

## 27001 - Calculus I

### Syllabus Information

**Academic Year:** 2022/23

**Subject:** 27001 - Calculus I

**Faculty / School:** 100 - Facultad de Ciencias

**Degree:** 453 - Degree in Mathematics

**ECTS:** 13.5

**Year:** 1

**Semester:** Annual

**Subject Type:** Basic Education

**Module:**

## 1. General information

### 1.1. Aims of the course

It is a basic course in the degree. The goal is that the student understands which kind of problems require the use of one variable calculus and how to make use of it to deal with this kind of problems.

These approaches and objectives are aligned 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 learning outcomes of the module provides training and competence to contribute to some extent to their achievement: (4) Quality education, (5) Gender equality, (8) Decent work and economic growth, (9) Industry, innovation and infrastructure, (10) Reducing inequality, (17) Partnerships for the goals.

### 1.2. Context and importance of this course in the degree

The course is included in the module of Initiation to Mathematical Analysis. It is advisable to have passed this course before continuing with other courses in this module. As a basic course, the knowledge of the contents in Calculus I is convenient for most of the subjects in later courses.

### 1.3. Recommendations to take this course

It is advisable the presence in the theoretical and practical lectures and work in a continuous way with the material, notes, scripts for practical lectures, and problem sheets provided by the instructor. It is also advisable to make use of individual tutorization, the schedule of which will be provided at the beginning of the course. The people who cannot follow the course in a presential way will be evaluated with exams corresponding to the official periods in May or June and June or July.

## 2. Learning goals

### 2.1. Competences

**After passing this course the student will be more competent to:**

Develop in the handle of the goals described in the Learning outcomes section.

Among the general competences that the student graduated in mathematics acquires, we point out the following:

CG1. Having and comprehending knowledge in the area of Mathematics in a level that, starting from the education acquired in secondary studies, makes use of advanced texts and includes some aspects that imply knowledge from the vanguard in the study of Mathematics.

CT3. Distinguish, when in front of a problem, what is substantial and what is accessory. Formulate conjectures and reason in order to confirm them or refute them. Identify mistakes in incorrect reasonings, and so on.

CE1. Understand and make use of the mathematical language and methods. Know rigorous proofs of basic theorems in different branches of Mathematics.

CE3. Solve mathematical problems by basic calculus skills and other techniques.

### 2.2. Learning goals

**In order to pass this course, the student must show the following:**

He/She knows how to handle inequalities, sequences, and series.

He/She analyzes and draws graphs of functions, deduces properties of a function from its graph, understands and works in an intuitive, geometric, and formal way with the notions of limit, derivative, and integral.

He/She computes derivatives of functions by using the chain rule.

He/She computes and studies extrem values of functions.

He/She computes integrals of functions.

He/She solves problems that imply the use of integration (computation of lengths, areas, volumes, areas of revolution bodies, and so on).

He/She understands the use of power series and their convergence.

### **2.3. Importance of learning goals**

They provide a basic formation in the degree (see *Context and importance of this course in the degree*).

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

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

There will be an assessment for each term. In order to pass the course it will be needed to pass each one of both terms. With this requisite, the final mark of the course will be the mean of the marks in both terms.

During the course there will be several short examinations and a global exam of the contents in each term. There will also be practical computer sessions.

The short examinations will take place during some lecture hours. The dates and the contents covered in each examination will be announced in advance. It is estimated that there will be two or three short examinations in each term, although this number might change if the circumstances so require. The short examinations marks will have a total weight of 20 percent in the mark of the corresponding term. If the development of the course allows it, these short examinations could be substituted or complemented with some short tasks.

There will be a global exam for the first term in January, in the date fixed by the Faculty of Sciences.

In each period of exams (May or June the first, June or July the second), in the dates fixed by the Faculty of Sciences, there will be a global exam for the first term and a global exam for the second term. In this two calls there will be a computer practical exam with a computer for those who did not pass this part in the practical computer sessions during the course.

The mark of a passed term will be kept during the academic year. Those students who pass one of the terms will not have to take an exam of that term any more.

In no case the students' right, according to present regulation, to pass the course by taking one final global exam will be violated.

## **4. Methodology, learning tasks, syllabus and resources**

### **4.1. Methodological overview**

**The methodology designed for this course is based on the following:**

- Theoretical lectures.
- Problem sessions and short tasks.
- Practical computer sessions.
- Individual tutoring.
- The use of Moodle.
- Autonomous work and study carried out by the student.

### **4.2. Learning tasks**

**The program offered to the student in order to help him/her achieve the expected results includes the following activities:**

- Attendance to the theoretical lectures
- Problem solving
- Individual tutoring

- Practical computer sessions

The teaching activities and assessment tasks will take place in a face-to-face mode, except in the case that, due to the health situation, the dispositions emitted by the competent authorities and by the University of Zaragoza compel to take them to a greater or lesser extent in a telematic form.

### 4.3. Syllabus

This course will address the following topics:

1. **Real numbers.** Inequalities.
2. **Sequences of real numbers.** Convergence. Computation of limits.
3. **Series of real numbers.** Series of non-negative terms. Convergence criteria. Series of any kind of terms. Methods to sum series.
4. **Continuity.** Limits of functions. Continuous functions. Properties. Weierstrass, Bolzano and Darboux theorems. Classification of discontinuities.
5. **Differentiability.** Differentiation rules. Rolle's and Mean Value theorem. Extreme values of functions. L'Hôpital's rule. Taylor's and Young's theorems. Applications.
6. **Integration.** Riemann's integral. Properties of the integral. Fundamental theorems of integral calculus. Applications of integral calculus. Improper integrals.
7. **Power series.** Convergence of power series. Differentiability and integrability of power series.

### 4.4. Course planning and calendar

See the academic calendar in the University of Zaragoza websites as well as the timetable in the Faculty of Sciences website and Moodle.

The short examinations will take place during some lecture hours. The dates will be announced well in advance, taking into account the preferences of the students.

A written exam will take place in January in the date fixed by the Faculty of Sciences.

Written exams will take place in the official calls in May or June and June or July, in the dates fixed by the Faculty of Sciences..

### 4.5. Bibliography and recommended resources

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=27001>