Course guide
330056 - M2 - Mathematics II

Last modified: 28/04/2025

Unit in charge: Manresa School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING (Syllabus 2021). (Compulsory subject).
BACHELOR'S DEGREE IN MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING / BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2024). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: JOSEP FREIXAS BOSCH

Others: RESTA DE PROFESSORAT DEL DEPARTAMENT DE MATEMÀTIQUES

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE1: Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial differential equations, numerical methods, numerical algorithms, statistics and optimization.

Transversal:
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
3. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
4. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

TEACHING METHODOLOGY

Face-to-face sessions in large groups where the professor will explain the basics of each subject, with examples, indicate exercises or tasks for the students to do.
Independent work sessions for students to study and deepen what the professor has presented. Students will have support material at Atenea from which they will do the proposed exercises or tasks.
Face-to-face sessions in small groups where the professor will solve the doubts that the students have after their independent study, additionally exercises will be solved.
Activities 1 and 2 consist of a written part in small (or large) groups and/or resolution of questionnaires and/or delivery of proposed exercises (which may or may not be carried out in the classroom). Activity 3, broken down into two partial tests, is part of the face-to-face sessions in large groups.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of Mathematics II, the students must be able to:

- Recognize curves and polinomic surfaces of the second degree.
- Find and interpret the singular points of the surfaces expressed as graphs of a function.
- Model real geometric varieties using curves, surfaces or regions given by inequalities.
- Calculate areas of bidimensional regions and surfaces, volumes of solids, mass centers, inertia moments of basic bidimensional and tridimensional figures.
- Use the appropriate mathematical tools to calculate some physical applications as: work, potential or flow.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours small group	30,0	20.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

1. SCALAR FIELDS

Description:
Conics and quadrics.
Representation of scalar fields and contour lines.
Partial derivatives. Gradient vector. Directional derivatives.
Optimization.

Related activities:
The contents of this part are evaluated as part of activities 1 and 3. Activity 1 may consist of a written part and/or questionnaires and/or delivery of proposed exercises. Activity 3 will be a written test.

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study : 18h

2. MULTIPLE INTEGRATION

Description:
Applications of the integral calculus of one variable.
The double integral: definition and properties. Variable change to polar coordinates. Applications.
The triple integral: definition and properties. Variable change to cylindrical and spherical coordinates. Applications.

Related activities:
The contents of this part are evaluated as part of activities 1, 2 and 3. Activities 1 and 2 may consist of a written part and/or questionnaires and/or delivery of proposed exercises. Activity 3 will be a written test.

Full-or-part-time: 60h
Theory classes: 12h
Laboratory classes: 12h
Self study : 36h

3. VECTORIAL CALCULUS

Description:
Parameterized curves. Arc length.
Line integral of scalar fields and vector fields. Applications.
Parameterized surfaces. Area of a surface.
Surface integral of scalar fields and vector fields. Applications.
Divergence and rotational. Integral theorems.

Related activities:
The contents of this part are evaluated as part of activities 2 and 3. Activity 2 may consist of a written test and/or questionnaires and/or delivery of proposed exercises. Activity 3 is a written test.

Full-or-part-time: 60h
Theory classes: 12h
Laboratory classes: 12h
Self study : 36h

ACTIVITIES

A1: SCALAR FIELDS AND INTEGRATION: APPLICATIONS

Description:
Identification of conics and quadrics, scalar fields, calculation of bidimensional areas and volumes of revolution with respect to straight lines. Double integral.

All parts of the activity: written and/or complementary part must be delivered to the professor. All of them represent a part of the continuous evaluation.

Specific objectives:
At the end of these activities, students should be able to:

1. Identify conics and quadrics.
2. Determine domains of scalar fields, interpret scalar fields from their level curves.
3. Know and interpret the concepts of partial derivative, directional derivative and gradient.
4. Pose and solve optimization problems.
5. Calculate bidimensional areas, volumes of revolution with respect to straight lines.
6. Know the theoretical aspects of double integration.

Material:
Notes, textbook, problem lists and miscellaneous material available at ATENEA.

Delivery:
All parts of the activity: written part and/or complementary part must be delivered to the professor.
All of them represent a part of the continuous evaluation.

Full-or-part-time: 4h
Self study: 3h
Laboratory classes: 1h

A2: MULTIPLE INTEGRATION, LINE INTEGRAL AND SURFACE INTEGRAL: APPLICATIONS

Description:
Calculation of areas and volumes. Calculation of the mass centers and moments of inertia of flat regions and solids. Calculation of the work done by a field of forces along a curve. Conservative fields, potential and associated theorems. Areas of surfaces, flow of a fluid through a surface.

All parts of the activity: written and/or complementary part must be delivered to the professor. All of them represent a part of the continuous evaluation.

Specific objectives:
At the end of these activities, students should be able to:
1. Calculate plane areas and volumes of solids using double and triple integrals.
2. Use double and triple integrals to calculate various physical applications, such as centers of mass or moments of inertia.
3. Calculate line integrals, identify conservative vector fields and apply Green's and Stokes' theorems. Use the main results of the line integral to calculate various applications: work, rotational, fluid movements, etc.
4. Use surface integrals to calculate various applications such as: surface areas or the flow of a field through a surface.

Material:
Textbook, notes, problem lists and various material available at ATENEA.

Delivery:
All parts of the activity: written part and/or complementary part must be delivered to the professor.
All of them represent a part of the continuous evaluation.

Full-or-part-time: 4h
Self study: 3h
Laboratory classes: 1h

A3. WRITTEN PARTIAL TESTS: P1 and P2

Description:
Two written tests to be done individually in the theory class.

Specific objectives:
Assess the general achievement of the objectives of contents 1, 2 and 3.
1. Understand the concepts and use the properties related to scalar fields and be able to apply them to solve modeling and optimization problems.
2. Acquire the basic concepts and properties of double and triple integrals of scalar fields and know how to apply them to the calculation of areas, volumes, centers of mass and moments of inertia.
3. Achieve the fundamental concepts and properties of line and surface integrals and know how to apply them to the calculation of surface areas, work, flow through a surface.

Material:
Tests statements (delivered just before starting the tests).

Delivery:
The tests done must be delivered to the professor.
They represent a part of the continuous evaluation.

Full-or-part-time: 16h
Self study: 12h
Theory classes: 4h

GRADING SYSTEM

The qualification is obtained from the marks obtained in activities 1 and 2 and activity 3 broken down into two parts P1 and P2. Activities A1, A2, P1 and P2 all have a maximum value of 10 and include all course activities.

The final grade (NF) is obtained from the continuous assessment grade (QC) and the overall exam grade (QF).

The objectives of the subject will be considered achieved if the QC continuous assessment rating is greater than or equal to 5 where QC = 0.1*(A1+A2)+0.4*(P1+P2).

Students with a QC course grade of less than 5 must take an overall exam and obtain a grade greater than or equal to 5 in order to pass the subject.
The final grade is obtained from: NF = maximum (QC,QF).

EXAMINATION RULES.

All activities are compulsory.
If any of the activities of the subject is not carried out, it will be considered a zero.

BIBLIOGRAPHY

Basic:

- Stewart, James. Cálculo multivariable. 4ª ed. México: International Thomson, 2001. ISBN 9706861238.
- Thomas, George Brinton. Cálculo. Vol. 2, Varias variables [on line]. 11ª ed. México: Pearson Educación, 2005-2006 [Consultation: 08/09/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5852. ISBN 9702606446.
- Larson, Ron; Hostetler, Robert P.; Edwards, Bruce H. Cálculo y geometría analítica. Vol. 2. 6ª ed. Madrid: McGraw-Hill, 1999. ISBN 8448123530.
- Bradley, Gerald L.; Smith, Karl J. Cálculo. Vol. 2, Cálculo de varias variables. Madrid: Prentice Hall, 1998. ISBN 8489660778.
- Strang, Gilbert. Cálculo y geometría analítica. 2a. Cambridge: Wellesley-Cambrigde Press, 1991. ISBN 9780961408824.
- Mora, Walter. Cálculo en varias variables: visualización interactiva con Wolfram CDFPlayer [on line]. Primera. Costa Rica: Tecnológica de Costa Rica, 2017 [Consultation: 20/07/2023]. Available on: https://galois.azc.uam.mx/mate/LIBROS/WMora-ITCR-CalculoVariasVariables.pdf. ISBN 9789930541043.