



# Non-Commutative Algebra

## Syllabus

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<b>Course code:</b>	1606
<b>Number of ECTS credits:</b>	6
<b>Semester:</b>	2nd (February-June)
<b>Prerequisites:</b>	The student should have passed 60 ECTS of basic courses and other 60 credits in compulsory courses
<b>Recommended components:</b>	You should be familiar with the basic language of abstract algebra: groups, rings, fields, etc.
<b>Language of instruction:</b>	Spanish, unless all the students agree to have instruction in English (students are allowed to ask questions and write homeworks and exams in English)

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### Course description

Non-Commutative Algebra deals with non-commutative algebraic objects, mostly non-commutative rings, and with their applications on other areas of mathematics, as for example Group Theory, Geometry and Topology.

### Learning outcomes and competences

After completion of this course you will:

1. know the basic theorems of ring and module theory.
2. be able to understand some proofs of non-commutative algebra.
3. be able to solve some problems of ring and module theory.

### Course contents

1. **Rings.** Examples of non-commutative rings. Subrings and ideals. Quotient rings. Homomorphisms of rings.
2. **Modules.** Modules and submodules. Operations with modules and submodules. Homomorphism of modules. Free and projective modules.
3. **Semisimple rings and semisimple modules.** Simple modules. Semisimple modules. Wedderburn-Artin Theorem. Maschke Theorem.
4. **Decomposition of modules on direct sum.** Indecomposable modules. Krull-Schmitz Theorem.

5. **Chain conditions on rings and modules.** Noetherian, artinian and of finite length rings and modules. Jordan-Hölder Theorem. Hopkins-Levitzky Theorem.
6. **Representation of groups.** Linear representations of groups. Characters. Applications to Group Theory.

## References

1. F.W. Anderson y K.R. Fuller, Rings and categories of modules, Springer-Verlag, 1992.
2. P.M. Cohn, An Introduction to Ring Theory, Springer 2000
3. I.M. Isaacs, Character theory of finite groups, Academic Press, 1976
4. T.Y. Lam, A first course in noncommutative rings, Springer, 2001
5. R.S. Pierce, Associative Algebras, Springer-Verlag, 1982
6. L.H. Rowen, Ring Theory, Academic Press, 1988