

Functions of a Real Variable

Code: 100087
ECTS Credits: 12

Degree	Type	Year	Semester
2500149 Mathematics	FB	1	A

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Josep Maria Burgués Badía
Juan Jesús Donaire Benito
Francesc Mañosas Capellades
Joaquin Martin Pedret
Laura Prat Baiget

Prerequisites

It is essential that the students are able to handle with algebraic manipulation of fractions, expressions that contain roots and powers, resolution of linear systems and basic arithmetic of numbers and polynomials. It is also recommended to know the elementary properties of trigonometrical functions. Finally, we hope that the student can do, without much difficulty, the graphic representation of relatively simple functions of one variable. We also presume that the person who attends this course is familiar with logical reasoning and who knows how to deny sentences or proposals.

The most important requirement is, however, a great curiosity to understand and deepen the concepts that will be studied.

Objectives and Contextualisation

The objective of the subject is that the student learns solidly the basic concepts of the Infinitesimal Calculus: functions of discrete variable (sequences) or continuous, the concepts of limit, derivative and the theory of integration. It is also a basic objective to achieve a certain skill in the manipulation and calculation of limits, derivatives and integrals and to know how to apply the fundamental theorems of this theory. Finally, there is also a generic educational objective: that the student begin to develop the ability to analyze and to reason rigorously.

Competences

- Assimilate the definition of new mathematical objects, relate them with other contents and deduce their properties.
- Calculate and reproduce certain mathematical routines and processes with agility.
- Develop critical thinking and reasoning and know how to communicate it effectively, both in ones own languages and in a third language.
- Formulate hypotheses and devise strategies to confirm or reject them.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Understand and use mathematical language.
- Use computer applications for statistical analysis, numeric and symbolic calculus, graphic display, optimisation or other purposes to experiment with Mathematics and solve problems.

Learning Outcomes

1. Assimilate the mathematical concepts and objects of the subject as described in its contents.
2. Calculate and study the extrema of functions.
3. Calculate derivatives of functions using the chain rule, the implicit function theorem, etc.
4. Calculate integrals of functions of a variable.
5. Deal with inequalities and successions, analyse and draw functions, deduce the properties of a function on the basis of the graph, understand and work intuitively, geometrically and formally with the notions of limit, derivative and integral.
6. Demonstrate knowledge of the inherent objects of calculus with functions of a real variable and of its properties and uses.
7. Develop autonomous strategies for problem-solving such as identifying the field of course-related problems, discriminating routine problems from non-routine ones, designing an a priori strategy to solve a problem, evaluating a strategy and modifying it if necessary and in the context of a specific problem translate theoretical results that could be useful for resolving it.
8. Develop critical thinking and reasoning and know how to communicate it effectively, both in ones own languages and in a third language.
9. Follow and understand an oral explanation of a mathematical subject related with the course.
10. Read and understand course level mathematical texts.
11. Solve problems that imply the use of integrals (longitudes, areas, volumes, etc.).
12. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.

Content

I. The real line.

II. Sequences of real numbers.

- Sequences. Limit. Monotonicity
- Accumulation points. Subsequences.
- The Bolzano-Weierstrass theorem
- Cauchy sequences.

III. Continuity of one variable functions.

- Functions of one variable. Limits.
- Continuity..
- Bolzano and Wierstrass theorems
- Monotone functions. Inverse function.

IV. Differential Calculus.

- Derivative of a function at a point. Derivative of a function. Algebraic properties.

- The chain's rule. Derivative of the inverse.
- Critical points, maxima and minima.
- Rolle's theorem. Mean value theorem. L'Hopital's rule.

V. Aproximation by Taylor's polinomial

- Contact order between fonctions
- Taylor polynomial. Properties
- Local study of a function.

VI. Riemann integral

- Computing areas. Lower and upper sums. Integrability. Integral
- Fundamental Theorem of Calculus
- Calculation of primitives
- Geometric and phisic applications of the integral

Methodology

The subject has two groups of theory, two problem groups and four seminars-practicals.

The group to which the student belongs can be consulted on the website of the degree course <http://mat.uab.cat/gmat>.

There will be two sessions of one hour a week of theory and two sessions of problems. The Seminars will be devoted to work in a tutored group.

The hours and classrooms must be consulted on the website of the degree.

In yhe Moodle of the subject, the student will have at his disposal the necessary material to follow all the sessions There you can find, notes, lists of problems, observations made by teachers or teachers

News that may be relevant to the development of the subject.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theory classes	59	2.36	
Type: Supervised			
Classes of problems	30	1.2	
Tutored activities	25	1	
Type: Autonomous			
Realization of problems	100	4	
Test Preparation	22	0.88	
Theory Study	50	2	

Assessment

The subject has a single call that closes in July. There will be two short tests, one per semester, which will provide a qualification T. Four of the seminars (two in the first semester and two in the second) will include an

assessable activity. The evaluated seminars will provide a qualification S. There will be two partial tests at the end of each semester with qualifications P1, P2. Based on these activities, a continuous evaluation note C will be obtained, given by

$$C = 0.15 T + 0.15 S + 0.35 P1 + 0.35 P2$$

Finally the June qualification will be

$$J = \text{Max} \{C, 0.5 P1 + 0.5 p2\}$$

If J is greater than or equal to 5, the student has passed the subject. Students who have not passed the subject or those who want to improve their qualification may submit to a proof of recovery or improvement of note, with contents of the whole course.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Continuous evaluation	30	10	0.4	
Semester exam February	35	2	0.08	1, 3, 2, 6, 7, 8, 10, 5, 12, 9
Semester exam June	35	2	0.08	1, 3, 2, 4, 6, 7, 8, 10, 5, 12, 11, 9

Bibliography

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F. Mañosas Apunts de Funcions de variable Real. Campus Virtual

R. Larson, R. P. Hostetler, B. Edwards. Cálculo I. Ediciones Pirámide. 2002.

J. M. Ortega. Introducció a l'Anàlisi Matemàtica. Manuals de la Universitat Autònoma de Barcelona 4, Bellaterra 1990.

W. Rudin. Principios de Análisis Matemático. Ed. McGraw-Hill. 1980.