

Module Handbook

[TUK](#) [MODHB](#) [Homepage](#)

Course MAT-70-11-K-4

Functional Analysis (4V+2U, 9.0 LP)

Course Type

SWS	Type	Course Form	CP (Effort)	Presence-Time / Self-Study	
-	K	Lecture with exercise classes (V/U)			
4	V	Lecture	6.0 CP	56 h	124 h
2	U	Exercise class (in small groups)	3.0 CP	28 h	62 h
(4V+2U)			9.0 CP	84 h	186 h

Basedata

SWS	4V+2U
CP, Effort	9.0 CP = 270 h
Position of the semester	1 Sem. in SuSe
Level	[4] Bachelor (Specialization)
Language	[EN] English
Lecturers	Grothaus, Martin, Prof. Dr. (PROF DEPT: MAT) Hussein, Amru, Jun. Prof. Dr. (PROF DEPT: MAT) Ritter, Klaus, Prof. Dr. (PROF DEPT: MAT) + further Lecturers of the department Mathematics
Area of study	[MAT-SPAS] Analysis and Stochastics
Lifecycle-State	[NORM] Active

Possible Study achievement

- Verification of study performance: **proof of successful participation in the exercise classes (ungraded)**
- Examination number (Study achievement): 84020 ("Exercise Class Functional Analysis")
- Details of the examination (type, duration, criteria) will be announced at the beginning of the course.

Contents

- Hahn-Banach theorem and its applications,
- Baire category theorem and its applications (uniform boundedness principle, Banach-Steinhaus-Theorem, open mapping theorem, inverse mapping theorem, closed graph theorem),
- Weak convergence (Banach-Alaoglu theorem, reflexive Banach spaces, Mazur lemma and its applications),
- Projections (closed complement theorem),
- Bounded operators (adjoint operator, spectrum, resolvent, normal operators),
- Compact operators (Fredholm operators, Fredholm alternative and its applications, spectral theorem(Riesz-Schauder) and its application to normal operators),
- Unbounded operators (graph, symmetric and self-adjoint operators).

Competencies / intended learning achievements

The students have studied and understand the mathematical concepts in infinite-dimensional spaces with a special emphasis on analytical aspects. They have gained the basic analytical tools required for solving differential and integral equations in theory and application.

Literature

- H.-W. Alt: Lineare Funktionalanalysis,
- H. Heuser: Funktionalanalysis,
- M. Reed, M, B. Simon: Functional Analysis I,
- D. Werner: Funktionalanalysis.

Materials

Further literature will be announced in the lecture; Exercise material is provided.

Registration

Registration for the exercise classes via the online administration system URM (<https://urm.mathematik.uni-kl.de>).

Requirements for attendance (informal)

Modules:

- [MAT-10-1-M-2] Fundamentals of Mathematics (M, 28.0 LP)

Courses

- [MAT-12-23-K-3] Introduction to Functional Analysis (2V+1U, 4.5 LP)
- [MAT-12-28-K-3] Measure and Integration Theory (2V+1U, 4.5 LP)

Requirements for attendance (formal)

None

References to Course [MAT-70-11-K-4]

Module	Name	Context	
[MAT-30-10L-M-5]	Specialisation Module (Teachers Training Programme Mathematics)	WP: Obligation to choose in Obligatory-Modulteil #A (Lectures)	4V, 6.0 LP
[MAT-70-11-M-4]	Functional Analysis	P: Obligatory	4V+2U, 9.0 LP
Course-Pool	Name		
[MAT-70-4V-KPOOL-4]	Elective Courses Analysis and Stochastics (4V, B.Sc.)		
[MAT-70-KPOOL-4]	Specialisation Analysis and Stochastics (B.Sc.)		
[MAT-80-4V-KPOOL-4]	Elective Courses Modelling and Scientific Computing (4V, B.Sc.)		