

Module Handbook (<https://modhb.uni-kl.de/>)

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## Module MAT-10-1-M-2

Fundamentals of Mathematics (M, 28.0 LP)

### Module Identification

Module Number	Module Name	CP (Effort)
MAT-10-1-M-2	<i>Fundamentals of Mathematics</i>	28.0 CP (840 h)

### Basedata

CP, Effort	28.0 CP = 840 h
Position of the semester	2 Sem. from WiSe/SuSe
Level	[2] Bachelor (Fundamentals)
Language	[DE] German
Module Manager	Lossen, Christoph, Dr. habil. (WMA   DEPT: MAT) (/staff/24/)
Lecturers	Lecturers of the department Mathematics
Area of study	[MAT-GRU] Mathematics (B.Sc. year 1 and 2)
Reference course of study	[MAT-82.105-SG] B.Sc. Mathematics (/mhb/FB-MAT/cos-509/)
Lifecycle-State	[NORM] Active

#### Notice

The courses are also offered in distance learning as part of the programme „Früheinstieg in das Mathematikstudium“ (FIMS), see <https://fims.mathematik.uni-kl.de> (<https://fims.mathematik.uni-kl.de>)

### Module Part #A "*Fundamental of Mathematics I*" (Obligatory, 15.0 LP)

Type/SWS	Course Number	Choice in Module-Part	SL	PL	CP	Sem.
2V+2U	MAT-10-11B-K-2 (/mhb/courses/MAT-10-11B-K-2/)	P	SL1	PL1	6.0	WiSe/SuSe
4V+2U+2T	MAT-10-11A-K-2 (/mhb/courses/MAT-10-11A-K-2/)	P	SL1	PL1	9.0	WiSe/SuSe

- About [MAT-10-11B-K-2]: Title: "Fundamentals of Mathematics I: Linear Algebra"; Presence-Time: 56 h; Self-Study: 124 h

- About [MAT-10-11B-K-2]: The study achievement must be obtained. It is a prerequisite for the examination for PL1 .
- About [MAT-10-11A-K-2]: Title: "Fundamentals of Mathematics I: Analysis"; Presence-Time: 112 h; Self-Study: 158 h
- About [MAT-10-11A-K-2]: The study achievement must be obtained. It is a prerequisite for the examination for PL1 .

## Module Part #B "*Fundamentals of Mathematics II*" (Obligatory, 13.0 LP)

Type/SWS	Course Number	Choice in Module-Part	SL	PL	CP	Sem.
6V+2U+1T	MAT-10-12-K-2 (/mhb/courses/MAT-10-12-K-2/)	P	qU-Schein	PL1	13.0	WiSe/SuSe

- About [MAT-10-12-K-2]: Title: "Fundamentals of Mathematics II"; Presence-Time: 126 h; Self-Study: 264 h
- About [MAT-10-12-K-2]: The study achievement [**qU-Schein**] **proof of successful participation in the exercise classes (incl. written examination)** must be obtained.

### Study achievement SL1

- Verification of study performance: **proof of successful participation in the exercise classes (incl. written examination)**
- Study achievement is a prerequisite for the examination.
- Examination number (Study achievement): 82015 ("Exercise Class Fundamentals of Mathematics I")

The proof of successful participation in the exercise classes (incl. written examination) for "Fundamentals of Mathematics I" can be obtained in two parts (proof of successful participation in the exercise classes of [MAT-10-11B-K-2] (/mhb/courses/MAT-10-11B-K-2/) *Fundamentals of Mathematics I: Linear Algebra* and proof of successful participation in the exercise classes of [MAT-10-11A-K-2] (/mhb/courses/MAT-10-11A-K-2/) *Fundamentals of Mathematics I: Analysis*).

### Examination achievement PL1

- Form of examination: **oral examination (30-45 Min.)**
- Examination Frequency: each semester
- Examination number: 82017 ("Fundamentals of Mathematics I/II")

Instead of the proof of successful participation in the exercise classes for "Fundamentals of Mathematics I" (SL1), the prerequisite for the examination PL1 can also be fulfilled in form of the proof of successful participation in the exercise classes for "Fundamentals of Mathematics II" (incl. written examination).

### Evaluation of grades

The grade of the module examination is also the module grade.

#### Contents

- real and complex numbers (axiomatic),
- sequences, limit values, and series; power series; elementary functions,
- continuity,
- differentiation (especially: Taylor expansion, curves, implicit function theorem, inverse function theorem, extrema under constraints),
- integration (one- and multi-dimensional; in particular: Fubini's theorem, variable transformation),
- basic topological terms (metric spaces, connection, compactness),
- vector spaces; linear mappings, matrices and linear systems of equations; dual space; determinants,
- geometry of the Euclidean space (especially: orthogonal transformations, projections),
- eigenvalues, diagonalisability, principal axis transformation, calculation of the Jordan normal form.

In particular, the respective courses treat the following contents:

#### A.1 Fundamentals of Mathematics I: Analysis

real and complex numbers; sequences, limit values, and series; power series; elementary functions; continuity and differentiation in the one-dimensional case; integration in the one-dimensional case;

#### A.2 Fundamentals of Mathematics I: Linear Algebra

vector spaces; linear mappings, matrices and linear systems of equations;

#### B. Fundamentals of Mathematics II:

metric spaces; differentiation and integration in the multidimensional case; geometry of Euclidean space; diagonalisability, principal axis transformation, calculation of the Jordan normal form.

### Competencies / intended learning achievements

The students know and understand the basic concepts, statements and methods of Analysis and Linear Algebra. They realise the connections between Analysis and Linear Algebra. Their ability to abstract has been enhanced. They are trained in analytical thinking and their mathematical imagination has been stimulated. By means of a proof- and structure-oriented approach, they have learned to understand mathematical evidence and to independently prove or disprove mathematical statements in simple examples.

In the exercise classes they have acquired a confident, precise and independent handling of the terms, statements and methods from the lectures.

In the exercise classes and tutorials, the students' presentation and communication skills were trained through written work and presentations held by themselves; the students are able to acquire knowledge through self-study and at the same time their ability to work in a team was promoted by working in small groups.

### Literature

- O. Forster: Analysis 1, Analysis 2,
- H. Heuser: Lehrbuch der Analysis, Teil 1 und Teil 2,
- M. Barner, F. Flohr: Analysis I, Analysis II,
- K. Königsberger: Analysis 1, Analysis 2,
- G. Fischer: Lineare Algebra,
- H.-J. Kowalsky, G.O. Michler: Lineare Algebra,
- S. Bosch: Lineare Algebra,
- K. Jänich: Linear Algebra.

### Requirements for attendance (informal)

None

### Requirements for attendance (formal)

None

### References to Module / Module Number [MAT-10-1-M-2]

Course of Study	Section	Choice/Obligation
[MAT-82.105-SG] B.Sc. Mathematics (/mhb/FB-MAT/cos-509/)	Fundamentals of Mathematics	[P] Compulsory
[MAT-82.276-SG] B.Sc. Business Mathematics (/mhb/FB-MAT/cos-516/)	Fundamentals of Mathematics	[P] Compulsory