Course guide
200201 - TG - Galois Theory

Last modified: 11/04/2024

Unit in charge: School of Mathematics and Statistics
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN MATHEMATICS (Syllabus 2009). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: JORDI GUARDIA RUBIES

Others: Primer quadrimestre:
JORDI GUARDIA RUBIES - M-A

PRIOR SKILLS

Contents of Algebraic Structures: permutation groups, polynomial rings, fields.

REQUIREMENTS

The course Algebraic Structures of 3rd year.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
3. CE-2. Solve problems in Mathematics, through basic calculation skills, taking in account tools availability and the constraints of time and resources.
4. CE-4. Have the ability to use computational tools as an aid to mathematical processes.
5. Ability to solve problems from academic, technical, financial and social fields through mathematical methods.

Generical:
1. CB-4. Have the ability to communicate their conclusions, and the knowledge and rationale underpinning these to specialist and non-specialist audiences clearly and unambiguously.
2. To have developed those learning skills necessary to undertake further interdisciplinary studies with a high degree of autonomy in scientific disciplines in which Mathematics have a significant role.
6. CG-1. Show knowledge and proficiency in the use of mathematical language.
7. CG-2. Construct rigorous proofs of some classical theorems in a variety of fields of Mathematics.
8. CG-3. Have the ability to define new mathematical objects in terms of others already know and ability to use these objects in different contexts.
9. CG-4. Translate into mathematical terms problems stated in non-mathematical language, and take advantage of this translation to solve them.
10. CG-6 Detect deficiencies in their own knowledge and pass them through critical reflection and choice of the best action to extend this knowledge.

Transversal:
11. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
12. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

TEACHING METHODOLOGY

Theory sessions where the teacher presents the contents of the course and problems sessions where the students and the professor solve the proposed problems..

LEARNING OBJECTIVES OF THE SUBJECT

Basic conceps and results of Galois theory and its applications to the resolution by radicals of polynomial equations and to the geometric constructions with ruler and compass.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours small group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Number Fields

Description:
Symmetric polynomials. Discrimant and resultant. Arithmetic in number fields. Norm and trace. Lattice of subextensions. Automorphisms group.

Full-or-part-time: 42h
Theory classes: 6h
Laboratory classes: 6h
Self study : 30h

Galois Theory

Description:
Galois extensions. Fundamental theorem of Galois theory. Galois group of a polynomial. Cyclic extensions. Cyclotomoc extensions.

Full-or-part-time: 45h
Theory classes: 9h
Laboratory classes: 9h
Self study : 27h

Applications

Description:
Solvability by radicals. General equation of degree n. Constructions with ruler and compass and origami.

Full-or-part-time: 45h
Theory classes: 9h
Laboratory classes: 9h
Self study : 27h

Ring of integers of a number field

Description:
Ring of integers. Integral bases. Ideal factorization. Non-monogenic extensions.

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study : 18h

GRADING SYSTEM

Along the course we will make some assessed activities, representing the 40% of the final grade of the course. A final exam (60%) will complement these activities to yield the final grade. If the final exam grade is higher than this weighted mean, the final grade will be that of the exam.

BIBLIOGRAPHY

Basic:
- Rotman, Joseph J. Galois theory. New York [etc.]: Springer-Verlag, 1998. ISBN 0387973052.
- Stewart, Ian. Galois theory. 3rd ed. London [etc.]: Chapman and Hall, 2004. ISBN 1584883936.
- Cox, D. Galois theory [on line]. 2a. Wiley, 2012 [Consultation: 26/06/2023]. Available on: https://onlinelibrary-wiley-com.recursos.biblioteca.upc.edu/doi/book/10.1002/9781118218457. ISBN 9781118218457.

Complementary:
- Artin, Emil. Galois theory. Publicación Mineola, Nueva York: Dover Publications, 1998. ISBN 0486623424.
- Fraleigh, John B. A First course in abstract algebra. 7th ed. Pearson Education, 2014. ISBN 9781292024967.
- Hungerford, Thomas W. "A Counter example in Galois Theory". American mathematical monthly [on line]. V. 97, núm. 1 (1990), p. 54-57 [Consultation: 26/06/2023]. Available on: https://www-jstor-org.recursos.biblioteca.upc.edu/journal/amermathmont.- Lang, Serge. Algebra. 3rd ed. Reading, Mass: Addison Wesley, 1993. ISBN 0201555409.
- Lidl, Rudolf ; Niederreiter, Harald ; Cohn, P.M. Finite fields. 2nd ed. Cambridge [etc.]: Cambridge University Press, 1997. ISBN 0521392314.
- Cohen, H. A Course in computational algebraic number theory. 2a. Springer-Verlag, 2000. ISBN 3540556400.