Universidad Zaragoza

Academic Year/course: 2022/23

30100 - Mathematics I

Syllabus Information

Academic Year: 2022/23
Subject: 30100 - Mathematics I
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: First semester
Subject Type: Basic Education
Module:

1. General information

1.1. Aims of the course

Many of the usual tools that engineering and defence professionals use in their practice rest on basic mathematical methods. The aims of this subject are precisely the knowledge of these methods, from both theoretical and applied points of view. The acquired knowledge and techniques will serve as the basis for other subjects of the Degree.

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.

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- 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.

SPECIALIZATION IN DEFENSE:

- Objective 4: Quality education.

1.2. Context and importance of this course in the degree

Mathematics I is a compulsory subject of 6 ECTS credits taught in the first semester of the first year of the Bachelor's Degree in Industrial Organisational Engineering. This subject provides training and tools that enable the student to overcome other scientific subjects of the curriculum that have mathematics as a basic tool, such as physics, statistics, computer science, mechanics or economics. The unifying character of Mathematics, that is, language and critical thinking and reasoning, simplifies problems dealt with in the above mentioned subjects.

SPECIALIZATION IN DEFENCE: This subject contributes to the training of Army Officers, providing the knowledge and skills of calculus and problem solving necessary for the performance of their duties.

1.3. Recommendations to take this course

It is recommended that students have followed the scientific-technological orientation at high school.

To follow this course successfully, it is also required a continuous effort and daily work from the beginning. It is advisable that the students make use of the different mechanisms provided by the teacher in order to overcome the difficulties that they may encounter.

2. Learning goals

2.1. Competences

When the subject is successfully passed, the student will have the?

C04 - Ability to solve problems and take decisions with initiative, creativity and critical reasoning.

C06 ? Ability to communicate knowledge and skills in Spanish

C11 ? Ability to continue learning and develop self-learning strategies.

C05 - Ability to apply Information and Communication Technologies (ICTs) within the field of engineering.

C12 ? Ability to solve mathematical problems in engineering. Ability to apply knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, differential equations, partial differential equations, numerical methods and algorithmic.

2.2. Learning goals

The student, to pass this subject, must show the following results:

1. Solve mathematical problems in Engineering.
2. Apply knowledge of Differential and Integral Calculus; 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

The results of the learning process are important since they provide the students the necessary mathematical basis for other subjects of a scientific-technological nature of the Degree, such as, Physics, Computer Science, Mechanics, Statistics, Operations Research, Economics, Electronics, Resistance of materials... The ability to apply mathematical techniques to solve problems of different fields related to engineering is a fundamental ability of an engineer/officer, as well as the use of the existing resources and the interpretation of the obtained results.

To know how to apply the fundamental results of the Differential and Integral Calculus of functions of one and several variables. The student shall also be capable of describing basic concepts such as limit, continuity, derivability and integration, as well as their most important applications and geometric interpretations.

To develop and experience problem solving strategies and distinguish the most suitable method for each situation.

Ability to reason the difficulty of solving a problem accurately and the necessity to resort to the application of numerical approximation methods for its resolution, determining the degree of accuracy and its error.

To know how to use some mathematical software and its applications in the Differential and Integral Calculus of functions of one and several variables.

Ability to propose and solve problems concerning the previous areas and applied to the Bachelor's Degree in Industrial Organisational Engineering, selecting in a critical way the most suitable theoretical methods and results. In the case of complex analytical procedures, the student shall be able to use the mathematical software proposed in section 4 to solve the above-mentioned problems.

To solve the problems of section 4, working as a team, and expand the information and methods proposed in the classroom. To make oral presentations of the obtained results by using the proper mathematical language and convenient computer programs.

To be able to express in a correct oral and written scientific language, the basic concepts of the subject as well as the problem solving process.

3. Assessment (1st and 2nd call)

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

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The student must show has achieved the expected learning goals through the following assessment tasks:

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.

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Assessment tasks:

- Theoretical-practical short assessments, such as questionnaires or short questions.
- Applied short assessments, such as questionnaires or short questions.
- Written questions, aimed at the detailed resolution of theoretical-practical problems.
- Applied software assessment.

First call

Continuous assessment:

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

1. Continuous assessment test 1. It will consist of carrying out a test containing theoretical-practical short assessments, applied short assessments, and solve problems in a detailed way. This assessment test 1 corresponds to units 1, 2, 3, 4, 5 and 6. Its weight in the final grade is 55%.
2. Continuous assessment test 2. It will consist of carrying out a test containing theoretical-practical short assessments, applied short assessments, and solve problems in a detailed way. This assessment test 2 corresponds to units 7, 8, 9 and 10. Its weight in the final grade is 40%.
3. Applied software assessment. It will consist of solving problems through the use of mathematical software. This issue will be done through Moodle. 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 questions. To pass the subject, the student's final grade must be equal to or greater than 5.

Final Exam

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 Final Exam set in the academic calendar, prevailing, in any case, the best of both grades (final mark of the continuous assessment, mark of the final exam). This Final Exam will have a weight of 100% in the final grade. It will consist of carrying out a test containing theoretical-practical short assessments, applied short assessments, and solve problems in a detailed way, without the requirement of achieving a minimum grade in each of the questions. This test covers the entire syllabus. 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 Final Exam in the academic calendar for the second call. This final exam will have a weight of 100% in the final grade. It will consist of carrying out a test containing theoretical-practical short assessments, applied short assessments, and solve problems in a detailed way, without the requirement of achieving a minimum grade in each of the tests. This Final Exam covers the entire syllabus. 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 mathematical concepts used to solve problems.

- The use of adequate strategies and procedures in its resolution.
- The absence of mathematical errors in the development and solutions.
- Clear and detailed explanations with justification in the answers.
- The correct interpretation of the results obtained.
- Correct use of the terminology and notation of the subject.
- Orderly, clear and organized exposition of the procedures used.
- Proper use of computer tools and/or mathematical software (if applicable).
- The result and final quality of the work (if applicable).

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

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

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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 I 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.

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- Lectures in which the main concepts are presented to the students, encouraging their active participation.
- Problem sessions alternating the presentation of worked-out examples by the teacher and the solution of problems by the students themselves.
- Symbolic, numerical and graphic calculation tools to consolidate concepts and verify results.
- Personal and autonomous work of the students throughout the term.
- Personalized attention by mentoring sessions either individually or in-group.

The approach, methodology and assessment of this course is prepared to be equivalent in any teaching scenario. It will be adjusted to the socio-sanitary conditions of each moment, as well as to the indications given by the competent authorities.

4.2. Learning tasks

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

It 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**:
    - **Theory Classes**: The theoretical concepts of the subject are explained and illustrative examples are developed as a 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.

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In-class lectures:
In-class lectures will flexibly alternate the theoretical exposition and the presentation of worked-out examples by the teacher with problem-solving periods in which the student will play the main role. When appropriate, the teacher will use symbolic, numerical and graphic calculation tools for concept consolidation.

Autonomous work by the student
In addition to regular problem sheets, for each lesson, the teachers will provide the students with self-evaluation exercises sheets in order to facilitate the training of the student in the main aspects of the subject. Also, some additional material (links to web sites, documents, etc.) will be made available for those students willing to deepen and broaden their knowledge.

Mentoring:
Teachers will be available for mentoring sessions in which the students can solve the questions and difficulties that may have arisen during their autonomous work.

4.3. Syllabus

The course will address the following topics:

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1.- Complex numbers.
2.- Real functions of one variable. Limits.
3.- Continuity.
4.- Differential Calculus.
5.- Classical theorems.
6.- Applications of Differentiation.
7.- Newton's method. Interpolation.
8.- Riemann's integral.
9.- The Fundamental Theorem of Calculus. Improper Integrals.
10.- Applications of Integration. Numerical quadrature.
11.- Functions of several variables: limits and continuity.
12.- Directional and partial derivatives.
13.- The Chain Rule.
14.- Tangent Planes and differentiability.
15.- Extrema. Extrema with constraints: Lagrange's multipliers.

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In-class lectures' program:

Lesson 1: Function of one real variable.
Lesson 2: Derivatives of functions of one real variable.
Lesson 3: Indefinite integrals.
Lesson 4: Definite integrals.
Lesson 5: Improper integrals.
Lesson 6: Functions of several real variables.
Lesson 7: Derivatives of functions of several real variables.
Lesson 8: Integration of functions of several real variables.
Lesson 9: Vector calculus.
Lesson 10: Sequences and series.

Computer-based program:

- Functions and functions approximation.
- Symbolic and numerical differentiation.
- Symbolic and numerical integration.

4.4. Course planning and calendar

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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.

S P E C I A L I Z A T I O N I N D E F E N C E :

The planning will be organized according to the previously presented program. Of course, this planning is subject to modifications according to the actual calendar. In particular, the dates of examinations and assignments deadlines will be announced on time in Moodle.

4.5. Bibliography and recommended resources

Students are encouraged to make use of the material that is made available at the Moodle Platform.

The bibliography is available at: http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=30100

Perfil Empresa

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=30100