Universitat Autònoma de Barcelona

2023/2024

Fundamental Mathematics

Code: 100089
ECTS Credits: 9

Degree	Type	Year	Semester
2500149 Mathematics	OB	1	1

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

Eduardo Gallego Gómez

Marc Masdeu Sabate

Prerequisites

Beyond a good understanding of the basic notions in arithmetic and some skill in handling algebraic expressions, no prerequisites are needed for this course. Nonetheless it is important to have the will to understand the mathematical arguments and to sharpen one's crtical thinking.

Objectives and Contextualisation

In the first part of the course we will introduce the basic language of mathematics. A great deal of time will be dedicated to getting to handle this new language correctly, as it is essential to understand, produce and share mathematics.

Particular stress will be put on the logic arguments (implication, equivalence, contraposition). The student will get acquainted to these through the diverse themes of the course: basic set theory, arithmetic, polynomials, etc.

Competences

- Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.

- Apply critical spirit and thoroughness to validate or reject both one's own arguments and those of others.
- 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.
- Identify the essential ideas of the demonstrations of certain basic theorems and know how to adapt them to obtain other results.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- 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. Acquire basic training to be able read the headings of results and their demonstrations, identify situations in which counter-examples are necessary.
2. Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
3. Adapt theoretical reasoning to new demonstrations and situations.
4. Apply critical spirit and thoroughness to validate or reject both one's own arguments and those of others.
5. Deal with the basic concepts of set theory as shown in the table of contents.
6. Resolve congruencies and calculate roots of polynomials
7. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
8. 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.
9. Understand equivalence and order ratios.
10. Understand quotient sets and work with them.
11. Understand some demonstration methods.
12. Understand the basic concept of application and know how to apply it.
13. Use symbolic computation to resolve congruencies and decompose polynomials.
14. Use the methods of some demonstrations to make specific calculations: resolution of Diophantine equations and congruence equations, factorisation of polynomials if any root is known

Content

1. Logic

2. Set theory

3. Groups

4. Arithmetic

5. Polynomials

6. The complex numbers

Methodology

There are three type of activities the student is supposed to attend: the lectures (3 hours /week) mainly concerned with the description of the theoretical concepts, problem solving sessions (1 hour/week) and seminars (2 hours on alternate weeks), similar to the problem solving sessions but where students work in groups supervised by a teaching assistant. The course has a web page in the UAB online campus gathering all information and communications between students and professors, and where all material, including problem sheets, solutions, etc are published regularly.

The methodology and the activities are adapted to the training objectives of the course: introduce the mathematical language, learn to use it correctly, see demonstrations and demonstration methods. To achieve the objectives it is important that the first-year student sees and understands the development of the theory but also, and may be above all, that she/he tries to do the exercises, writing them correctly, imitating what she/he has seen in theory lectures.

It must be borne in mind that the correct assimilation of the syllabus of this subject requires dedication, continuous and sustained work on the part of the student. In an indicative way, you would have to work on a personal basis as many hours a week as class hours has the subject. In case of doubts it is important to ask the instructors.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	40	1.6	4, 11, 12, 10, 5, 13
Problem session	30	1.2	8, 7
Type: Supervised			
Working seminars	12	0.48	
Type: Autonomous			
Studying theoretical concepts and solving problems	131	5.24	3, 4, 11, 12, 10, 9, 5, 8, 7, 6, 13, 14

Assessment

Students will be evaluated according to the following guidelines:

1) The homework counts for 15% of the total grade.

2) Seminars count for 25% of the final grade.

3) Mid term exam: 30% of the final grade.

4) Final Exam: 30% of the final grade.

To pass without attending the reevaluation exam, the mean grade of the Mid-term Exam and the Final Exam has to be at least 3.5.

Students with a score (after 1,2,3,4) not high enough to pass (and only these students) may attend the reevaluation exam. Then, the grade of this exam will replace that of the mid-term and final exams. Activities 1 and 2 cannot be re-evaluated.

Students not attending 50% of all evaluation activities (and only these students), will get the mark "Not assessable".

Guidelines for students in "unique global evaluation":

1. There will be the same three types of evaluations: exam, homework and seminars, with the same relative weights and the same conditions for re-evaluation.
2. Exams: There will be a single final exam including the full content of the course.
3. Homework: The student will be asked to make an oral presentation of one of the exercises that have been worked out in the problem sessions of the course.
4. Seminars: The studen will be asked to make an oral presentation of some topics discussed in the seminar sessions of the course.
5. All these evaluation procedures will take place the same day of the final exam.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final test	30%	3	0.12	3, 4, 11, 12, 10, 9, 5, 8, 7, 6, 13, 14
Homework assignments	15%	0	0	3, 1, 4, 11, 12, 10, 9, 5, 8, 7, 6, 13, 14
Mid-term test	30%	3	0.12	3, 4, 11, 12, 10, 9, 5, 8, 7, 6, 13, 14
Reevaluation exam	60%	3	0.12	3, 4, 11, 12, 10, 9, 5, 8, 7, 6, 13, 14
Seminars	25%	3	0.12	4, 11, 2, 12, 10, 9, 5, 8, 7, 13, 14

Bibliography

Main textbook:

J. Aguadé, *Matemàtiques: comenceu per aquí*. Manuscript to be published.

Other interesting books:

M. Aigner i G. M. Ziegler, *Proofs from The Book*. Springer Verlag, 1999.

R. Antoine, R. Camps i J. Moncasi. *Introducció a l'àlgebra abstracta amb elements de matemàtica discreta*. Manuals de la UAB, Servei de Publicacions de la UAB, núm. 46, Bellaterra, 2007.

A. Cupillari, *The nuts and bolts of proofs*. Elsevier Academic Press, 2005.

P.J. Eccles, *An introduction to mathematical reasoning, numbers, sets and functions*. Cambridge University Press, Cambridge, 2007.

D.C. Ernst, *An Introduction to Proof via Inquiry-Based Learning*. Northern Arizona University 2017

A. Reventós, *Temes diversos de fonaments de les matemàtiques*. Apunts.

Software

Sage