

Academic Year/course: 2022/23

30106 - Mathematics II

Syllabus Information

Academic Year: 2022/23

Subject: 30106 - Mathematics II

Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
179 - Centro Universitario de la Defensa - Zaragoza

Degree: 425 - Bachelor's Degree in Industrial Organisational Engineering
563 - Bachelor's Degree in Industrial Organisational Engineering

ECTS: 6.0

Year: 1

Semester: Second semester

Subject Type: Basic Education

Module:

1. General information

1.1. Aims of the course

Mathematical methods are a basic tool in Engineering. The aims of the course are precisely the knowledge of these tools, in a way that is both theoretical and applied to real problems (using mathematical software). This knowledge and techniques will serve as the basis for other subjects.

These approaches and objectives are in line with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (<https://www.un.org/sustainabledevelopment/es/>), in such a way that the acquisition of the course learning outcomes provides training and competence to contribute to their achievement to some degree.

SPECIALIZATION IN BUSINESS

- Goal 4. Quality Education:
 - 4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.
 - 4.5 By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations.
- Goal 9. Industry, Innovation and Infrastructure,
 - 9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending.
 - 9.b Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities.

DEFENSE

- Goal 4. Quality Education.
- Goal 16. Peace, justice and solid institutions.

1.2. Context and importance of this course in the degree

The subject is compulsory and forms part of the basic education of the students.

It is taught in the second semester of the first course and its content is part of the basis for other subjects. The practical approach of the subject helps to achieve this objective.

The unifying character of Mathematics simplifies problems dealt with in other subjects, and makes evident the similarities in apparently different problems.

DEFENCE:

This subject contributes to the training of Army Officers, providing tools for decision-making and developing the skills that Army Officers need to perform their duties and thus contribute to the fulfillment of the mission.

1.3. Recommendations to take this course

Students should have the knowledge and skills achieved in Mathematics I and II through the final years of high school (preferably, with curriculum in science and technology, especially in the management of matrices and resolution of systems of equations). It is recommended that students have assimilated the concepts of the module Mathematics I (30100) taught during the first semester.

To follow this course appropriately, continuous study is required. Moreover, students' questions should be answered just as they arise, both in class or during office hours.

2. Learning goals

2.1. Competences

- 1: Ability to solve problems and take decisions with initiative, creativity and critical reasoning.
- 2: Ability to communicate knowledge and skills in Spanish.
- 3: Ability to continue learning and develop self-learning strategies.
- 4: Ability to apply Information and Communication Technologies (ICTs) within the field of engineering.
- 5: Ability to solve mathematical problems in Engineering. Ability to apply knowledge about Linear Algebra, Numerical Methods, Geometry and Differential Geometry.

2.2. Learning goals

At the end of this module, the student should be able to:

1. Solve mathematical problems in Engineering.
2. Apply knowledge of Linear Algebra; Analytic Geometry and Differential Geometry; Numerical Methods and Algorithmics.
3. Know how to use numerical methods in solving proposed mathematical problems.
4. Knows the reflective use of symbolic and numerical calculation tools.
5. Possesses abilities of scientific-mathematical thinking, to ask and answer specific mathematical questions.
6. Has the ability to handle mathematical language; in particular, symbolic and formal language.

2.3. Importance of learning goals

Students are provided with basic mathematical and procedural knowledge that will be useful for other modules in the degree such as: Physics, Computer Studies, Mechanics, Statistics, Operative Research, Economy, Electronics, Resistance of Materials? The ability to apply mathematical techniques to solve concrete problems in different fields related to Engineering constitutes a fundamental skill for an engineer/officer, as well as the use of the available sources and the appropriate interpretation of results.

- 1: Apply the fundamental results of Linear Algebra, Analytic Geometry and Differential Geometry. Describe basic concepts such as: matrix, solution of a linear system, orthogonality, vector subspace, euclidean elements, curves and surfaces in 3-space.
- 2: Develop problem-solving strategies, distinguishing the most suitable method in each situation.
- 3: Explain the difficulties in attaining the exact solution of a problem and the necessity to apply numerical methods, determining their order of accuracy and error.
- 4: Use mathematical software to solve Linear Algebra problems as well as line and surface integrals.
- 5: Set and solve problems related to the areas above and applied to Industrial Organisational Engineering, selecting the most suitable methods and theoretical results. Moreover, students should be able to use the mathematical software proposed in no. 4 when these real problems are too complex for being solved by analytical methods.
- 6: Solve the problems described in no. 5 working as a team, expanding the information and methods proposed in class. Make oral presentations about the attained results, using an appropriate mathematical language and suitable computer programs.
- 7: Express, both orally and in writing, the basic concepts of the subject and the problem solving process, making use of scientific language.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

SPECIALIZATION IN BUSINESS

Continuous assessment:

- 2 midterm exam. Related learning goals: 1, 2, 3, 4, 5 and 7. Weight in the final grade: 80%.
- 4 Test: Related learning goals: 1, 2, 3, 4, 5, 6 and 7. Weight in the final grade: 20%.

Global assessment:

- Final exam. Related learning goals: 1, 2, 3, 4, 5 and 7. Weight in the final grade: 100%.

Assessment criteria: The assessment criteria are the same for all assessment tasks:

- understanding the mathematical concepts used to solve problems;
- the use of efficient strategies and procedures in their resolution;
- clear and detailed explanations;
- the absence of mathematical errors in development and solutions;
- correct use of terminology and notation; orderly, clear and organized exhibition.

DEFENSE

Continuous assessment:

The students will be able to pass the total of the subject by the continuous evaluation procedure. To do this, they must demonstrate that they have achieved the expected learning outcomes by passing the evaluation instruments indicated below which will be carried out throughout the semester:

1. Continuous assessment test 1. It will consist of carrying out a written exercise with a part of theoretical-practical questions and another of development problems corresponding to topics of Part I. Its weight in the final grade is 40%.
2. Continuous assessment test 2. It will consist of carrying out a written exercise with a part of theoretical-practical questions and another of development problems corresponding to topics of Part II. Its weight in the final grade is 40%.
3. Continuous assessment test 3. It will consist of carrying out a practical group work and its corresponding oral presentation. In this work, concepts of the subject, application of numerical approximation methods and use of mathematical software will be evaluated, as well as the oral expression of the concepts and procedures used. Its weight in the final grade is 15%.
4. Continuous assessment test 3. It will consist of elaborating a portfolio of the contents of the subject worked on in the classroom. Its weight in the final grade is 5%.

In the final mark of the continuous assessment (100%) all the tests of the evaluation instruments carried out throughout the course and its weight will be taken into account, without the requirement of achieving a minimum grade in each of the tests. To pass the subject, the student's final grade must be equal to or greater than 5.

Global Test:

First call

The students who do not pass the subject by continuous assessment or who would like to improve their grades, will have the right to take the Global Test set in the academic calendar, prevailing, in any case, the best of both grades. This global test will have a weight of 100% in the final grade. It will consist of an exam with two parts: a first with theoretical-practical questions and a second containing development problems and applied aspects. To pass the subject, the student's final grade must be equal to or greater than 5.

Second call

The students who do not pass the subject in the first call will have the right to take the Global Test set in the academic calendar for the second call. This global test will consist of an exam with two parts: a first with theoretical-practical questions and a second containing development problems and applied aspects and it will have a weight of 100% in the final grade. To pass the subject, the student's final grade must be equal to or greater than 5.

Assessment criteria

In the evaluation of each assessment the following criteria will be followed:

- Understanding of the mathematical concepts used to solve problems.
- Use of efficient strategies and procedures in their resolution.
- Clear and detailed explanations.
- Absence of mathematical errors in development and solutions;
- Correct use of terminology and notation; orderly, clear and organized exhibition.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

SPECIALIZATION IN BUSINESS

The learning process designed for this subject is based on the following:

Strong interaction between the teacher/student. This interaction is brought into being through a division of work and responsibilities between the students and the teacher. Nevertheless, it must be taken into account that, to a certain degree, students can set their learning pace based on their own needs and availability, following the guidelines set by the teacher.

Matemáticas II is conceived as a stand-alone combination of contents, yet organized into two fundamental and complementary forms, which are: the theoretical concepts of each teaching unit and the solving of problems or resolution of questions, at the same time supported by other activities.

The approach, methodology and assessment of this guide are intended to be the same for any teaching scenarios. They will be adapted to the social-health situation at any particular time, as well as to the instructions given by the authorities concerned.

DEFENCE

The proposed methodology tries to encourage the student's continuous work and focuses on practical aspects through the use of active methodologies in the classroom such as: problem solving, problem-based learning (PBL), group work and use of mathematical software. The teaching team will adapt the theoretical explanations to the development of the subject.

Throughout the semester, the student must take several evaluative tests.

The approach, methodology and assessment of this guide are intended to be the same for any teaching scenarios. They will be adapted to the social-health situation at any particular time, as well as to the instructions given by the authorities concerned.

4.2. Learning tasks

SPECIALIZATION IN BUSINESS

The programme offered to the student to help them achieve their target results is made up of the following activities...

Involves the active participation of the student, in a way that the results achieved in the learning process are developed, not taking away from those already set out, the activities are the following:

- **Face-to-face generic activities:**
 - **Lectures:** The theoretical concepts of the subject are explained and illustrative examples are developed as support to the theory when necessary.
 - **Practice Sessions:** Problems and practical cases are carried out, complementary to the theoretical concepts studied.
 - **Individual Tutorials:** Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.
- **Generic non-class activities:**
 - Study and understanding of the theory taught in the lectures.
 - Understanding and assimilation of the problems and practical cases solved in the practical classes.
 - Preparation of seminars, solutions to proposed problems, etc.
 - Preparation of summaries and reports.
 - Preparation of the written tests for continuous assessment and final exams.

The subject has 6 ECTS credits, which represents 150 hours of student work in the subject during the semester, in other words, 10 hours (Lectures: 4 h.; Other Activities: 6 h.) per week for 15 weeks of class.

The overall distribution is:

- 52 hours of lectures, with 50% theoretical demonstration and 50% solving type problems.
- 8 hours of written assessment tests.
- 90 hours of personal study, divided up over the 15 weeks of the semester.

There is a tutorial calendar timetable set by the teacher that can be requested by the students who want a tutorial.

DEFENCE

The subject consists of different types of activities:

1. Classes in which problem solving, theoretical explanations and the use of mathematical software are combined. These classes encourage student participation in the teaching-learning process.
2. Personalized attention in tutorials both in small groups and individually.
3. Continuous autonomous study and work by the student from the beginning of the course.
4. Self-evaluation activities of each of the topics through the Moodle platform.
5. Carrying out assessment tests.

4.3. Syllabus

SPECIALIZATION IN BUSINESS

- 1.- Systems of Linear Equations.
- 2.- Determinants.
- 3.- Numerical linear algebra.
- 4.- Vector Spaces.
- 5.- Orthogonality and Least Squares
- 6.- The Geometry of Vector Spaces.
- 7.- Diagonalization.
- 8.- Singular value decomposition.
- 9.- Multiple integrals: double integrals.
- 10.- Multiple integrals: change of variables; triple integrals.
- 11.- Plane and space curves: curvature and torsion.
- 12.- Line Integrals: the fundamental theorem for line integrals; Green's theorem.
- 13.- Surfaces: normal vector.
- 14.- Surface Integrals: Stokes' theorem, Gauss' theorem.

DEFENCE

The contents of the subject are the following:

PART I

- Matrices, linear systems and determinants.
- Vector spaces.

PART II

- Euclidean spaces.
- Linear maps.
- Eigenvalues and eigenvectors: Diagonal form.
- Bilinear and quadratic forms.

4.4. Course planning and calendar

SPECIALIZATION IN BUSINESS

A detailed schedule will be published on the Moodle page of the subject.

The dates of the final exams will be those that are officially published on the School website.

DEFENCE

The specific dates for the scheduled activities are made public on the Moodle platform, <http://moodle.unizar.es>, in which students are enrolled at the beginning of the course.

Besides, the course schedule can be found on the website of the Centro Universitario de la Defensa: <http://cud.unizar.es>

4.5. Bibliography and recommended resources

Bibliography available in:

SPECIALIZATION IN BUSINESS

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=30106>

DEFENCE

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=30106>