27001 - Calculus I

Syllabus Information

Academic year: 2023/24
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

The object of this module is the differential and integral calculus of real functions of one real variable, with attention to both the practical part and the theory: sequences and series of real numbers; continuous functions, limits and derivatives; calculus of primitives, the Riemann integral and improper integrals; and power series.

The approaches and objectives of this module are aligned with the Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda; the learning activities could contribute to some extent to the achievement of the goals 4 (quality education), 5 (gender equality), 8 (decent work and economic growth), and 10 (reducing inequality).

2. Learning results

- Handle and solve inequalities with real numbers.
- Know the fundamental properties of elementary functions.
- Understand the concept of sequence of real numbers, limit of a sequence and the Bolzano-Weierstrass theorem.
- Handle the rules for the calculation of limits of sequences.
- Understand the idea of series of real numbers and know some convergence criteria, as well as some methods of summation.
- Understand the ideas of continuous function and limit of a real function of a real variable.
- Handle the rules for the calculation of limits of functions.
- Understand Bolzano's theorem and Weierstrass' theorem about absolute extremes.
- Understand the idea of derivative, its properties, its relation with the increasing or decreasing of a function, its extrema and convexity, the mean value theorems, L'Hôpital's rule and Taylor's formula.
- Understand the definition of the Riemann integral and the most relevant theorems of the integral calculus (Barrow's rule, fundamental theorem, integration by parts, changes of variable).
- Know some methods of calculus of primitives and some applications of the integral calculus.
- Understand the idea of improper integral and know some convergence criteria.
- Understand and handle the main properties of power series.
- Understand the importance of rigor in mathematics and the role of proofs and understand the epsilon-delta and similar arguments.

3. Syllabus

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. Academic activities

Master classes: 90 hours.
Problem solving: 35 hours.
Computer classes: 10 hours.
Study: 187 hours.
Assessment tests: 15.5 hours.

5. Assessment system

There will be an assesment 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 dates and the contents covered in each short 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.

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

In each period of exams (May or June the first, June or July the second), in the dates fixed by the Facuty 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.