Study programmes: Master studies – Mathematics
Course name: Selected Topics of Algebra
Lecturers: Milan Božić, Aleksandar Lipkovski, Dragana Todorić, Zoran Petrović
Status: Optional
ECTS: 8
Attendance prerequisites: Algebra 1, Algebra 2
Course aims: Acquisition of advanced general and specific knowledge of algebra
Course outcome: Upon completion of the course, students have advanced knowledge of Ring and Module theory. They understand the fundamental notions and know basic theorems and main constructions. They are qualified to solve problems from the mentioned areas and follow advanced courses in which algebra plays an important part.

Course content:

Rings-compulsory part. Ideals and congruences, homomorphisms, quotient ring. Isomorphism theorems. Prime and maximal ideals. Unique factorization domains, Euclidean and principal ideal domains. Ring of fractions and localization. Polynomial and power series rings. Factorization in polynomial rings.

Modules-compulsory part. Modules and algebras. Quotient module and isomorphism theorems. Direct products, direct sums, free modules, modules over PIDs. Canonical forms of matrices.

Introduction to homological algebra-optional part. Products, coproducts, exact sequences. Projective and injective modules. The *Hom* functor and duality. Tensor product. Tensor algebra. Symmetric and alternating products. Inverse and direct limits.

Introduction to algebraic geometry-optional part. Finiteness chain conditions. Prime and primary ideals. Primary decomposition. Noetherian rings and modules. Hilbert's basis theorem. Rings extensions. Dedekind domains. Algebraic variety. Hilbert's nullstellensatz.

Introduction to noncommutative algebra-optional part. Semisimple modules. Schur's lemma. Jacobson theorem. Simple and semisimple rings. Matrix rings and endomorphisms. Structure of semisimple rings, Wedderburn theorem and non-formal introduction to group representation theory. Maschke's theorem. Jacobson radical. Two important theorems (Hopkins-Levitzki, Nakayama).

Literature: G. Kalajdžić, *Algebra*, Matematički fakultet, Beograd, 1998; T. Hungerford, *Algebra,* Algebra (Graduate texts in Mathematics) Springer 1st ed. 1974. Corr. 5th printing edition 2003; S. Lang, *Algebra,* Addison-Wesley Publ. Co., New York 1984; Robert B. Ash, *Abstract Algebra: The Basic Graduate Year*, www 2000.

Number of hours: 5	Lectures: 3	Tutorials: 2		

Teaching and learning methods: Frontal / Interactive / Tutorials / Lectures / Exercises

Assessment (maximal 100 points)			
Course assignments	**Points**	**Final exam**	**Points**
Lectures	-	Written exam	20
Exercises / Tutorials	-	Oral exam	40
Colloquia	20		
Essay / Project	20		