Universidad Zaragoza

**Year : 2019/20**

# 30100 - Mathematics I

## Syllabus Information

**Academic Year:** 2019/20
**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
457 - 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.

## 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.

## 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:**

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.

### 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.

## 3.Assessment (1st and 2nd call)

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

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The assessment of this subject will be carried out through activities of the following types:

- Theoretical-Practical Tests.
- Applied Tests.

The Theoretical-Practical Tests evaluate the capacity of mathematical reasoning, and analytical and numerical development in theoretical-practical problems. During the semester, and coordinately with the rest of the subjects of the course, there may be written continuous assessment tests corresponding to the first block of the subject. A grade equal to or higher than 4.5 in these continuous assessment tests will exempt the interested student from the repetition of the first block in the final evaluation test of the first call of the course. In this case, the student must pass the corresponding part of the theoretical and practical contents not covered in the continuous assessment tests. To pass the Theoretical-Practical Tests in the first call of the course, students must obtain a grade equal to or higher than 4.5 in each of the blocks and the average of them must be greater than or equal to 5. In the second call, the exam will not have an explicit separation between blocks and it will be enough to obtain a grade greater than or equal to 5 to pass the theoretical-practical module.

The Applied Tests evaluate the ability of mathematical reasoning and the skills in the use of symbolic, numerical and graphic calculation tools in problems of applied character. During the semester, following the presentation of the contents, a series of computer practicum will be carried out. The evaluation of each computer practicum will be done through one or more of the following methods: individual written questionnaires, collection of the work files, and/or the preparation of a report. To pass the Applied Tests it will be necessary to obtain an average grade equal to or greater than 5. The passing of these practical sessions during the semester will exempt the interested student from taking a final evaluation test of the Applied Tests.

**To pass the subject** it will be necessary to fulfill the following two conditions: (1) to score a grade equal to or greater than 5 in the average grade of the Theoretical-Practical Tests, (2) to score a grade greater than or equal to 5 in the average grade of the Applied Tests.

The final grade of the subject will be a weighted average of the marks obtained in the Theoretical-Practical and the Applied Tests. The weight corresponding to the Theoretical-Practical Tests will be at least 85%, whereas the weight corresponding to the Applied Tests will not exceed 15% of the final mark.

In the case of not passing the subject in the first call of the course but overcoming one of the modules (Theoretical-Practical or Applied Test), the qualification of the passed module may be maintained at the second call of the subject within the academic year.

## 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.

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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.
- Computer-based sessions using suitable mathematical software.
- Personal and autonomous work of the students throughout the term.
- Personalized attention by mentoring sessions either individually or in-group.

## 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**:
  - **Lectures**: 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.

*Computer-based sessions:*

During the term, four computer-based sessions will take place, either in the classroom (using the students' personal laptops) or in the computer laboratory. These sessions will start with a brief theoretical introduction by the teacher, followed by a period of autonomous work by the students (with the help of the teacher) and will end with a short assessment task.

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

Computer-based sessions' program:

Session 1: Introduction to mathematical software.
Session 2: Functions and functions approximation.
Session 3: Symbolic and numerical differentiation.
Session 4: 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.

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The planning of in-class and computer-based sessions 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 the deadlines for written assignments 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://psfunizar7.unizar.es/br13/egAsignaturas.php?codigo=30100