

Course guide

3200011 - MM1 - Mathematical Methods I

Last modified: 10/07/2025

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual 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 TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Compulsory subject).

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

LECTURER

Coordinating lecturer: Xavier Puerta Coll

Others: José Domínguez
José Gibergans Báguena
Rodrigo Ramírez
Oscar Oliver
Xavier Molinero
Jordi Saludes
Robert Velasquez

PRIOR SKILLS

Is highly desirable to have completed mathematics courses provided in the curriculum of the different types of secondary education giving access to degree studies.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CENG1-DIDP. Ability to solve mathematical problems that may arise in engineering. Aptitude to apply knowledge of: linear algebra; geometry; differential geometry; differential and integral calculus; numerical methods; statistical techniques. (Basic training module).
CE01-INDUS. Ability to solve mathematical problems that may arise 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. (Basic training module)

Transversal:

CT06 N1. Self-directed learning - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Basic:

CB1. That students have demonstrated possession and understanding of knowledge in a field of study that is based on general secondary education, and is typically found at a level that, while supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study.

TEACHING METHODOLOGY

- Lectures presenting content.
- Face-to-face sessions of practical work.
- Independent work study and conducting exercises.
- Preparation and implementation of individual and / or group activities.

In the sessions of explanatory content teacher introduce the theoretical foundations of the subject, concepts, methods and illustrated with suitable examples to facilitate understanding results. The students will independently study to assimilate the concepts, solve exercises either manually or with the help of computer.

Students will become familiar in the use of a mathematical software package in order to use it as a tool for numerical, symbolic and graphic calculation.

LEARNING OBJECTIVES OF THE SUBJECT

Students will have to consolidate the fundamental concepts of differential and integral calculus. They will also have to know and understand the concepts and results of linear algebra and geometry.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

TOPIC 1: COMPLEX NUMBERS

Description:

- 1.1. The concept of complex numbers.
- 1.2. Graphical representation.
- 1.3. Binomial, polar and trigonometric forms.
- 1.4. Operations with complex numbers.
- 1.5. Euler's formula.
- 1.6. Exponentiation. De Moivre's formula.
- 1.7. N-th root of a complex number.
- 1.8. Applications

Specific objectives:

- Understand the concept and representations of complex numbers and basic operations with complex numbers.

Full-or-part-time: 20h

Theory classes: 4h

Practical classes: 4h

Self study : 12h

TOPIC 2: SINGLE-VARIABLE DIFFERENTIAL CALCULUS

Description:

- 2.1. Derivative of a function at a point. Geometric interpretation of the derivative. The derivative function. Chain rule. Implicit differentiation. Differential of a function. Theorems.
- 2.2. Extrema. Optimization.
- 2.3. Finding roots: Bisection method; Newton method.
- 2.4. Taylor polynomial. Linear approximation.

Specific objectives:

- Understand the concept of continuous and derivable functions.
- Correctly interpret the meaning of a derivative.
- Correctly apply the concepts of linear approximation and Taylor polynomial approximation.
- Correctly carry out basic operations and use the technique of optimisation.
- Use of numerical methods to find zeros of a general function.

Full-or-part-time: 45h

Theory classes: 9h

Practical classes: 9h

Self study : 27h

TOPIC 3: INTEGRAL CALCULUS

Description:

- 3.1. Definite integration: Fundamental Theorem of Calculus. Barrow's rule.
- 3.2. Applications of definite integral.
- 3.3. Improper integrals.
- 3.4. Introduction to numerical integration.

Specific objectives:

For students to:

- Understand the concept of a Riemann definite integral, the fundamental theorem of calculus, and Barrow's rule.
- Apply the definite integral to find areas, moments of inertia, volumes, etc..
- Understand the concept of improper integral and the techniques for calculating them.
- Knowledge of numerical integration.

Full-or-part-time: 45h

Theory classes: 9h

Practical classes: 9h

Self study : 27h

TOPIC 4: LINEAR ALGEBRA: VECTOR SPACES AND DIAGONALISATION

Description:

- 4.1. Vector spaces over \mathbb{R} .
- 4.2. Subspaces of \mathbb{R}^n : Vector subspaces. Generated subspaces. Linear independence. Bases.
- 4.3. Diagonalisation. Eigenvectors and eigenvalues.

Specific objectives:

- Understand the specific concepts and techniques applicable to vector spaces, in particular \mathbb{R}^n spaces: vector subspaces, the generating set of a subspace, linear dependence and independence, bases.
- Calculate the eigenvalues and eigenvectors of a matrix and understand the diagonalisation technique.

Full-or-part-time: 40h

Theory classes: 8h

Practical classes: 8h

Self study : 24h

GRADING SYSTEM

The evaluation of the course will be partial evaluations by the following weights:

- Midterm exams: 40% first one and 40% second one.
- Tasks: 20%

In case of not obtaining a satisfactory mark in the first part, the exam may be repeated on the day and time of the second part, with the same weight. The mark of the renewal (can go from 0 to 10) only replaces the initial mark of the first partial if it is higher than it, and there is no restriction to appear. Only the note of the first partial will be redirected.

EXAMINATION RULES.

The evaluations consist of the partial exams and other evaluable activities that are part of the continuous evaluation. If any of the exams or activities are not carried out, it will be considered qualified with zero.

The irregular actions (for example to copy, to let copy) it will mean the qualification of fail with 0 in the act of evaluation.

BIBLIOGRAPHY

Basic:

- García Pineda, Pilar; Núñez del Prado, José Antonio; Sebastián Gómez, Alberto. Iniciación a la matemática universitaria: curso 0 de matemáticas. Madrid: Thomson, cop. 2007. ISBN 9788497324793.
- Larson, R. E.; Hostetler, R. P.; Edwards, B. H. Cálculo [on line]. 9ª ed. México: McGraw-Hill, 2010 [Consultation: 04/11/2021]. Available on : https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5686.
- Lay, David C; McDonald, Judi J; Lay, Steven R. Algebra lineal y sus aplicaciones [on line]. 5a ed. México: Pearson educación, 2016 [Consultation: 09/05/2022]. Available on : https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=6765. ISBN 9786073237451.
- Larson, Ron; Ibarra, Joel. Matemáticas IV: álgebra lineal. Ciudad de México: Cengage Learning, 2019. ISBN 9786075268200.
- Tomeo Perucha, Venancio; Uña Juárez, Isaías; San Martín Moreno, Jesús. Problemas resueltos de cálculo en una variable. Madrid: Thomson, 2005. ISBN 8497322894.

Complementary:

- Burgos Román, Juan de. Algebra lineal y geometría cartesiana [on line]. 3a ed. Madrid [etc.]: McGraw-Hill, cop. 2006 [Consultation: 09/05/2022]. Available on : https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4141. ISBN 8448149009.
- Rogawski, Jon. Cálculo [on line]. 2a ed. original. Barcelona: Reverté, cop. 2012 [Consultation: 09/05/2022]. Available on : <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5635409>. ISBN 9788429151664.
- Piskunov, N. Cálculo diferencial e integral. México: Limusa, 1994. ISBN 9681839854.

RESOURCES

Other resources:

- Exercises
- Theoretical notes
- Basic Maple tutorials