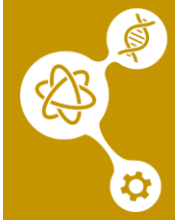
Academic Year 2026/2027

Course Guide:

MATHEMATICS II



FACULTY OF CHEMICAL SCIENCES

1. IDENTIFICATION

Degree	Bachelor's Degree in Chemical Engineering			Code	801538
Course	Mathematics II			ECTS Credits	9
Subject Area	Mathematics				
Module	Basic				
Course Type	Basic	Course	Second	Semester	First
Responsible Department	Mathematical Analysis and Applied Mathematics				

Teaching Staff

Group A

Activity	Lecturer	Email	Office
Lectures Seminars Tutorials			

Grupo B

Activity	Lecturer	Email	Office
Lectures Seminars Tutorials			

2. OBJECTIVES

General Objective

To develop the concept of differential equations and the methods of analysis and solving of both differential equations and systems thereof, with particular emphasis on models arising in the experimental sciences. Special attention will be given to models and applications in the fields of chemistry and chemical engineering.

Specifics Objectives

- Solving differential equations.

3. PRIOR KNOWLEDGE AND RECOMENDATIONS

prior Knowledge

Proper follow-up of this subject requires that the student has previously acquired the knowledge and competences covered by the official Spanish secondary education (Bachillerato) mathematics syllabi, and those described in the course "Mathematics I" of the first year of the degree. Although enrolment is not formally conditioned on this prior knowledge, effective mastery of this knowledge is essential to follow this course with a reasonable prospect of success.

Recommendations

Students who do not possess the above-mentioned prerequisite knowledge are strongly advised to acquire it prior to the commencement of the course.

A solid working knowledge of linear algebra is highly recommended.

A basic level of English is recommended, sufficient to handle English-language bibliographic materials, conduct information searches, and communicate both in writing and orally in that language.

Familiarity with computer tools and software for solving complex problems is advisable.

4. CONTENT

Brief Description

First-order ordinary differential equations. Second-order and higher-order linear ordinary differential equations. Systems of linear differential equations. Numerical methods for solving ordinary differential equations. Partial differential equations.

Syllabus

Topic 1. First-Order Ordinary Differential Equations. Initial value problems. Elementary integration methods: separation of variables, homogeneous equations, exact equations and integrating factors. The particular case of the first-order linear differential equation. Applications to mathematical modelling.

Topic 2. Higher-Order Differential Equations. Structure of the general solution of a linear equation with constant coefficients. Series solutions of linear differential equations. The Laplace transform as a solution method.

Topic 3. Systems of Linear Differential Equations. Fundamental matrices and solution space. Elements of stability theory for autonomous systems. Classification and stability of equilibrium points.

Topic 4. Numerical Methods for Ordinary Differential Equations. Euler's method, the trapezoidal method, and Runge-Kutta methods.

Topic 5. Second-Order Partial Differential Equations. Classification of second-order PDEs. Introduction to the method of separation of variables and Fourier series.

5. COMPETENCES

Generic Competences

GC1	Use concepts from basic and technological subjects that enable autonomous learning of new methods and theories and the ability to address new situations.
GC5	Perform calculations, measurements, valuations, expert assessments, studies, and reports in the relevant field of knowledge.

Specific Competences

CE1-M5	Solve elementary first-order differential equations and linear second-order differential equations.
CE1-M6	Calculate the solution of a linear system of ordinary differential equations in terms of the eigenvalues and eigenvectors of the matrix.
CE1-M7	Use the main numerical methods for solving differential equations.

Cross-cutting

CT1	Demonstrate capacity for analysis and synthesis.
CT7	Work in a team, demonstrating interpersonal skills.
CT10	Integrate acquired knowledge and apply it to solving real problems.
CT11	Learn autonomously.

6. WORKLOAD DISTRIBUTION BY ACTIVITY

Mathematics II is a core module course within the Bachelor's degree in chemical engineering, carrying an allocation of 9 ECTS credits delivered throughout the first semester. In accordance with ECTS guidelines, the total student workload amounts to 225 hours per year, distributed as follows:

Activity	In-class (hours)	Self-study (hours)	Credits
Lectures and practical classes (in-person)	60	90	6
Seminars	15	22,5	1,5
Tutorials / guided work	4	6	0,4
Preparation of assignments and exams	6	21,5	1,1
Total	**85**	**140**	**9**

7. METHODOLOGY

During in-person lectures, the course content will be presented in accordance with the attached syllabus.

A problem and practical exercise set will be made available on the virtual campus platform, with the aim of encouraging students to attempt independent solutions.

Seminars are in-person practical sessions devoted to the resolution of exercises and problems.

Office hours: Students will be organised into groups, each of which will attend four one-hour office-hour sessions during the semester.

8. BIBLIOGRAPHY

Basic

- R. FERREIRA y S. RODRIGUEZ. "*Ecuaciones Diferenciales y Cálculo Vectorial*", Garceta, 2013.
- D. ZILL. "*Ecuaciones diferenciales*". Grupo Editorial Iberoamérica, 1986.
- S. CHAPRA y R. CANALES. "*Métodos numéricos para ingenieros*". McGraw Hill, 1989.
- G. F. SIMMONS. "*Ecuaciones diferenciales (con aplicaciones y notas históricas)*". McGraw Hill, 1996.
- W. BOYCE y R. DiPRIMA. "*Ecuaciones diferenciales con problemas con valores en la frontera*", Limusa, 2000.

Complementary

- S. RODRÍGUEZ, "Matemáticas para estudiantes en Químicas", Síntesis, 2007.
- E. STEINER, "Matemáticas para ciencias aplicadas", Reverté, 2005
- J. LÓPEZ-GÓMEZ, "Ecuaciones Diferenciales y Variable Compleja", Prentice Hall, Madrid, 2001.
- J. LÓPEZ-GÓMEZ, "Problemas de Ecuaciones Diferenciales y Variable Compleja", Prentice Práctica, Madrid, 2002.
- L. VÁZQUEZ, S. JIMÉNEZ, C. AGUIRRE y P. J. PASCUAL: "Métodos numéricos para la física y la ingeniería", McGraw Hill, 2009.
- J. M. VEGAS, "Ecuaciones Diferenciales y en diferencias, Sistemas Dinámicos", Thomson, 2003.

9. ASSESSMENT

Assessment consists of continuous evaluation components (in-course assessments) and a final examination.

❖ **WRITTEN EXAMS: 100%**

– Two **in-course exams** throughout the semester (**20%** of the final grade).

– A **final** written **examination** of 3 hours duration will be held (**80%** of the final grade).

The following competences are assessed: GC1, GC5, SC1, TC1, TC7, TC10, and TC11.

❖ **EXTRAORDINARY ASSESSMENT: 100%**

Students who do not pass the course through regular assessment will be entitled to sit a three-hour extraordinary resit examination, which accounts for 100% of the final grade.

The results of the in-course assessments will be communicated to students sufficiently in advance of the final examination to allow adequate academic planning. In any case, results will be published within a maximum period of 20 days. A minimum period of seven days between the publication of results and the date of the final examination shall be guaranteed.

ACTIVITY PLANNING - TIMETABLE

TOPIC	ACTIVITY	HOURS	GROUPS	START	END
1. First-Order Differential Equations	Lectures	18	1	Week 1	Week 6
	Problem Solving Classes	8	1		
	Practical Classes	1	1		
2. Higher-Order Differential Equations	Lectures	12	1	Week 7	Week 9
	Problem Solving Classes	6	1		
	Practical Classes	1	1		
3. Systems of Differential Equations and Numerical Methods for Ordinary Differential Equations	Lectures	12	1	Week 10	Week 13
	Problem Solving Classes	8	1		
	Practical Classes	3	1		
4. Classification of Second Ordenr Partial Differential Equations. Introduction to separation of variables method and Fourier Series.	Lectures	6	1	Week 14	Week 15
	Problem Solving Classes	1	1		
	Practical Classes	1	1		
	Scheduled Practical Classes	4	2	Variable*	

* The scheduling of tutorial sessions is subject to the overall timetable for all courses in the academic year.

SUMMARY OF THE ACTIVITIES

TEACHING ACTIVITY	ASSOCIATED COMPETENCES	LECTURER ACTIVITY	STUDENT ACTIVITY	ASSESSMENT	C	NC	TOTAL	G
Lectures	GC1, GC5, SC1, TC1, TC7, TC10, TC11	Delivery of syllabus content.	Active listening; comprehension; clarification of queries; note-taking for subsequent study.	In-course assessments and final examinations.	60	140		**80% + 20%**
Seminars	GC1, GC5, SC1, TC1, TC7, TC10, TC11	Application of theory to problem and exercise solving.	Solving problems; formulating questions; presenting solutions at the board.	In-course assessments and final examinations.	15			
Tutorials	GC1, GC5, SC1, TC1, TC10	Guidance to direct student study.	Consultation with the lecturer regarding conceptual and methodological difficulties encountered during independent study.	Compulsory attendance on assigned dates.	4			
Examinations	GC1, GC5, SC1, TC1, TC6, TC7, TC10, TC11	Setting, invigilating, and marking examinations. Overall grading.	Preparation and sitting of examinations.		6			

C (h): Contact activities

NC (h): Non-contact activities (independent study)

G: Grade