

27011 - Algebraic Structures

Syllabus Information

Academic Year: 2022/23

Subject: 27011 - Algebraic Structures

Faculty / School: 100 - Facultad de Ciencias

Degree: 453 - Degree in Mathematics

ECTS: 6.0

Year: 2

Semester: Second semester

Subject Type: Compulsory

Module:

1. General information

1.1. Aims of the course

The goal of this course is to introduce the students to abstract algebra.

This will be done starting with the algebraic structures of commutative rings, extending their more concrete. knowledge of integers and polynomials.

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 student should have passed the courses *Números y conjuntos* and *Álgebra lineal* before enrolling in this course, as this is strongly based on them. The course is a step further in the abstraction process, which is part of the realm of Mathematics.

1.3. Recommendations to take this course

This course assumes an interactive approach in its structure and in its presentation, which requires engaged participation from all members of the class. The student's presence is essential to the liveliness of this course and concomitantly to their individual success in it. Therefore, regular attendance is expected.

Students should work on the exercises and problems sheets regularly, should study on a continuous basis and should make use of the office hours (their schedule will be communicated at the beginning of the course).

2. Learning goals

2.1. Competences

Being successful in this course should mean that the student is competent to:

- Reason in an abstract way.
- Recognize algebraic structures and be able to delve into their behavior.
- Be able to write and communicate abstract concepts of Mathematics.
- Be able to learn by oneself, and to look for information through different media.

2.2. Learning goals

The student, in order to pass this course, should show proficiency in the following aspects:

- Be familiar with quotient structures.
- Operations in abelian groups.

- Operations in commutative rings, with special emphasis on the rings of integers and of polynomials.
- Construction of new rings from known ones and checking the properties that are inherited.
- Factorization as a product of irreducible elements.
- Manipulate algebraic expressions with algebraic elements.

2.3. Importance of learning goals

Being able to do abstract and logical reasoning is an essential part of mathematics.

3. Assessment (1st and 2nd call)

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

The student will show that she/he has reached the learning goals through the following activities of continuous evaluation:

15% obtained from the resolution of questions of problems posed in the lectures, in the tutoring sessions, or in specific collections of problems proposed by the teacher.

50% obtained from the result of exams which at least one will take place,

The remaining 35% will be obtained from an exam of global nature. Taking this exam will be voluntary for the students that will overcome the course with the points obtained from the above procedures.

At any rate, the student has the right of being graded on the ground of a single global exam instead of the previous procedure.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, problem-solving sessions, tutorials and autonomous work and study.

4.2. Learning tasks

This course is organized as follows:

- **Lectures.**
- **Problem-solving sessions.** Interactive classes for exercises and problems.
- **Autonomous work and study.** Use of the Moodle.
- **Tutorials.** Professor will attend students during office hours, which is highly recommended.
- **Small groups.** Question discussing and problem-solving

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

- **Topic 1. Arithmetic.**
 - Integers.
 - Congruences.
- **Topic 2. Rings.**
 - Groups and monoids.
 - Rings: definitions, constructions, and homomorphisms.
- **Topic 3. Factorization.**
 - Factorization in integral domains.
 - Factorizations in polynomial rings.
- **Topic 4. Introduction to module theory.**
 - Definitions.
 - Free and torsion modules.
 - The theorems of structure.

4.4. Course planning and calendar

There will be four one-hour classes each week of the corresponding semester.

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the Faculty of Sciences website and Moodle.

4.5. Bibliography and recommended resources

- N. Bourbaki, Elements of Mathematics. Algebra, (2 vol.) Springer.
- P. M. Cohn, Groups, Rings and Fields, Springer
- N. Jacobson, Basic algebra I and II, Dover Publications, inc.
- S. Lang, Algebra, Springer.
- B. L. van der Waerden, Modern algebra, 2 vols. Springer.

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=27011>