Study programmes: PhD studies – Mathematics-Algebra

Course name: Homological Methods in Algebra

Lecturers: Zoran Petrović, Aleksandar Lipkovski

Status: Optional

ECTS: 9

Attendance prerequisites: Algebra 4

Course aims: Acquisition of general and advanced knowledge of homological algebra and category theory

Course outcome: Upon completion of the course, students have extended their knowledge of category theory and acquired some advanced knowledge of homological algebra. They understand the following notions: complexes, derived functors, projective and injective resolutions, cohomology of groups, cohomology of Lie algebras, spectral sequences, derived category. Students know basic and more advanced theorems from these fields as well as main constructions. They are qualified to solve problems from the mentioned areas, to follow advanced courses in algebra and other fields of mathematics in which homological algebra and category theory plays an important part, and are able to understand the main problems from the current reaserch in these fields.

Course content: Compexes and cohomology: complexes and exact sequences; standard complexes in algebra; spectral sequences. Categories and functors: basic concepts; adittive and Abelian categories; functors in Abelian categories; some classical derived functors. Homological methods in algebra: cyclic (co)homology; (co)homology of discrete groups; cohomology of Lie algebras. Derived categories and derived functors: basic concepts; derived category as a localization of a homotopy category; the structure of the derived category; sheaf cohomology. Triangulated categories: basic concepts and examples.

Literature:

S. I. Gelfand, Yu. I. Manin: *Homological Algebra*, Springer, New York, 1999.
H. Stambach, *A course in homological algebra*, Springer, New York, 1971.
S. Mac Lane, *Categories for the working mathematician*, Springer, New York, 1971.

Number of hours: 10	**Lectures:** 4	**Tutorials:** 6

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

Assessment (maximal 100 points)

Course assignments	Points	Final exam	Points
Lectures	-	Written exam	30
Exercises / Tutorials	-	Oral exam	30
Colloquia			
Seminars	40		