UNIVERSITÄT
BIELEFELD

Module Guide
24-M-AL-HAL Homological Algebra

Fakultät für Mathematik

Version dated Dec 14, 2025

This module guide reflects the current state and is subject to change. Up-to-date information and the latest version of this document can be found online via the page

https://ekvv.uni-bielefeld.de/sinfo/publ/modul/533531925

The current and valid provisions in the module guide are binding and further specify the subject-related regulations (German "FsB") published in the Official Announcements of Bielefeld University.

24-M-AL-HAL Homological Algebra

Faculty

Fakultät für Mathematik

Person responsible for module

Herr Prof. Dr. William Crawley-Boevey

Herr Prof. Dr. Henning Krause

Regular cycle (beginning)

This module is part of a long-term overall curriculum plan for the Master's programme, which ensures that modules with an amount of at least 20 CP are offered in all five fields each year. The module is offered at irregular intervals as part of this overall curriculum planning.

Credit points

10 Credit points

Competencies

Non-official translation of the module descriptions. Only the German version is legally binding.

Students master the essential contents and methods of Homological Algebra, in particular they can independently carry out very complex proofs in this arearequiring a high level of mathematical expertise. The essential competences in Homological Algebra include

- Describe key concepts and definitions in Homological algebra.
- Explain important theorems and results, and outline their proofs.
- Use diagram chasing to study commutative diagrams.
- Compute Ext and Tor in specific examples.

Furthermore, the students recognise further-reaching connections to mathematical facts already acquired. They can transfer and apply the knowledge and methods they have learnt so far to deeper mathematical problem areas. Students also expand their mathematical intuition as a result of more intensive study.
In the tutorials, students develop their ability to discuss mathematical topics and thus further prepare themselves for the requirements of the Master's module, in particular for the scientific discussion within the Master's seminar presentation and the defence of their Master's thesis.

Content of teaching

The following basic content of teaching from the field of Homological Algebra is compulsory:

- Categories and functors
- Additive and abelian categories
- Chain and cochain complexes

- Diagram Lemmas
- Projective, injective and flat modules
- Ext and Tor
- Homological dimensions

In addition, the following content of teaching can be covered, for example:

- Derived categories and triangulated categories
- Spectral Sequences
- (Co)homology of groups
- (Co)homology of topological spaces

Recommended previous knowledge

Linear algebra, rings and modules.

Necessary requirements

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Explanation regarding the elements of the module

Module structure: 1 SL, 1 bPr [1]

Courses

Title	Type	Regular cycle	Workload [5]	LP[2]

Lecture Homological Algebra	lecture	This module is part of a long-term overall curriculum plan for the Master's programme, which ensures that modules with an amount of at least 20 CP are offered in all five fields each year. The module is offered at irregular intervals as part of this overall curriculum planning.	60 h (60 + 0)	2 [Pr]
Tutorials Homological Algebra	exercise	This module is part of a long-term overall curriculum plan for the Master's programme, which ensures that modules with an amount of at least 20 CP are offered in all five fields each year. The module is offered at irregular intervals as part of this overall curriculum planning.	90 h (30 + 60)	3 [SL]

Study requirements

Allocated examiner	Workload	LP[2]

Teaching staff of the course **Tutorials Homological Algebra (exercise)** Regular completion of the exercises, each with a recognisable solution approach, as well as participation in the exercise groups for the module's lecture. As a rule, participation in the exercise group includes presenting solutions to exercises twice after being asked to do so as well as regular contributions to the scientific discussion in the exercise group, for example in the form of comments and questions on the proposed solutions presented. The organiser may replace some of the exercises with face-to-face exercises.	see above	see above

Examinations

Allocated examiner	Type	Weighting	Workload	LP[2]
Teaching staff of the course **Lecture Homological Algebra (lecture)** (electronic) written examination in presence of usually 120 minutes, oral examination in presence or remote of usually 40 minutes, A remote electronic written examination is not permitted.	e-Klausur o. Klausur o. mündliche e-Prüfung o. mündliche Prüfung	1	150h	5

Legend

1	The module structure displays the required number of study requirements and examinations.
2	LP is the short form for credit points.
3	The figures in this column are the specialist semesters in which it is recommended to start the module. Depending on the individual study schedule, entirely different courses of study are possible and advisable.
4	Explanations on mandatory option: "Obligation" means: This module is mandatory for the course of the studies; "Optional obligation" means: This module belongs to a number of modules available for selection under certain circumstances. This is more precisely regulated by the "Subject-related regulations" (see navigation).
5	Workload (contact time + self-study)
SoSe	Summer semester
WiSe	Winter semester
SL	study requirement
Pr	Examination
bPr	Number of examinations with grades
uPr	Number of examinations without grades