

## 27011 - Algebraic Structures

### Información del Plan Docente

<b>Academic Year</b>	2017/18
<b>Faculty / School</b>	100 - Facultad de Ciencias
<b>Degree</b>	453 - Degree in Mathematics
<b>ECTS</b>	6.0
<b>Year</b>	2
<b>Semester</b>	Second semester
<b>Subject Type</b>	Compulsory
<b>Module</b>	---

### 1. General information

#### 1.1. Introduction

Short presentation of the course

Prime and irreducible elements and the problem of factorization will be considered in the rings of integers and of polynomials over a field. These concepts and properties will be studied in several classes of commutative rings: euclidean domains, principal ideal domains and unique factorization domains).

Modules over principal ideal domains will be considered briefly, with special emphasis on abelian groups.

Finally, field extensions, mostly obtained as quotients of polynomial rings will be introduced.

There will be two groups, according to the language: Spanish and English.

Students taking the English option will have this reflected in the so called "Suplemento Europeo al Título".

Moreover, those students who pass at least 18ECTS by means of English options will get for free the credits of the course (24900): "Idioma Moderno Inglés B1.

#### 1.2. 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).

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### 1.3.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.

### 1.4.Activities and key dates

The exams will be given following the official dates established by the School of Sciences at the beginning of the academic year.

Students should follow regularly both the theoretical classes and the classes devoted to exercises and problems.

## 2.Learning goals

### 2.1.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.
- Work on finite fields.

### 2.2.Importance of learning goals

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

## 3.Aims of the course and competences

### 3.1.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.

### 3.2.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.

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- Be able to write and communicate abstract concepts of Mathematics.
- Be able to learn by oneself, and to look for information through different media.
- All the bla, bla, bla, one may think of.

### 4. Assessment (1st and 2nd call)

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

10% of the final grade will be obtained by means of a continuous evaluation throughout the course. This will include solving exercises sheets and share the information with the classmates.

There will be a final exam which will amount for the remaining 90% of the final grade.

The student has the right to base his/her final graded on just a global exam.

### 5. Methodology, learning tasks, syllabus and resources

#### 5.1. Methodological overview

The learning process of this course is based on:

- Theory classes.
- Interactive classes of exercises.
- Individual self-study and individual attention during office hours.

#### 5.2. Learning tasks

The learning activities of this course consist of:

- Theory classes.
- Interactive classes of exercises.
- Self-study, using material uploaded to the associated Moodle webpage on the "Anillo Digital Docente" of the university (enrolled students are given the keys to access it).
- Personal attention during office hours (highly recommended!).

#### 5.3. Syllabus

- Integers.
  - o Division
  - o Congruences
- Rings
  - o Definitions and examples
  - o Homomorphisms and ideals
  - o Field of fractions
  - o Divisibility
  - o Matrices over a principal ideal domain
  - o Appendix: The Axiom of Choice and Zorn's Lemma
- Modules
  - o Definition and examples
  - o Direct sums. Free modules
  - o Finitely generated modules over PIDs
- Polynomials
  - o Irreducibility
  - o Roots
  - o Resultant and discriminant

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- o The Fundamental Theorem of Algebra
  - Fields
- o Algebraic extensions
- o Quadratic, cubic and quartic equations
- o Ruler and compass constructions
- o Appendix: pi is transcendental

### 5.4.Course planning and calendar

Consult the schedule approved by the School of Sciences.

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

### 5.5.Bibliography and recommended resources

- Beachy, J.A.: Abstract Algebra on line. <http://www.math.niu.edubeachy/aaol>
- Dorronsoro, José. Números, grupos y anillos / José Dorronsoro, Eugenio Hernández . - [1ª ed.], 2a reimp. Harlow [etc.] : Addison-Wesley ; Madrid: Universidad Autónoma de Madrid, 1999
- Dummit, David Steven. Abstract algebra / David S. Dummit, Richard M. Foote . - 2nd ed. Upper Saddle River,N.J. : Prentice Hall, cop.1999
- Herstein, I. N.. Álgebra abstracta / I. N. Herstein. - México : Grupo Editorial Iberoamericano, 1988
- Kostrikin, A.I.. Introducción al álgebra / A.I. Kostrikin ; traducido del ruso por Roberto Anibal Sala . - 2a ed. amp. y rev. Moscú : Mir, 1983
- Xambó-Descamps, Sebastián. Introducción al álgebra. Vol. 1 / Sebastián Xambó, Félix Delgado, Concha Fuertes . Madrid : Editorial Complutense, D.L. 1993
- Xambó-Descamps, Sebastián. Introducción al álgebra. Vol. 2 / Sebastián Xambó, Félix Delgado, Concha Fuertes. - Valladolid : Universidad de Valladolid, 1998

In the "Anillo Digital Docente" there will be material available to the students, like course notes, exercises sheets, samples of previous years exams, more references, ....