Module Handbook
Mathematics Master 2016 (Master of Science (M.Sc.))
SPO 2016
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KIT DEPARTMENT OF MATHEMATICS
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1.1 Master Thesis

Mandatory

M-MATH-102917 Master Thesis 30 CR
### 1.2 Mathematical Methods 1

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Part of: Mathematical Methods 1

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#### Modelled Conditions

The following conditions have to be fulfilled:

1. The field **Mathematical Methods 2 / Field Algebra and Geometry** must not have been started.
2. The field **Complementary Field / Field Algebra and Geometry** must not have been started.
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### Modelled Conditions
The following conditions have to be fulfilled:

1. The field **Mathematical Methods 2 / Field Analysis** must not have been started.
2. The field **Complementary Field / Field Analysis** must not have been started.
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**Modelled Conditions**

The following conditions have to be fulfilled:

1. The field Mathematical Methods 2 / Field Applied and Numerical Mathematics must not have been started.
2. The field Mathematical Methods 2 / Field Stochastics must not have been started.
3. The field Complementary Field / Field Applied and Numerical Mathematics must not have been started.

### 1.2.4 Field Stochastics

**Part of: Mathematical Methods 1**

**Credit: 24**

**Election block: Field Stochastics (at least 24 credits)**

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**Modelled Conditions**

The following conditions have to be fulfilled:

1. The field Mathematical Methods 2 / Field Stochastics must not have been started.
2. The field Mathematical Methods 2 / Field Applied and Numerical Mathematics must not have been started.
3. The field Complementary Field / Field Stochastics must not have been started.
1.3 Mathematical Methods 2

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## 1.3.1 Field Algebra and Geometry

### Credits
16

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### Modelled Conditions

The following conditions have to be fulfilled:

1. The field Mathematical Methods 1 / Field Algebra and Geometry must not have been started.
2. The field Complementary Field / Field Algebra and Geometry must not have been started.
### 1.3.2 Field Analysis

Part of: Mathematical Methods 2

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**Modeled Conditions**

The following conditions have to be fulfilled:

1. The field **Mathematical Methods 1 / Field Analysis** must not have been started.
2. The field **Complementary Field / Field Analysis** must not have been started.
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1. FIELD OF STUDY STRUCTURE

## Mathematical Methods 2

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### Modelled Conditions

The following conditions have to be fulfilled:

1. The field *Mathematical Methods 1 / Field Applied and Numerical Mathematics* must not have been started.
2. The field *Mathematical Methods 1 / Field Stochastics* must not have been started.
3. The field *Complementary Field / Field Applied and Numerical Mathematics* must not have been started.

### 1.3.4 Field Stochastics

Part of: Mathematical Methods 2

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### Modelled Conditions

The following conditions have to be fulfilled:

1. The field *Mathematical Methods 1 / Field Stochastics* must not have been started.
2. The field *Mathematical Methods 1 / Field Applied and Numerical Mathematics* must not have been started.
3. The field *Complementary Field / Field Stochastics* must not have been started.
1.4 Complementary Field

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### 1.4.1 Field Algebra and Geometry

Part of: Complementary Field

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**Modelled Conditions**

The following conditions have to be fulfilled:

1. The field Mathematical Methods 1 / Field Algebra and Geometry must not have been started.
2. The field Mathematical Methods 2 / Field Algebra and Geometry must not have been started.
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**Modelled Conditions**

The following conditions have to be fulfilled:

1. The field **Mathematical Methods 1 / Field Analysis** must not have been started.
2. The field **Mathematical Methods 2 / Field Analysis** must not have been started.
### 1.4.3 Field Applied and Numerical Mathematics

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Part of: Complementary Field
### Election block: Field Applied and Numerical Mathematics (at least 1 item as well as between 16 and 24 credits)

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## 1 FIELD OF STUDY STRUCTURE

### Complementary Field

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### Modelled Conditions

The following conditions have to be fulfilled:

1. The field **Mathematical Methods 1 / Field Applied and Numerical Mathematics** must not have been started.
2. The field **Mathematical Methods 2 / Field Applied and Numerical Mathematics** must not have been started.

### 1.4.4 Field Stochastics

**Part of: Complementary Field**

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### Modelled Conditions

The following conditions have to be fulfilled:

1. The field **Mathematical Methods 1 / Field Stochastics** must not have been started.
2. The field **Mathematical Methods 2 / Field Stochastics** must not have been started.
### 1.4.5 Subject Computer Science

**Part of:** Complementary Field  
**Credits:** 16-24

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### 1.4.6 Subject Physics

**Part of:** Complementary Field  
**Credits:** 16-24

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## 1.4.7 Subject Economics
Part of: Complementary Field

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## 1.4.8 Subject Mechanical Engineering
Part of: Complementary Field

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## 1.4.9 Subject Electrical Engineering
Part of: Complementary Field

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1.6 Mathematical Specialization

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1.8 Additional Examinations
### Election block: Additional Examinations (at most 30 credits)

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2 Modules

### 2.1 Module: Adaptive Finite Elemente Methods (MATHNM19) [M-MATH-102900]

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<td>Prof. Dr. Willy Dörfler</td>
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| 6 CR | Dörfler |

**Prerequisites**
none
2.2 Module: Advanced Inverse Problems: Nonlinearity and Banach Spaces (MATHNM44) [M-MATH-102955]

**Responsible:** Prof. Dr. Andreas Rieder

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

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**Mandatory**

| T-MATH-105927 | Advanced Inverse Problems: Nonlinearity and Banach Spaces | 5 CR | Rieder |

**Prerequisites**

none
2.3 Module: Algebra (MATHAG05) [M-MATH-101315]

**Responsible:** Prof. Dr. Frank Herrlich

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementary Field / Field Algebra and Geometry
- Mathematical Specialization
- Additional Examinations

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**Mandatory**

| T-MATH-102253 | Algebra | 8 CR | Herrlich, Kühnlein |

**Prerequisites**

None
# 2.4 Module: Algebraic Geometry [M-MATH-101724]

**Responsible:** Prof. Dr. Frank Herrlich  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Algebra and Geometry  
- Mathematical Methods 2 / Field Algebra and Geometry  
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- Mathematical Specialization  
- Additional Examinations  

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Herrlich, Kühnlein
2.5 Module: Algebraic Number Theory [M-MATH-101725]

**Responsible:** PD Dr. Stefan Kühnlein

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
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- Mathematical Specialization
- Additional Examinations

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Kühnlein
## 2.6 Module: Algebraic Topology (MATHAG34) [M-MATH-102948]

**Responsible:** Prof. Dr. Roman Sauer  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Methods 1 / Field Algebra and Geometry  
Mathematical Methods 2 / Field Algebra and Geometry  
Complementary Field / Field Algebra and Geometry  
Mathematical Specialization  
Additional Examinations

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### Mandatory

| T-MATH-105915 | Algebraic Topology | 8 CR | Kammeyer, Sauer |

### Prerequisites

none
## 2.7 Module: Algebraic Topology II (MATHAG41) [M-MATH-102953]

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### Mandatory

| T-MATH-105926 | Algebraic Topology II | 8 CR | Sauer |

### Prerequisites
none
# M 2.8 Module: Algorithm Engineering (2400051) [M-INFO-100795]

**Responsible:** Prof. Dr. Peter Sanders  
Prof. Dr. Dorothea Wagner  
**Organisation:** KIT Department of Informatics  
**Part of:** Complementary Field / Subject Computer Science

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## 2.9 Module: An Introduction to Periodic Elliptic Operators [M-MATH-105096]

**Responsible:** Prof. Dr. Roland Griesmaier  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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**Prerequisites**  
None
2.10 Module: Analytical and Numerical Homogenization [M-MATH-105636]

**Responsible:** Prof. Dr. Marlis Hochbruck

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

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**Mandatory**

| T-MATH-111272 | Analytical and Numerical Homogenization | 6 CR | Hochbruck |

**Competence Goal**

The topic of the lecture are numerical multiscale methods presented exemplarily for elliptic problems. Students know the basic analytical results for existence and uniqueness of the solution of multiscale problems and from homogenization theory. In addition, they know methods for the numerical approximation of multiscale and the homogenized solution. They are able to analyze the convergence of these methods and assess the pros and cons of the different approaches.

**Prerequisites**

none

**Content**

- Analytical fundamentals (basic results from analysis for elliptic partial differential equations and from homogenization theory)
- Approximation of the homogenized solution (e.g. heterogeneous multiscale method)
- Approximation of the multiscale solution (e.g. local orthogonal decomposition)

**Annotation**

Upon request the lecture will be held in english.
2.11 Module: Applications of Operations Research (WW3OR5) [M-WIWI-101413]

**Responsible:** Prof. Dr. Stefan Nickel  
**Organisation:** KIT Department of Economics and Management  
**Part of:** Complementary Field / Subject Economics

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### Election block: Compulsory Elective Courses (between 1 and 2 items)

- **T-WIWI-102704** Facility Location and Strategic Supply Chain Management  
  - 4,5 CR  
  - Nickel
- **T-WIWI-102714** Tactical and Operational Supply Chain Management  
  - 4,5 CR  
  - Nickel

### Election block: Supplementary Courses (at most 1 item)

- **T-WIWI-102726** Global Optimization I  
  - 4,5 CR  
  - Stein
- **T-WIWI-106199** Modeling and OR-Software: Introduction  
  - 4,5 CR  
  - Nickel
- **T-WIWI-106545** Optimization Under Uncertainty  
  - 4,5 CR  
  - Rebennack

### Competence Certificate
The assessment is carried out as partial exams (according to § 4(2), 1 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module.

The assessment procedures are described for each course of the module separately.

The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

### Competence Goal
The student

- is familiar with basic concepts and terms of Supply Chain Management,
- knows the different areas of Supply Chain Management and their respective optimization problems,
- is acquainted with classical location problem models (in the plane, on networks and discrete) as well as fundamental methods for distribution and transport planning, inventory planning and management,
- is able to model practical problems mathematically and estimate their complexity as well as choose and adapt appropriate solution methods.

### Prerequisites
At least one of the courses **Facility Location and strategic Supply Chain Management** and **Tactical and operational Supply Chain Management** has to be taken.

### Content
Supply Chain Management is concerned with the planning and optimization of the entire, inter-company procurement, production and distribution process for several products taking place between different business partners (suppliers, logistics service providers, dealers). The main goal is to minimize the overall costs while taking into account several constraints including the satisfaction of customer demands.

This module considers several areas of Supply Chain Management. On the one hand, the determination of optimal locations within a supply chain is addressed. Strategic decisions concerning the location of facilities like production plants, distribution centers or warehouses are of high importance for the rentability of supply chains. Thoroughly carried out, location planning tasks allow an efficient flow of materials and lead to lower costs and increased customer service. On the other hand, the planning of material transport in the context of Supply Chain Management represents another focus of this module. By linking transport connections and different facilities, the material source (production plant) is connected with the material sink (customer). For given material flows or shipments, it is considered how to choose the optimal (in terms of minimal costs) distribution and transportation chain from the set of possible logistics chains, which asserts the compliance of delivery times and further constraints.

Furthermore, this module offers the possibility to learn about different aspects of the tactical and operational planning level in Supply Chain Management, including methods of scheduling as well as different approaches in procurement and distribution logistics. Finally, issues of warehousing and inventory management will be discussed.

### Recommendation
The courses Introduction to Operations Research I and II are helpful.
Annotation
The planned lectures and courses for the next three years are announced online.

Workload
The total workload of the module is about 240 hours. The workload is proportional to the credit points of the individual courses.
2.12 Module: Applications of Topological Data Analysis [M-MATH-105651]

**Responsible:** Dr. Andreas Ott

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Analysis
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Algebra and Geometry
- Complementary Field / Field Analysis
- Complementary Field / Field Stochastics
- Mathematical Specialization

**Additional Examinations**

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**Mandatory**

| T-MATH-111290 | Applications of Topological Data Analysis | 4 CR | Ott |

**Prerequisites**

None
## 2.13 Module: Applied Information Theory [M-ETIT-100444]

**Responsible:** Dr.-Ing. Holger Jäkel  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** Complementary Field / Subject Electrical Engineering

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**Prerequisites**

none
Module: Aspects of Geometric Analysis [M-MATH-103251]

Responsible: Prof. Dr. Tobias Lamm
Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Algebra and Geometry
Mathematical Methods 1 / Field Analysis
Mathematical Methods 2 / Field Algebra and Geometry
Mathematical Methods 2 / Field Analysis
Complementary Field / Field Algebra and Geometry
Complementary Field / Field Analysis
Mathematical Specialization
Additional Examinations

Credits 4
Grading scale Grade to a tenth
Recurrence Irregular
Duration 1 term
Level 4
Version 1

Mandatory
T-MATH-106461 Aspects of Geometric Analysis 4 CR Lamm

Competence Certificate
oral exam; duration: about 20 minutes

Competence Goal
- The students have got to know topics of Geometric analysis.
- They are able to use and explain the techniques they have learned in the course.

Prerequisites
none

Content
Classical or recent topics of Geometric analysis, for example
- Geometric evolution equations,
- Geometric variational problems,
- The theory of minimal surfaces,
- Regularity of geometric objects,
- The isoperimetric problem,
- Spectral theory on manifolds.

Recommendation
Elementare Geometrie, Klassische Methoden partieller Differentialgleichungen/Partial differential equations, Functional analysis
Module: Aspects of Time Integration (MATHNM36) [M-MATH-102934]

Responsible: Prof. Dr Katharina Schratz
Organisation: KIT Department of Mathematics

Part of:
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
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<td>Asymmetric Encryption Schemes</td>
<td>3 CR</td>
<td>Müller-Quade</td>
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### Module: Asymptotic Stochastics (MATHST07) [M-MATH-102902]

**Responsible:** Prof. Dr. Vicky Fasen-Hartmann  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Methods 1 / Field Stochastics  
Mathematical Methods 2 / Field Stochastics  
Complementary Field / Field Stochastics  
Mathematical Specialization  
Additional Examinations

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| Mandatory | | | | |
|-----------|-----------------|-----------------|---------|
| T-MATH-105866 | Asymptotic Stochastics | | 8 CR |

**Prerequisites**  
none
# Module: Banach Algebras (MATHAN32) [M-MATH-102913]

**Responsible:** PD Dr. Gerd Herzog  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 2 / Field Analysis  
- Complementary Field / Field Analysis  
- Mathematical Specialization  
- Additional Examinations

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**Prerequisites**

none
Module: Batteries and Fuel Cells [M-ETIT-100532]

**Responsible:** Dr.-Ing. Andre Weber

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** Complementary Field / Subject Electrical Engineering

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**Mandatory**

| T-ETIT-100983 | Batteries and Fuel Cells | 5 CR | Weber |

**Prerequisites**

none
## Module: Bifurcation Theory [M-MATH-103259]

**Responsible:** Dr. Rainer Mandel  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 2 / Field Analysis  
- Complementary Field / Field Analysis  
- Mathematical Specialization  
- Additional Examinations

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### Mandatory

| T-MATH-106487 | Bifurcation Theory | 5 CR | Mandel |

### Prerequisites
None

### Annotation
Course is held in English
2.21 Module: Bott Periodicity [M-MATH-104349]

Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Algebra and Geometry
Mathematical Methods 2 / Field Algebra and Geometry
Complementary Field / Field Algebra and Geometry
Mathematical Specialization
Additional Examinations

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Mandatory

| T-MATH-108905 | Bott Periodicity | 5 CR | Tuschmann |

Prerequisites
None
# Module: Boundary and Eigenvalue Problems (MATHAN09) [M-MATH-102871]

**Responsible:** Prof. Dr. Wolfgang Reichel  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Methods 1 / Field Analysis  
Mathematical Methods 2 / Field Analysis  
Complementary Field / Field Analysis  
Mathematical Specialization  
Additional Examinations

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Module: Boundary Element Methods [M-MATH-103540]

**Responsible:** PD Dr. Tilo Arens

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

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**Prerequisites**

None
## 2.24 Module: Boundary value problems for nonlinear differential equations (MATHAN21) [M-MATH-102876]

**Responsible:** Prof. Dr. Wolfgang Reichel  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Methods 1 / Field Analysis  
Mathematical Methods 2 / Field Analysis  
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Mathematical Specialization  
Additional Examinations

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# 2.25 Module: Brownian Motion (MATHST10) [M-MATH-102904]

**Responsible:** Prof. Dr. Nicole Bäuerle  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Stochastics  
- Mathematical Methods 2 / Field Stochastics  
- Complementary Field / Field Stochastics  
- Mathematical Specialization  
- Additional Examinations

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| T-MATH-105868 | 4 CR | Brownian Motion  
Bäuerle, Fasen-Hartmann, Last |

**Prerequisites**
none
## Module: CAT(0) cubical complexes (MATHAG32) [M-MATH-103083]

### Responsible:
Prof. Dr. Petra Schwer

### Organisation:
KIT Department of Mathematics

### Part of:
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementary Field / Field Algebra and Geometry
- Mathematical Specialization
- Additional Examinations

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# Module: Classical Methods for Partial Differential Equations (MATH08) [M-MATH-102870]

| Responsible: | Prof. Dr. Michael Plum |
| Organisation: | KIT Department of Mathematics |
| Part of: | Mathematical Methods 1 / Field Analysis  
 Mathematical Methods 2 / Field Analysis  
 Complementary Field / Field Analysis  
 Mathematical Specialization  
 Additional Examinations |

| Credits | 8 |
| Grading scale | Grade to a tenth |
| Recurrence | Each winter term |
| Duration | 1 term |
| Level | 4 |
| Version | 1 |

**Mandatory**

| T-MATH-105832 | Classical Methods for Partial Differential Equations | 8 CR | Frey, Hundertmark, Lamm, Plum, Reichel, Schnaubelt |
## 2.28 Module: Combinatorics (MATHAG37) [M-MATH-102950]

**Responsible:** Prof. Dr. Maria Aksenovich  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Algebra and Geometry  
- Mathematical Methods 2 / Field Algebra and Geometry  
- Complementary Field / Field Algebra and Geometry  
- Mathematical Specialization  
- Additional Examinations

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<th>8 CR</th>
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**Competence Certificate**

The final grade is given based on the written final exam (3h).

By successfully working on the problem sets, a bonus can be obtained. To obtain the bonus, one has to achieve 50% of the points on the solutions of the exercise sheets 1-6 and also of the exercise sheets 7-12. If the grade in the final written exam is between 4,0 and 1,3, then the bonus improves the grade by one step (0,3 or 0,4).

### Competence Goal

The students understand, describe, and use fundamental notions and techniques in combinatorics. They can analyze, structure, and formally describe typical combinatorial questions. The students can use the results and methods such as inclusion-exclusion, generating functions, Young tableaux, as well as the developed proof ideas, in solving combinatorial problems. In particular, they can analyze the existence and the number of ordered and unordered arrangements of a given size. The students understand and critically use the combinatorial methods. Moreover, the students can communicate using English technical terminology.

### Prerequisites

None

### Content

The course is an introduction into combinatorics. Starting with counting problems and bijections, classical methods such as inclusion-exclusion principle and generating functions are discussed. Further topics include Catalan families, permutations, Young tableaux, partial orders, and combinatorial designs.

### Annotation

- Regular cycle: every 2nd year, summer semester  
- Course is held in English
2.29 Module: Communication Engineering I [M-ETIT-102103]

**Responsible:** Prof. Dr.-Ing. Laurent Schmalen

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** Complementary Field / Subject Electrical Engineering

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Mandatory

| T-ETIT-101936 | Communication Engineering I | 6 CR | Schmalen |

**Competence Certificate**

Type of examination: written exam. Duration of Examination: approx. 180 minutes.

**Prerequisites**

none
2.30 Module: Communications Engineering II [M-ETIT-105274]

**Responsible:** Dr.-Ing. Holger Jäkel  
Prof. Dr.-Ing. Laurent Schmalen

**Organisation:** KIT Department of Electrical Engineering and Information Technology  
Part of: Complementary Field / Subject Electrical Engineering

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**Mandatory**

T-ETIT-110697 Communications Engineering II  
4 CR Jäkel, Schmalen

**Competence Certificate**
The assessment will be carried out in the form of a written exam of 120 minutes.

**Competence Goal**
The students are able to analyze even more complex problems in communications engineering. You can independently develop and validate solutions and use problem-solving software. The transfer of the learned methods enables the students to quickly grasp other topics and to work on them with the appropriate methodological knowledge.

**Module grade calculation**
The module grade is the grade of the written exam.

**Prerequisites**
Knowledge of basic engineering mathematics including integral transformations and probability theory as well as basic knowledge of communications engineering.

**Content**
The course broadens the questions dealt with in the lecture Communication Engineering I. The focus here is on the detailed analysis of known algorithms and the introduction of new methods that were not discussed in the lecture Communications Engineering I, especially in the areas of system and channel modeling, equalization and synchronization.

**Recommendation**
Previous visit to the lecture "Communications Engineering I", "Probability Theory" and "Signals and Systems" is recommended.

**Annotation**
The module can be started for the first time in summer term 2020. Please note: The German course "Nachrichtentechnik II" takes place every summer term (starting summer term 2020) and the English version "Communications Engineering II" takes place every winter term (starting winter term 2020/2021).

**Workload**
1. Attendance Lecture: 15 * 2 h = 30 h  
2. Preparation / Postprocessing Lecture: 15 * 4 h = 60 h  
3. Presence Exercise: 15 * 1 h = 15 h  
4. Preparation / follow-up Exercise: 15 * 2 h = 30 h  
5. Exam preparation and presence in the same: charged in preparation / follow-up  
Total: 135 h = 4 LP
### 2.31 Module: Commutative Algebra [M-MATH-104053]

**Responsible:** Prof. Dr. Frank Herrlich  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Algebra and Geometry  
- Mathematical Methods 2 / Field Algebra and Geometry  
- Complementary Field / Field Algebra and Geometry  
- Mathematical Specialization  
- Additional Examinations

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**Prerequisites**  
None
2.32 Module: Comparison Geometry (MATHAG30) [M-MATH-102940]

**Responsible:** Prof. Dr. Wilderich Tuschmann

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementary Field / Field Algebra and Geometry
- Mathematical Specialization
- Additional Examinations

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**Prerequisites**
none
2.33 Module: Comparison of Numerical Integrators for Nonlinear Dispersive Equations [M-MATH-104426]

Responsible: Prof. Dr Katharina Schratz
Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Applied and Numerical Mathematics
                                  Mathematical Methods 2 / Field Applied and Numerical Mathematics
                                  Complementary Field / Field Applied and Numerical Mathematics
                                  Mathematical Specialization
                                  Additional Examinations

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Prerequisites

None

Content

We will compare numerical integrators (e.g., splitting methods, exponential integrators) for nonlinear dispersive equations such as the nonlinear Schrödinger equation and Kortweg-de Vries equation. We will analyze their convergence properties with regard to the regularity assumptions on the solution.
### Module: Complex Analysis (MATHAN16) [M-MATH-102878]

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<th>Dr. Christoph Schmoeger</th>
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#### Mandatory

| T-MATH-105849  | Complex Analysis | 8 CR | Herzog, Plum, Reichel, Schmoeger, Schnaubelt |

#### Content

- infinite products
- Mittag-Leffler theorem
- Montel's theorem
- Riemann mapping theorem
- conformal mappings
- univalent (schlicht) functions
- automorphisms of some domains
- harmonic functions
- Schwarz reflection principle
- regular and singular points of power series
2.35 Module: Compressive Sensing (MATHNM37) [M-MATH-102935]

**Responsible:** Prof. Dr. Andreas Rieder

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
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## 2.36 Module: Computational Geometry [M-INFO-102110]

**Responsible:**  
Jun.-Prof. Dr. Thomas Bläsius  
Prof. Dr. Dorothea Wagner

**Organisation:**  
KIT Department of Informatics  
Part of: Complementary Field / Subject Computer Science

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### Module: Computer-Assisted Analytical Methods for Boundary and Eigenvalue Problems (MATHAN11) [M-MATH-102883]

**Responsible:** Prof. Dr. Michael Plum  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 2 / Field Analysis  
- Complementary Field / Field Analysis  
- Mathematical Specialization  
- Additional Examinations  

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## 2.38 Module: Continuous Time Finance (MATHST08) [M-MATH-102860]

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<tr>
<th>Responsible</th>
<th>Prof. Dr. Nicole Bäuerle</th>
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2.39 Module: Control Theory (MATHAN18) [M-MATH-102941]

Responsible: Prof. Dr. Roland Schnaubelt
Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Analysis
Mathematical Methods 2 / Field Analysis
Complementary Field / Field Analysis
Mathematical Specialization
Additional Examinations

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Mandatory

| T-MATH-105909 | Control Theory | 6 CR | Schnaubelt |

Prerequisites
none
2.40 Module: Convex Geometry (MATHAG07) [M-MATH-102864]

Responsible: Prof. Dr. Daniel Hug
Organisation: KIT Department of Mathematics

Part of:
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Algebra and Geometry
- Complementary Field / Field Stochastics
- Mathematical Specialization
- Additional Examinations

Credits 8
Grading scale Grade to a tenth
Recurrence Irregular
Duration 1 term
Level 4
Version 1

Mandatory
T-MATH-105831 Convex Geometry 8 CR Hug

Competence Goal
The students
- know fundamental combinatorial, geometric and analytic properties of convex sets and convex functions and apply these to related problems,
- are familiar with fundamental geometric and analytic inequalities for functionals of convex sets and their applications to geometric extremal problems and can present central ideas and techniques of proofs,
- know selected integral formulas for convex sets and the required results on invariant measures.
- know how to work self-organized and self-reflexive.

Content
1. Convex Sets
   1.1. Combinatorial Properties
   1.2. Support and Separation Properties
   1.3. Extremal Representations
2. Convex Functions
   2.1. Basic Properties
   2.2. Regularity
   2.3. Support Function
3. Brunn-Minkowski Theory
   3.1. Hausdorff Metric
   3.2. Volume and Surface Area
   3.3. Mixed Volumes
   3.4. Geometric Inequalities
   3.5. Surface Area Measures
   3.6. Projection Functions
4. Integralgeometric Formulas
   4.1. Invariant Measures
   4.2. Projection and Section Formulas
## 2.41 Module: Decision and Game Theory (WM4VWL10) [M-WIWI-102970]

### Responsible:
Prof. Dr. Clemens Puppe

### Organisation:
KIT Department of Economics and Management

### Part of:
Complementary Field / Subject Economics

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<td>T-WIWI-102614 Experimental Economics 4,5 CR Weinhardt</td>
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<td>T-WIWI-102861 Advanced Game Theory 4,5 CR Ehrhart, Puppe, Reiß</td>
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### Competence Certificate
The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module separately. The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

### Competence Goal
The student learns the basics of individual and strategic decisions on an advanced and formal level. He learns to analyze economic problems through abstract and method-based thinking and to design solution strategies. In the tutorials, the concepts and results of the lecture will be applied in case studies.

### Prerequisites
None

### Content
See German version.

### Workload
The total workload for this module is approximately 270 hours. For further information see German version.
### Module: Designtheory with Applications in Statistics (MATHST22) [M-MATH-103087]

**Responsible:** Dr. rer. nat. Bruno Ebner  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Stochastics  
- Mathematical Methods 2 / Field Stochastics  
- Complementary Field / Field Stochastics  
- Mathematical Specialization  
- Additional Examinations

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**Mandatory**

| T-MATH-106122 | Designtheory with Applications in Statistics | 8 CR | Ebner, Folkers |
2.43 Module: Differential Geometry (MATHAG04) [M-MATH-101317]

<table>
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<tr>
<th>Responsible:</th>
<th>Prof. Dr. Wilderich Tuschmann</th>
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**Prerequisites**

None
2.44 Module: Digital Signatures (2400057) [M-INFO-100743]

**Responsible:** Prof. Dr. Dennis Hofheinz

**Organisation:** KIT Department of Informatics

**Part of:** Complementary Field / Subject Computer Science

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**Mandatory**

| T-INFO-101280 | Digital Signatures | 3 CR | Hofheinz |

**Competence Goal**

The student
- knows important signature schemes that are relevant in theory and practice (such as DSA and tree-based signatures),
- understands basic security notions and their relation (such as existential unforgeability under chosen-message attacks),
- is able to understand and apply basic proof techniques (such as reductions and hybrid arguments)

**Content**

Digital signatures are a fundamental primitive of modern cryptography. Their practical applications include, for instance, authenticated e-mail or certificate hierarchies on the internet.

This lecture will give an overview of important signature schemes with theoretical or practical relevance. This includes:
- One-time signatures, tree-based signatures, and chameleon hash functions
- RSA-based signatures
- Signatures in bilinear groups

Goal of this lecture is not only to describe these schemes, but also to discuss their security. Therefore we will introduce various security notions for digital signatures, and analyze whether the presented schemes provably meet these notions (under certain hardness assumptions).

Depending on the student's preferences, the remaining time will be used to discuss advanced topics, such as:
- Schnorr signatures
- Programmable hash functions
- Tightness of reductions
- Analysis of hardness assumptions in the generic group model

**Workload**

90 h
Module: Digital Technology [M-ETIT-102102]

**Responsible:** Prof. Dr.-Ing. Jürgen Becker

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** Complementary Field / Subject Electrical Engineering

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**Mandatory**

| T-ETIT-101918 | Digital Technology | 6 CR | Becker |

**Prerequisites**

none
2.46 Module: Discrete Dynamical Systems [M-MATH-105432]

**Responsible:** PD Dr. Gerd Herzog

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

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**Mandatory**

| T-MATH-110952 | Discrete Dynamical Systems | 3 CR | Herzog |

**Prerequisites**
none
2.47 Module: Discrete Time Finance (MATHST04) [M-MATH-102919]

**Responsible:** Prof. Dr. Nicole Bäuerle

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Stochastics
- Mathematical Specialization
- Additional Examinations

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**Mandatory**

| T-MATH-105839 | Discrete Time Finance | 8 CR | Bäuerle, Fasen-Hartmann |

**Prerequisites**
none
### Module: Dispersive Equations [M-MATH-104425]

**Responsible:** Prof. Dr. Wolfgang Reichel  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 2 / Field Analysis  
- Complementary Field / Field Analysis  
- Mathematical Specialization  
- Additional Examinations

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**Prerequisites**  
None
## 2.49 Module: Distributed Discrete Event Systems [M-ETIT-100361]

**Responsible:** Prof. Dr.-Ing. Michael Heizmann  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** Complementary Field / Subject Electrical Engineering  

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**Prerequisites**  
none
# 2.50 Module: Dynamical Systems (MATHAN43) [M-MATH-103080]

**Responsible:** Prof. Dr. Jens Rottmann-Matthes  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 2 / Field Analysis  
- Complementary Field / Field Analysis  
- Mathematical Specialization  
- Additional Examinations

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## Mandatory

| T-MATH-106114 | Dynamical Systems | 8 CR | Rottmann-Matthes |

## Prerequisites

none
Module: Economic Theory and its Application in Finance (WW4VWL14) [M-WIWI-101502]

**Responsible:** Prof. Dr. Kay Mitusch  
**Organisation:** KIT Department of Economics and Management  
**Part of:** Complementary Field / Subject Economics

<table>
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**Election block: Compulsory Elective Courses (1 item)**

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**Election block: Supplementary Courses (1 item)**

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**Competence Certificate**
The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The exams are offered at the beginning of the recess period about the subject matter of the latest held lecture. Re-examinations are offered at every ordinary examination date. The assessment procedures are described for each course of the module separately. The overall grade for the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

**Competence Goal**
The students

- have learnt the methods of formal economic modeling, particularly of General Equilibrium Theory and contract theory
- will be able to apply these methods to the topics in Finance, specifically the areas of financial markets and institutions and corporate finance
- have gained many useful insights into the relationship between firms and investors and the functioning of financial markets

**Prerequisites**
One of the courses T-WIWI-102861 "Advanced Game Theory" and T-WIWI-102609 "Advanced Topics in Economic Theory" is compulsory.

**Content**
The mandatory course "Advanced Topics in Economic Theory" is devoted in equal parts to General Equilibrium Theory and to contract theory. The course "Asset Pricing" will apply techniques of General Equilibrium Theory to valuation of financial assets. The courses "Corporate Financial Policy" and "Finanzintermediation" will apply the techniques of contract theory to issues of corporate finance and financial institutions.

**Workload**
The total workload for this module is approximately 270 hours. For further information see German version.
2.52 Module: Eigenvalue Problems in Complicated Domains [M-MATH-103262]

**Responsible:** Dr. Andrii Khrabustovskyi

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

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<tr>
<td>T-MATH-106497</td>
<td>Eigenvalue Problems in Complicated Domains</td>
<td>4</td>
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</table>

**Competence Goal**
At the end of the course the students will know several methods of perturbation theory and spectral theory. They will be able to apply these methods to various eigenvalue problems in complicated domains. They will know several associated concepts: capacity, strong/weak connectivity etc.

**Prerequisites**
none

**Content**
In the first part of the course we treat some abstract topics: various types of resolvent convergence and their properties, spectral convergence, convergence in varying Hilbert spaces, min-max principle and its applications.

Then, in the second part, we apply these methods to the main object of our interest – eigenvalue problems in domains with complicated geometry. The following topics will be treated:

- Eigenvalue problems in varying domains: general results.
- Laplace operator in a domain with a hole. Capacity.
- Homogenization in perforated domains.
2.53 Module: Electromagnetics and Numerical Calculation of Fields [M-ETIT-100386]

**Responsible:** Prof. Dr.-Ing. Thomas Zwick

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** Complementary Field / Subject Electrical Engineering

**Credits:** 4

**Grading scale:** Grade to a tenth

**Recurrence:** Each winter term

**Duration:** 1 term

**Language:** English

**Level:** 4

**Version:** 2

**Mandatory**

<table>
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<td>T-ETIT-100640</td>
<td>Electromagnetics and Numerical Calculation of Fields</td>
<td>4 CR</td>
<td>Zwick</td>
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</table>

**Competence Certificate**

Success control is carried out in the form of a written test of 120 minutes.

**Competence Goal**

Students with very different background in electromagnetic field theory will be brought to a high level of comprehension. They will understand the concept of electric & magnetic fields and of electric potential & vector potential and they will be able to solve simple problems of electric & magnetic fields using mathematics. They will understand the equations and solutions of wave creation and wave propagation. Finally the student will have learnt the basics of numerical field calculation and be able to use software packages of numerical field calculation in a comprehensive and critical way.

The student will

- be able to deal with all quantities of electromagnetic field theory (E, D, B, H, J, M, P, ...), in particular: how to calculate and how to measure them,
- derive various equations from the Maxwell equations to solve simple field problems (electrostatics, magnetostatics, steady currents, electromagnetics),
- be able to deal with the concept of field energy density and solve practical problems using it (coefficients of capacitance and coefficients of inductance),
- be able to derive and use the wave equation, in particular: to solve problems how to create a wave and calculate solutions of wave propagation through various media,
- be able to outline the concepts, the main application areas and the limitations of methods of numerical field calculation (FDM, FDTD, FIM, FEM, BEM, MoM, TLM)
- be able to use one exemplary software package of numerical field calculation and solve simple practical problems with it.

**Module grade calculation**

The module grade is the grade of the written exam.

**Prerequisites**

none
**Content**
This course first gives a comprehensive recap of Maxwell equations and important equations of electromagnetic field theory. In the second part the most important methods of numerical field calculation are introduced.

Maxwell's equations, materials equations, boundary conditions, fields in ferroelectric and ferromagnetic materials
electric potentials, electric dipole, Coulomb integral, Laplace and Poisson's equation, separation of variables in cartesian, cylindrical and spherical coordinates

Dirichlet Problem, Neumann Problem, Greens function, Field energy density and Poynting vector,
electrostatic field energy, coefficients of capacitance, vector potential, Coulomb gauge, Biot-Savart-law, magnetic field energy, coefficients of inductance magnetic flux and coefficients of mutual inductance, field problems in steady electric currents,

law of induction, displacement current
general wave equation for E and H, Helmholtz equation
skin effect, penetration depth, eddy currents
retarded potentials, Coulomb integral with retarded potentials
wave equation for potential and Vector potential and A, Lorentz gauge, plane waves
Hertzian dipole, near field solution, far field solution
transmission lines, fields in coaxial transmission lines
waveguides, TM-waves, TE-waves
finite difference method FDM
finite difference - time domain FDTD, Yee´s algorithm
finite difference - frequency domain
finite integration method FIM
finite element method FEM
boundary element method BEM, Method of Moments (MOM), Transmission Line Matrix Methal (TLM),
solving large systems of linear equations
basic rules for good numerical field calculation

The lecturer reserves the right to alter the contents of the course without prior notification.

**Recommendation**
Fundamentals of electromagnetic field theory.

**Workload**
Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:

Attendance time in lectures (3 h 15 appointments each) = 45 h
Self-study (4 h 15 appointments each) = 60 h
Preparation / post-processing = 20 h
Total effort approx. 125 hours = 4 LP

**Literature**
Matthew Sadiku (2001), Numerical Techniques in Electromagnetics.
CRC Press, Boca Raton, 0-8493-1395-3
Artech House, Boston, 1-58053-076-1
Springer Verlag, New York, 0-387-94877-5
IOS Press, Ohmsha, 1 58603 064 7
2.54 Module: Energy Economics and Technology (WW4BWLIIP5) [M-WIWI-101452]

Responsible: Prof. Dr. Wolf Fichtner
Organisation: KIT Department of Economics and Management
Part of: Complementary Field / Subject Economics

<table>
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<th>Credits</th>
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Election block: Compulsory Elective Courses (at least 9 credits)

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<td>3,5 CR</td>
<td>Jochem</td>
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<tr>
<td>T-WIWI-102650</td>
<td>Energy and Environment</td>
<td>4,5 CR</td>
<td>Karl</td>
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<tr>
<td>T-WIWI-102830</td>
<td>Energy Systems Analysis</td>
<td>3 CR</td>
<td>Ardone, Fichtner</td>
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<tr>
<td>T-WIWI-107464</td>
<td>Smart Energy Infrastructure</td>
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<td>T-WIWI-102695</td>
<td>Heat Economy</td>
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Competence Certificate
The assessment is carried out as partial written exams (according to Section 4(2), 1 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The examinations take place every semester. Re-examinations are offered at every ordinary examination date. The assessment procedures are described for each course of the module separately.

The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Competence Goal
The student
- gains detailed knowledge about present and future energy supply technologies (focus on final energy carriers electricity and heat),
- knows the techno-economic characteristics of plants for energy provision, for energy transport as well as for energy distribution and demand,
- is able to assess the environmental impact of these technologies.

Prerequisites
None

Content
*Heat Economy*: district heating, heating technologies, reduction of heat demand, statutory provisions
*Energy Systems Analysis*: Interdependencies in energy economics, energy systems modelling approaches in energy economics
*Energy and Environment*: emission factors, emission reduction measures, environmental impact
*Efficient Energy Systems and Electric Mobility*: concepts and current trends in energy efficiency, Overview of and economical, ecological and social impacts through electric mobility

Workload
The total workload for this module is approximately 270 hours. For further information see German version.
# 2.55 Module: Evolution Equations (MATHAN12) [M-MATH-102872]

**Responsible:** Prof. Dr. Roland Schnaubelt  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 2 / Field Analysis  
- Complementary Field / Field Analysis  
- Mathematical Specialization  
- Additional Examinations

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<td>T-MATH-105844</td>
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2.56 Module: Exponential Integrators [M-MATH-103700]

**Responsible:** Prof. Dr. Marlis Hochbruck  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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<td>Exponential Integrators</td>
<td>6 CR</td>
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</tbody>
</table>

**Competence Certificate**  
Oral exam of approximately 20 minutes

**Prerequisites**  
None

**Content**  
In this class we consider the construction, analysis, implementation and application of exponential integrators. The focus will be on two types of stiff problems.

The first one is characterized by a Jacobian that possesses eigenvalues with large negative real parts. Parabolic partial differential equations and their spatial discretization are typical examples. The second class consists of highly oscillatory problems with purely imaginary eigenvalues of large modulus.

Apart from motivating the construction of exponential integrators for various classes of problems, our main intention in this class is to present the mathematics behind these methods. We will derive error bounds that are independent of stiffness or highest frequencies in the system.

Since the implementation of exponential integrators requires the evaluation of the product of a matrix function with a vector, we will briefly discuss some possible approaches as well.
2.57 Module: Extremal Graph Theory (MATHAG42) [M-MATH-102957]

**Responsibility:** Prof. Dr. Maria Aksenovich

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementary Field / Field Algebra and Geometry
- Mathematical Specialization
- Additional Examinations

<table>
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**Mandatory**

| T-MATH-105931 | Extremal Graph Theory | 8 CR | Aksenovich |

**Competence Certificate**
The final grade is given based on an oral exam (approx. 30 min.).

**Competence Goal**
The students understand, describe, and use fundamental notions and techniques in extremal graph theory. They can analyze, structure, and formally describe typical combinatorial questions. The students understand and use Szemeredi’s regularity lemma and Szemerédi’s theorem, can use probabilistic techniques, such as dependent random choice and multistep random colorings, know the best bounds for the extremal numbers of complete graphs, cycles, complete bipartite graphs, and bipartite graphs with bounded maximum degree. They understand and can use the Ramsey theorem for graphs and hypergraphs, as well as stepping-up techniques for bounding Ramsey numbers. Moreover, the students know and understand the behavior of Ramsey numbers for graphs with bounded maximum degree. The students can communicate using English technical terminology.

**Content**
The course is concerned with advanced topics in graph theory. It focuses on the areas of extremal functions, regularity, and Ramsey theory for graphs and hypergraphs. Further topics include Turán's theorem, Erdös-Stone theorem, Szemerédi's lemma, graph colorings and probabilistic techniques.

**Recommendation**
Basic knowledge of linear algebra, analysis and graph theory is recommended.

**Annotation**
Course is held in English
Module: Extreme Value Theory (MATHST23) [M-MATH-102939]

**Responsible:** Prof. Dr. Vicky Fasen-Hartmann

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Stochastics
- Mathematical Specialization
- Additional Examinations

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<tbody>
<tr>
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**Prerequisites**
None
Module: Finance 1 (WW4BWLFBV1) [M-WIWI-101482]

Responsible: Prof. Dr. Martin Ruckes  
Prof. Dr. Marliese Uhrig-Homburg

Organisation: KIT Department of Economics and Management

Part of: Complementary Field / Subject Economics

<table>
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<td>Each term</td>
<td>1 term</td>
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Election block: Compulsory Elective Courses (9 credits)

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<td>T-WIWI-102643</td>
<td>Derivatives</td>
<td>4,5</td>
<td>Uhrig-Homburg</td>
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<tr>
<td>T-WIWI-102621</td>
<td>Valuation</td>
<td>4,5</td>
<td>Ruckes</td>
</tr>
<tr>
<td>T-WIWI-102647</td>
<td>Asset Pricing</td>
<td>4,5</td>
<td>Ruckes, Uhrig-Homburg</td>
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</table>

Competence Certificate
The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module separately.

The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Competence Goal
The student

- has core skills in economics and methodology in the field of finance
- assesses corporate investment projects from a financial perspective
- is able to make appropriate investment decisions on financial markets

Prerequisites
None

Content
The courses of this module equip the students with core skills in economics and methodology in the field of modern finance. Securities which are traded on financial and derivative markets are presented, and frequently applied trading strategies are discussed. A further focus of this module is on the assessment of both profits and risks in security portfolios and corporate investment projects from a financial perspective.

Workload
The total workload for this module is approximately 270 hours. For further information see German version.
### Module: Finance 2 (WW4BWLFBV2) [M-WIWI-101483]

**Responsible:** Prof. Dr. Martin Ruckes  
Prof. Dr. Marliese Uhrig-Homburg

**Organisation:** KIT Department of Economics and Management

**Part of:** Complementary Field / Subject Economics

<table>
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**Election block: Compulsory Elective Courses (at least 9 credits)**

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<td>Thimme</td>
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<td>T-WIWI-102647</td>
<td>Asset Pricing</td>
<td>4,5</td>
<td>Ruckes, Uhrig-Homburg</td>
</tr>
<tr>
<td>T-WIWI-108880</td>
<td>Blockchains &amp; Cryptofinance</td>
<td>4,5</td>
<td>Schuster, Uhrig-Homburg</td>
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<tr>
<td>T-WIWI-110995</td>
<td>Bond Markets</td>
<td>4,5</td>
<td>Uhrig-Homburg</td>
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<td>T-WIWI-110997</td>
<td>Bond Markets - Models &amp; Derivatives</td>
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<td>T-WIWI-110996</td>
<td>Bond Markets - Tools &amp; Applications</td>
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<td>Corporate Financial Policy</td>
<td>4,5</td>
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<td>Derivatives</td>
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<td>T-WIWI-110797</td>
<td>eFinance: Information Systems for Securities Trading</td>
<td>4,5</td>
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<td>Fixed Income Securities</td>
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<td>Financial Analysis</td>
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<td>Business Strategies of Banks</td>
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<tr>
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<td>Web App Programming for Finance</td>
<td>4,5</td>
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**Competence Certificate**

The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module separately.

The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

**Competence Goal**

The student is in a position to discuss, analyze and provide answers to advanced economic and methodological issues in the field of modern finance.

**Prerequisites**

It is only possible to choose this module in combination with the module Finance 1. The module is passed only after the final partial exam of Finance 1 is additionally passed.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The module M-WIWI-101482 - Finance 1 must have been started.
Content
The module Finance 2 is based on the module Finance 1. The courses of this module equip the students with advanced skills in economics and methodology in the field of modern finance on a broad basis.

Annotation
The courses eFinance: Information Engineering and Management for Securities Trading [2540454] and Financial Analysis [2530205] can be chosen from summer term 2015 on.

Workload
The total workload for this module is approximately 270 hours. For further information see German version.
## 2.61 Module: Finance 3 (WW4BWLFBV11) [M-WIWI-101480]

**Responsible:** Prof. Dr. Martin Ruckes  
Prof. Dr. Marliese Uhrig-Homburg  

**Organisation:** KIT Department of Economics and Management  

**Part of:** Complementary Field / Subject Economics

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### Election block: Compulsory Elective Courses (at least 9 credits)

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### Competence Certificate

The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module separately.

The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

### Competence Goal

The student is in a position to discuss, analyze and provide answers to advanced economic and methodological issues in the field of modern finance.

### Prerequisites

It is only possible to choose this module in combination with the module Finance 1 and Finance 2. The module is passed only after the final partial exams of Finance 1 and Finance 2 are additionally passed.

### Modeled Conditions

The following conditions have to be fulfilled:

1. The module M-WIWI-101482 - Finance 1 must have been started.  
2. The module M-WIWI-101483 - Finance 2 must have been started.
Content
The courses of this module equip the students with advanced skills in economics and methodology in the field of modern finance on a broad basis.

Workload
The total workload for this module is approximately 270 hours. For further information see German version.
Module: Finite Element Methods (MATHNM07) [M-MATH-102891]

**Responsible:** Prof. Dr. Willy Dörfler  
Prof. Dr. Christian Wieners

**Organisation:** KIT Department of Mathematics

**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

### Credits 8  
Grade to a tenth  
Each winter term  
1 term  
4  
1

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# 2.63 Module: Finite Group Schemes [M-MATH-103258]

**Responsible:** Prof. Dr. Frank Herrlich  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Algebra and Geometry  
- Mathematical Methods 2 / Field Algebra and Geometry  
- Complementary Field / Field Algebra and Geometry  
- Mathematical Specialization  
- Additional Examinations

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2.64 Module: Forecasting: Theory and Practice (MATHST28) [M-MATH-102956]

**Responsible:** Prof. Dr. Tilmann Gneiting

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Stochastics
- Mathematical Specialization
- Additional Examinations

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**Prerequisites**

None

**Annotation**

- Regular cycle: every 2nd year, starting winter semester 16/17
- Course is held in English
### Module: Formal Systems (24086) [M-INFO-100799]

**Responsible:** Prof. Dr. Bernhard Beckert  
**Organisation:** KIT Department of Informatics  
**Part of:** Complementary Field / Subject Computer Science

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**Mandatory**

| T-INFO-101336 | Formal Systems | 6 CR | Beckert |

Mathematics Master 2016 (Master of Science (M.Sc.))  
Module Handbook as of 21/09/2021
## 2.66 Module: Foundations of Continuum Mechanics (MATHNM11) [M-MATH-103527]

**Responsible:** Prof. Dr. Christian Wieners  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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**Mandatory**

| T-MATH-107044 | Foundations of Continuum Mechanics | 3 CR | Wieners |

**Prerequisites**  
none
# Module: Fourier Analysis (MATHAN14) [M-MATH-102873]

**Responsible:** Prof. Dr. Roland Schnaubelt  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 2 / Field Analysis  
- Complementary Field / Field Analysis  
- Mathematical Specialization  
- Additional Examinations

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**Content**

- Fourier series  
- Fourier transform on L1 and L2  
- Tempered distributions and their Fourier transform  
- Explicit solutions of the Heat-, Schrödinger- and Wave equation in R^n  
- the Hilbert transform  
- the interpolation theorem of Marcinkiewicz  
- Singular integral operators  
- the Fourier multiplier theorem of Mihlin
Module: Fourier Analysis and its Applications to PDEs [M-MATH-104827]

**Responsible:** Jun.-Prof. Dr. Xian Liao

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

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**Prerequisites**
None
2.69 Module: Fractal Geometry [M-MATH-105649]

**Responsible:** PD Dr. Steffen Winter

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Algebra and Geometry
- Complementary Field / Field Stochastics
- Mathematical Specialization
- Additional Examinations

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**Prerequisites**
None
2.70 Module: Functional Analysis (MATHAN05) [M-MATH-101320]

**Responsible:** Prof. Dr. Roland Schnaubelt

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

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**Mandatory**

| T-MATH-102255 | Functional Analysis | 8 CR Frey, Herzog, Hundertmark, Lamm, Plum, Reichel, Schmoeger, Schnaubelt |

**Prerequisites**

None
Module: Functions of Matrices (MATHNM39) [M-MATH-102937]

**Responsible:** PD Dr. Volker Grimm

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

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**Prerequisites**

none
2.72 Module: Functions of Operators (MATHNM38) [M-MATH-102936]

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# 2.73 Module: Fuzzy Sets (24611) [M-INFO-100839]

**Responsible:** Prof. Dr.-Ing. Uwe Hanebeck  
**Organisation:** KIT Department of Informatics  
**Part of:** Complementary Field / Subject Computer Science

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Module: Generalized Regression Models (MATHST09) [M-MATH-102906]

**Responsible:** PD Dr. Bernhard Klar

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Stochastics
- Mathematical Specialization
- Additional Examinations

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**Prerequisites**
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## 2.75 Module: Geometric Analysis (MATHAN36) [M-MATH-102923]

**Responsible:** Prof. Dr. Tobias Lamm  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Methods 1 / Field Analysis  
Mathematical Methods 2 / Field Analysis  
Complementary Field / Field Analysis  
Mathematical Specialization  
Additional Examinations

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**Prerequisites**
none
**Module: Geometric Group Theory (MATHAG12) [M-MATH-102867]**

**Responsible:** Prof. Dr. Roman Sauer  
**Organisation:** KIT Department of Mathematics

**Part of:**  
- Mathematical Methods 1 / Field Algebra and Geometry  
- Mathematical Methods 2 / Field Algebra and Geometry  
- Complementary Field / Field Algebra and Geometry  
- Mathematical Specialization  
- Additional Examinations

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Module: Geometric Group Theory II (MATHAG24) [M-MATH-102869]

Responsible: Prof. Dr. Roman Sauer
Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Algebra and Geometry
Mathematical Methods 2 / Field Algebra and Geometry
Complementary Field / Field Algebra and Geometry
Mathematical Specialization
Additional Examinations

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Module: Geometric Numerical Integration (MATHNM31) [M-MATH-102921]

**Responsible:** Prof. Dr Tobias Jahnke

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
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<td>6</td>
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**Prerequisites**
none
2.79 Module: Geometry of Schemes (MATHAG11) [M-MATH-102866]

**Responsible:** Prof. Dr. Frank Herrlich

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementery Field / Field Algebra and Geometry
- Mathematical Specialization
- Additional Examinations

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<td>8 CR</td>
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*Mathematics Master 2016 (Master of Science (M.Sc.))
Module Handbook as of 21/09/2021*
### Module: Global Differential Geometry (MATHAG27) [M-MATH-102912]

**Responsible:** Prof. Dr. Wilderich Tuschmann  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Algebra and Geometry  
- Mathematical Methods 2 / Field Algebra and Geometry  
- Complementary Field / Field Algebra and Geometry  
- Mathematical Specialization  
- Additional Examinations  

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**Prerequisites**  
none
2.81 Module: Graph Theory (MATHAG26) [M-MATH-101336]

**Responsible:** Prof. Dr. Maria Aksenovich

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementary Field / Field Algebra and Geometry
- Mathematical Specialization
- Additional Examinations

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Competence Certificate

The final grade is given based on the written final exam (3h).

By successfully working on the problem sets, a bonus can be obtained. To obtain the bonus, one has to achieve 50% of the points on the solutions of the exercise sheets 1-6 and also of the exercise sheets 7-12. If the grade in the final written exam is between 4,0 and 1,3, then the bonus improves the grade by one step (0,3 or 0,4).

Competence Goal

The students understand, describe and use fundamental notions and techniques in graph theory. They can represent the appropriate mathematical questions in terms of graphs and use the results such as Menger's theorem, Kuratowski's theorem, Turan's theorem, as well as the developed proof ideas, to solve these problems. The students can analyze graphs in terms of their characteristics such as connectivity, planarity, and chromatic number. They are well positioned to understand graph theoretic methods and use them critically. Moreover, the students can communicate using English technical terminology.

Prerequisites

None

Content

The course Graph Theory treats the fundamental properties of graphs, starting with basic ones introduced by Euler and including the modern results obtained in the last decade. The following topics are covered: structure of trees, paths, cycles and walks in graphs, minors, unavoidable subgraphs in dense graphs, planar graphs, graph coloring, Ramsey theory, and regularity in graphs.

Annotation

- Regular cycle: every 2nd year, winter semester
- Course is held in English
### 2.82 Module: Group Actions in Riemannian Geometry (MATHAG40) [M-MATH-102954]

**Responsible:** Prof. Dr. Wilderich Tuschmann  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Algebra and Geometry  
- Mathematical Methods 2 / Field Algebra and Geometry  
- Complementary Field / Field Algebra and Geometry  
- Mathematical Specialization  
- Additional Examinations

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**Prerequisites**

none
Module: Growth and Agglomeration (WW4VWL12) [M-WIWI-101496]

Responsible: Prof. Dr. Ingrid Ott
Organisation: KIT Department of Economics and Management
Part of: Complementary Field / Subject Economics

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Election block: Compulsory Elective Courses (9 credits)

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<td>T-WIWI-103107</td>
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<td>Growth and Development</td>
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Competence Certificate
The assessment is carried out as partial written exams (see the lectures descriptions).

The overall grade for the module is the average of the grades for each course weighted by the credits.

Competence Goal
The student

- gains deepened knowledge of micro-based general equilibrium models
- understands how based on individual optimizing decisions aggregate phenomena like economic growth or agglomeration (cities / metropolises) result
- is able to understand and evaluate the contribution of these phenomena to the development of economic trends
- can derive policy recommendations based on theory

Prerequisites
None

Modelled Conditions
The following conditions have to be fulfilled:

1. The course T-WIWI-102708 - Economics I: Microeconomics must have been started.
2. The course T-WIWI-102709 - Economics II: Macroeconomics must have been started.

Content
The module includes the contents of the lectures Endogenous Growth Theory [2561503], Spatial Economics [2561260] and International Economic Policy [2560254]. While the first two lectures have a more formal-analytic focus, the third lecture approaches fundamental ideas and problems from the field of international economic policy from a more verbal perspective.

The common underlying principle of all three lectures in this module is that, based on different theoretical models, economic policy recommendations are derived.

Recommendation
Attendance of the course Introduction Economic Policy [2560280] is recommended.

Successful completion of the courses Economics I: Microeconomics and Economics II: Macroeconomics is required.

Workload
The total workload for this module is approximately 270 hours. For further information see German version.
2.84 Module: Harmonic Analysis (MATHAN14) [M-MATH-105324]

**Responsible:** Prof. Dr. Dorothee Frey

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

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**Mandatory**

| T-MATH-111289 | Harmonic Analysis | 8 CR |

**Content**

- Fourier series
- Fourier transform on $L_1$ and $L_2$
- Tempered distributions and their Fourier transform
- Explicit solutions of the Heat-, Schrödinger- and Wave equation in $\mathbb{R}^n$
- the Hilbert transform
- the interpolation theorem of Marcinkiewicz
- Singular integral operators
- the Fourier multiplier theorem of Mihlin
Module: Harmonic Analysis for Dispersive Equations [M-MATH-103545]

**Responsible:** apl. Prof. Dr. Peer Kunstmann

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
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**Prerequisites**
None

**Content**
Fourier transform, Fourier multipliers, interpolation, singular integral operators, Mihlin's Theorem, Littlewood-Paley decomposition, oscillating integrals, dispersive estimates, Strichartz estimates, nonlinear equations.
2.86 Module: Homogeneous and Symmetric Spaces [M-MATH-105067]

**Responsible:** Prof. Dr. Enrico Leuzinger

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementary Field / Field Algebra and Geometry
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**Prerequisites**
None
Module: Homotopy Theory (MATHAG44) [M-MATH-102959]

**Responsible:** Prof. Dr. Roman Sauer

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementary Field / Field Algebra and Geometry
- Mathematical Specialization
- Additional Examinations

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8 CR Sauer
### 2.88 Module: Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy (24139 / 24678) [M-INFO-100725]

**Responsible:** Prof. Dr.-Ing. Tamim Asfour  
**Organisation:** KIT Department of Informatics  
**Part of:** Complementary Field / Subject Computer Science

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Asfour, Spetzger
Module: Human-Machine-Interaction in Anthropomatics: Basics (24100) [M-INFO-100824]

**Responsible:** Prof. Dr.-Ing. Jürgen Beyerer
Dr. Jürgen Geisler

**Organisation:** KIT Department of Informatics

**Part of:** Complementary Field / Subject Computer Science

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**Mandatory**

| T-INFO-101361 | Human-Machine-Interaction in Anthropomatics: Basics | 3 CR | Beyerer, Geisler |
## 2.90 Module: Informatics (WW4INFO1) [M-WIWI-101472]

### Responsible:
- Michael Färber
- Prof. Dr. Andreas Oberweis
- Prof. Dr. Harald Sack
- Prof. Dr. Ali Sunyaev
- Prof. Dr. Melanie Volkamer
- Prof. Dr.-Ing. Johann Marius Zöllner

### Organisation:
- KIT Department of Economics and Management

### Part of:
- Complementary Field / Subject Economics

### Credits: 9
### Grading scale: Grade to a tenth
### Recurrence: Each term
### Duration: 1 term
### Level: 4
### Version: 14

#### Election block: Compulsory Elective Area ()

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<td>4,5 CR</td>
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<td>4,5 CR</td>
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<td>4,5 CR</td>
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#### Election block: Seminars and Advanced Labs (between 0 and 1 items)

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<td>Sunyaev</td>
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<td>4,5 CR</td>
<td>Volkamer</td>
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<td>T-WIWI-109786</td>
<td>Advanced Lab Security</td>
<td>4,5 CR</td>
<td>Volkamer</td>
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<td>T-WIWI-109985</td>
<td>Project Lab Cognitive Automobiles and Robots</td>
<td>4,5 CR</td>
<td>Zöllner</td>
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<td>T-WIWI-109983</td>
<td>Project Lab Machine Learning</td>
<td>4,5 CR</td>
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<td>T-WIWI-109251</td>
<td>Selected Issues in Critical Information Infrastructures</td>
<td>4,5 CR</td>
<td>Sunyaev</td>
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</table>
Competence Certificate
The assessment is carried out as partial exams (according to Section 4(2) of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. For passing the module exam in every singled partial exam the respective minimum requirements has to be achieved.

The examinations are offered every semester. Re-examinations are offered at every ordinary examination date. The assessment procedures are described for each course of the module separately.

When every singled examination is passed, the overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Please note the following information about the module component exams of Prof. Dr. H. Schmeck:

Competence Goal
The student

- has the ability to master methods and tools in a complex discipline and to demonstrate innovativeness regarding the methods used,
- knows the principles and methods in the context of their application in practice,
- is able to grasp and apply the rapid developments in the field of computer science, which are encountered in work life, quickly and correctly, based on a fundamental understanding of the concepts and methods of computer science,
- is capable of finding and defending arguments for solving problems.

Prerequisites
It is only allowed to choose one lab.

Content
The thematic focus will be based on the choice of courses in the areas of Effiziente Algorithmen, Betriebliche Informations- und Kommunikationssysteme, Wissensmanagement, Komplexitätsmanagement and Software- und Systems Engineering.

Annotation
Detailed information on the recognition of examinations in the field of Informatics can be found at http://www.aifb.kit.edu/web/Auslandsaufenthalt.

Workload
The total workload for this module is approximately 270 hours. For further information see German version.
Module: Information Technology [M-ETIT-104539]

**M 2.91 Module: Information Technology [M-ETIT-104539]**

**Responsible:** Prof. Dr.-Ing. Eric Sax  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** Complementary Field / Subject Electrical Engineering

<table>
<thead>
<tr>
<th>Credits</th>
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**Mandatory**

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<td>Information Technology I - Practical Course</td>
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</table>

**Competence Certificate**

The module grade is the grade of the written exam. Successful completion of the internship is a prerequisite for passing the module.

The success control of the module consists of:
1. A "written exam" of 120 minutes for the courses lecture, exercise (4 CP)
2. A success control in the form of project documentation and control of the source code in the course of the practical course (2 CP)

**Competence Goal**

The students get to know the structure and functioning of information technology systems and their use. Students can
- differentiate the characteristics of embedded systems.
- name different programming languages and paradigms and compare their differences.
- explain the basic components of the C++ programming language and create programs in this language.
- list the components required to create an executable program and describe their interaction.
- represent program structures with the help of graphical description means.
- differentiate the object-oriented programming paradigm from traditional approaches and create object-oriented programs.
- graphically depict the structure of object-oriented programs.
- describe general computer architectures, compare their advantages and disadvantages, and explain options for increasing performance.
- describe different levels of abstraction for data storage. There are various ways to store, organize, name and evaluate data in a structured manner.
- describe the tasks of an operating system and reflect the basic functions of processes and threads.
- explain the phases and processes of project management and outline the planning of small projects.

By participating in the information technology internship, students can break down complex programming problems into simple and clear modules and develop suitable algorithms and data structures, and convert them into an executable program using a programming language.

**Module grade calculation**

The module grade is the grade of the written exam. Successful completion of the internship is a prerequisite for passing the module.

**Prerequisites**

None
Content

Lecture Information Technology I:
Basic lecture on information technology. The focus of the event is:
- Programming languages, program creation and program structures
- Object orientation
- Computer architectures and embedded systems
- Data structures and databases
- Project management
- Operating systems and processes

Exercise Information Technology I:
Accompanying the lecture, the basics of the programming language C++ are taught in the exercise. For this purpose, exercises with reference to the lecture material are given, and the solutions to this are explained in detail. The focus is on the construction and analysis of programs and their creation.

Internship Information Technology:
In the implementation into a structured and executable source code, in compliance with given quality criteria, the writing of complex C / C++ code sections and the handling of an integrated development environment are trained. The implementation takes place on a microcontroller board, which is already known from other courses. The project is processed in small teams, which break the entire project down into individual tasks and process them independently. Here, contents from lectures and exercises are taken up again and applied to specific problems. At the end of the internship, each project team should demonstrate the successful completion of their work on the "TivSeg platform".

Recommendation
Knowledge of the basics of programming is recommended (attendance of the MINT course C++). The contents of the module digital technology are helpful.

Workload
Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:
- Attendance time in 14 lectures and 7 exercises (21.5 hours)
- Preparation / follow-up of lecture and exercise (41 hours)
- Exam preparation and attendance in the same (40 hours)
- Information technology internship 5 appointments (7.5 hours)
- Preparation / follow-up of the internship (40 hours)
2.92 Module: Information Technology II and Automation Technology [M-ETIT-104547]

Responsible: Prof. Dr.-Ing. Eric Sax
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: Complementary Field / Subject Electrical Engineering

<table>
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<th>Credits</th>
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<td>T-ETIT-109319</td>
<td>Information Technology II and Automation Technology</td>
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Competence Certificate
Type of examination: written exam. Duration of Examination: approx. 120 minutes. Content: lecture and exercise.

Prerequisites
None
2.93 Module: Integral Equations (MATHAN07) [M-MATH-102874]

**Responsible:** PD Dr. Frank Hettlich

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Analysis
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Analysis
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

**Credits:** 8

**Grading scale:** Grade to a tenth

**Recurrence:** Irregular

**Duration:** 1 term

**Level:** 4

**Version:** 1

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<td>T-MATH-105834 Integral Equations</td>
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</table>

Arens, Griesmaier, Hettlich
Module: Internet seminar for evolution equations (MATHANISEM) [M-MATH-102918]

**M**

### 2.94 Module: Internet seminar for evolution equations (MATHANISEM) [M-MATH-102918]

**Responsible:** Prof. Dr. Roland Schnaubelt

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

**Credits:** 8

**Grading scale:** Grade to a tenth

**Recurrence:** Each winter term

**Duration:** 1 term

**Level:** 4

**Version:** 1

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</table>

**Prerequisites**

none
### Module: Introduction into Particulate Flows (MATHNM41) [M-MATH-102943]

- **Responsible:** Prof. Dr. Willy Dörfler
- **Organisation:** KIT Department of Mathematics
- **Part of:**
  - Mathematical Methods 1 / Field Applied and Numerical Mathematics
  - Mathematical Methods 2 / Field Applied and Numerical Mathematics
  - Complementary Field / Field Applied and Numerical Mathematics
  - Mathematical Specialization
  - Additional Examinations

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<td>Introduction into Particulate Flows</td>
<td>3 CR Dörfler</td>
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**Prerequisites**

none
2.96 Module: Introduction to Aperiodic Order [M-MATH-105331]

**Responsibility:** Prof. Dr. Tobias Hartnick  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Algebra and Geometry  
- Mathematical Methods 2 / Field Algebra and Geometry  
- Complementary Field / Field Algebra and Geometry  
- Mathematical Specialization  
- Additional Examinations

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**Mandatory**

| T-MATH-110811 | Introduction to Aperiodic Order | 3 CR | Hartnick |

**Prerequisites**

None
### 2.97 Module: Introduction to Fluid Dynamics [M-MATH-105650]

**Responsible:** Prof. Dr. Wolfgang Reichel  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 2 / Field Analysis  
- Complementary Field / Field Analysis  
- Mathematical Specialization  
- Additional Examinations

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<td>1 term</td>
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**Mandatory**  
|
| T-MATH-111297 | Introduction to Fluid Dynamics | 3 CR | Reichel |

**Competence Goal**  
The main aim of this lecture is to introduce students to mathematical fluid dynamics. In particular, by the end of the course students will be able to

- discuss and explain the various formulations of the Euler equations and when these formulations are equivalent,
- state major theorems and their relation,
- discuss weak formulations, existence and uniqueness results.

**Prerequisites**  
None

**Content**  
Mathematical description and analysis of fluid dynamics:

- physical motivation of the incompressible Euler and Navier-Stokes equations,
- Vorticity-Stream formulation and Eulerian and Lagrangian coordinates,
- Local existence theory and energy methods,
- Weak solutions and the Beale-Kato-Majda criterion.

**Recommendation**  
Partial Differential Equations
2.98 Module: Introduction to Geometric Measure Theory (MATHAG35) [M-MATH-102949]

**Responsible:** PD Dr. Steffen Winter

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementary Field / Field Algebra and Geometry
- Mathematical Specialization
- Additional Examinations

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<td>Introduction to Geometric Measure Theory</td>
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</table>

**Prerequisites**

none
Module: Introduction to Homogeneous Dynamics [M-MATH-105101]

**Responsible:** Prof. Dr. Tobias Hartnick  
**Organisation:** KIT Department of Mathematics

**Part of:**  
- Mathematical Methods 1 / Field Algebra and Geometry  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 1 / Field Stochastics  
- Mathematical Methods 2 / Field Algebra and Geometry  
- Mathematical Methods 2 / Field Analysis  
- Mathematical Methods 2 / Field Stochastics  
- Complementary Field / Field Algebra and Geometry  
- Complementary Field / Field Analysis  
- Complementary Field / Field Stochastics  
- Mathematical Specialization  
- Additional Examinations

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<td>6 CR</td>
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</table>

**Prerequisites**

None
2.100 Module: Introduction to Kinetic Equations [M-MATH-105837]

Responsible: Prof. Dr. Wolfgang Reichel
Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Analysis
         Mathematical Methods 2 / Field Analysis
         Complementary Field / Field Analysis
         Mathematical Specialization
         Additional Examinations

Credits 3  Grading scale Grade to a tenth  Recurrence Irregular  Duration 1 term  Language English  Level 4  Version 2

Mandatory

| T-MATH-111721 | Introduction to Kinetic Equations | 3 CR | Zillinger |

Competence Certificate
oral examination of circa 30 minutes

Competence Goal
The main aim of this lecture is to introduce students to the theory of kinetic transport equations. In particular, by the end of the course students will be able to

- discuss properties of the free transport, Boltzmann and Vlasov-Poisson equations,
- state major theorems and their relation,
- discuss notions of solutions and their properties,
- discuss the effects of phase mixing and challenges of nonlinear equations.

Module grade calculation
The module grade is the grade of the final oral exam.

Prerequisites
none

Content
Mathematical description and analysis of kinetic transport equations:

- the free transport, Boltzmann and Vlasov-Poisson equations,
- linear theory, phase mixing and Landau damping,
- equilibrium solutions and stability,
- nonlinear results and methods,
- renormalized solutions.

Recommendation
The course "Classical Methods for Partial Differential Equations" should be studied beforehand.

Workload
Total workload: 90 h
Attendance: 30 h
  - lectures and examination
Self studies: 60 h
  - follow-up and deepening of the course content,
  - literature study and internet research on the course content,
  - preparation for the module examination
2.101 Module: Introduction to Kinetic Theory [M-MATH-103919]

**Responsible:** Prof. Dr. Martin Frank

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

**Credits:** 4  
**Grading scale:** Grade to a tenth  
**Recurrence:** Each winter term  
**Duration:** 1 term  
**Language:** English  
**Level:** 4  
**Version:** 1

| Mandatory | T-MATH-108013 | Introduction to Kinetic Theory | 4 CR | Frank |

**Competence Goal**

After successfully taking part in the module’s classes and exams, students have gained knowledge and abilities as described in the “Inhalt” section. Specifically, students know common means of mesoscopic and macroscopic description of particle systems. Furthermore, students are able to describe the basics of multiscale methods, such as the asymptotic analysis and the method of moments. Students are able to apply numerical methods to solve engineering problems related to particle systems. They can name the assumptions that are needed to be made in the process. Students can judge whether specific models are applicable to the specific problem and discuss their results with specialists and colleagues.

**Prerequisites**

None

**Content**

- From Newton's equations to Boltzmann's equation
- Rigorous derivation of the linear Boltzmann equation
- Properties of kinetic equations (existence & uniqueness, H theorem)
- The diffusion limit
- From Boltzmann to Euler & Navier-Stokes
- Method of Moments
- Closure techniques
- Selected numerical methods

**Recommendation**

Partial Differential Equations, Functional Analysis
2.102 Module: Introduction to Matlab and Numerical Algorithms (MATHNM43) [M-MATH-102945]

**Responsible:** Dr. Daniel Weiß

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

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**Mandatory**

T-MATH-105913 Introduction to Matlab and Numerical Algorithms 5 CR Weiß, Wieners

**Prerequisites**

none
2.103 Module: Introduction to Microlocal Analysis [M-MATH-105838]

**Responsible:** Jun.-Prof. Dr. Xian Liao

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

**Credits:** 3

**Grading scale:** Grade to a tenth

**Recurrence:** Irregular

**Duration:** 1 term

**Language:** English

**Level:** 4

**Version:** 1

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**Mandatory**

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**Competence Certificate**
oral examination of circa 30 minutes

**Competence Goal**
- Students will become familiar with the notions of Fourier multipliers and pseudo-differential operators
- Students can state major theorems and their relation
- Students will understand the structure of the propagation of singularities by introducing the wave front set and apply them to the domain of partial differential equations, control theory, etc.

**Module grade calculation**
The module grade is the grade of the final oral exam.

**Prerequisites**
none

**Content**
1. Pseudo-differential operators
2. Symbolic calculus
3. Wavefront set
4. Propagation of singularities
5. Microlocal defective measure

**Recommendation**
The following courses should be studied beforehand: "Classical Methods for Partial Differential Equations" und "Functional Analysis".

**Workload**
Total workload: 90 h

- **Attendance:** 30 h
  - lectures and examination

- **Self studies:** 60 h
  - follow-up and deepening of the course content,
  - literature study and internet research on the course content,
  - preparation for the module examination
Module: Introduction to Scientific Computing (MATHNM05) [M-MATH-102889]

** Responsible:** Prof. Dr. Willy Dörfler  
Prof. Dr Tobias Jahnke  

**Organisation:** KIT Department of Mathematics  

**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations  

**Credits:** 8  
**Grading scale:** Grade to a tenth  
**Recurrence:** Each summer term  
**Duration:** 1 term  
**Level:** 4  
**Version:** 2

| Mandatory | | | | | | |
|---|---|---|---|---|---|
| T-MATH-105837 | Introduction to Scientific Computing | 8 CR | Dörfler, Hochbruck, Jahnke, Rieder, Wieners |

**Prerequisites**  
None
Module: Inverse Problems (MATHNM06) [M-MATH-102890]

**Responsible:** Prof. Dr. Roland Griesmaier

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Analysis
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Analysis
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

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Arens, Griesmaier, Hettlich, Rieder
2.106 Module: Key Competences [M-MATH-103053]

Organisation: KIT Department of Mathematics

Part of: Interdisciplinary Qualifications

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<td>Each term</td>
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Election notes

For self assignment of taken interdisciplinary qualifications of HoC, ZAK or SPZ the 'Teilleistungen' with the title "Self Assignment HoC-ZAK-SPZ ..." have to be selected according to the grading scale, not graded or graded.

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Prerequisites

None
2.107 Module: Key Moments in Geometry [M-MATH-104057]

**Responsible:** Prof. Dr. Wilderich Tuschmann

**Organisation:** KIT Department of Mathematics

**Part of:** Mathematical Methods 1 / Field Algebra and Geometry

Mathematical Methods 2 / Field Algebra and Geometry

Complementary Field / Field Algebra and Geometry

Mathematical Specialization

**Additional Examinations**

**Credits** 5

**Grading scale** Grade to a tenth

**Recurrence** Irregular

**Duration** 1 term

**Level** 4

**Version** 1

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**Mandatory**

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**Prerequisites**

None
Module: L2-Invariants (MATHAG38) [M-MATH-102952]

**Responsible:** Dr. Holger Kammeyer

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Algebra and Geometry
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

**Credits:** 5

**Grading scale:** Grade to a tenth

**Recurrence:** Irregular

**Duration:** 1 term

**Level:** 4

**Version:** 1

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**Prerequisites**
none
Module: Lie Groups and Lie Algebras [M-MATH-104261]

Responsibility: Prof. Dr. Enrico Leuzinger
Organisation: KIT Department of Mathematics
Part of:
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementary Field / Field Algebra and Geometry
- Mathematical Specialization
- Additional Examinations

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### 2.110 Module: Lie-Algebras (Linear Algebra 3) [M-MATH-105839]

**Responsible:** Prof. Dr. Tobias Hartnick  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Algebra and Geometry  
- Mathematical Methods 2 / Field Algebra and Geometry  
- Complementary Field / Field Algebra and Geometry  
- Mathematical Specialization  
- Additional Examinations

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<td>Lie-Algebras (Linear Algebra 3)</td>
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2.111 Module: Linear Electronic Networks [M-ETIT-101845]

**Responsible:** Prof. Dr. Olaf Dössel  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** Complementary Field / Subject Electrical Engineering

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<tr>
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**Competence Certificate**  
The content of the course Linear Electrical Networks (7 CP) will be checked in a written exam lasting 120 minutes. If the exam is passed, students can receive a grade bonus of up to 0.4 grade points if two project tasks have been successfully completed during the semester. The processing of the project tasks is evidenced by the submission of documentation or the project code.

**Competence Goal**  
In the Linear Electrical Networks module, the student acquires skills in the analysis and design of electrical circuits with linear components with direct current and alternating current. Here he is able to remember and understand the topics, and also to use the methods dealt with in order to analyze the electrical circuits with linear components and to assess their relevance, correct function and properties.

**Module grade calculation**  
The module grade corresponds to the grade of the partial performance linear electrical networks. As described in the section "Success assessment (s)", this is composed of the grade of the written exam Linear Electrical Networks and any grade bonus received.

**Content**  
Methods for the analysis of complex linear electrical circuits, Definitions of U, I, R, L, C, independent sources, dependent sources, Kirchhoff's equations, node potential method, mesh current method, equivalent voltage and current source, star-delta transformation, power matching, Operational amplifier, inverting amplifier, adder, voltage follower, non-inverting amplifier, differential amplifier, Sinusoidal currents and voltages, differential equations for L and C, complex numbers, Description of RLC circuits with complex numbers, impedance, complex power, power matching, Bridge circuits, Wheatstone, Maxwell and bridge circuits, Series and parallel resonant circuits, two port theory, Z, Y and A matrix, impedance transformation, locus curve and Bode diagram, Transformer, mutual inductance, transformer equations, equivalent circuits of the transformer, Three-phase current, power transmission and symmetrical load.

**Annotation**  
Attention: This module is part of the orientation test according to the SPO Bachelor Electrical Engineering and Information Technology.

**Workload**  
Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance.

The workload of the LV Linear Electrical Networks falls

1. Presence time in lectures, exercises
2. Preparation / post-processing
3. Exam preparation and presence in the same

The workload for point 1 corresponds to approximately 60 hours, for points 2-3 approximately 115 to 150 hours. The total workload for the LV Linear Electrical Networks is 175-210 hours. This corresponds to 7 LP.
# Module: Localization of Mobile Agents (24613) [M-INFO-100840]

**Responsible:** Prof. Dr.-Ing. Uwe Hanebeck  
**Organisation:** KIT Department of Informatics  
**Part of:** Complementary Field / Subject Computer Science

<table>
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**Mandatory**

| T-INFO-101377 | Localization of Mobile Agents | 6 CR | Hanebeck |

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Mathematics Master 2016 (Master of Science (M.Sc.))  
Module Handbook as of 21/09/2021
## M 2.113 Module: Markov Decision Processes (MATHST11) [M-MATH-102907]

**Responsible:** Prof. Dr. Nicole Bäuerle  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Stochastics  
- Mathematical Methods 2 / Field Stochastics  
- Complementary Field / Field Stochastics  
- Mathematical Specialization  
- Additional Examinations

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### Prerequisites

none
## 2.114 Module: Master Thesis (MATHMAST) [M-MATH-102917]

**Responsible:** Dr. Sebastian Grensing  
**Organisation:** KIT Department of Mathematics  
**Part of:** Master Thesis

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**Modeled Conditions**

The following conditions have to be fulfilled:

1. You need to earn at least 70 credits in the following fields:
   - Complementary Field
   - Mathematical Methods 1
   - Mathematical Methods 2
   - Mathematical Specialization
   - Mathematical Seminar
   - Interdisciplinary Qualifications
# Module: Mathematical Methods in Signal and Image Processing (MATHNM16) [M-MATH-102897]

**Responsible:** Prof. Dr. Andreas Rieder  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Methods 1 / Field Applied and Numerical Mathematics  
Mathematical Methods 2 / Field Applied and Numerical Mathematics  
Complementary Field / Field Applied and Numerical Mathematics  
Mathematical Specialization  
Additional Examinations

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**Prerequisites**

none
## Module: Mathematical Methods of Imaging [M-MATH-103260]

**Responsible:** Prof. Dr. Andreas Rieder  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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**Mandatory**

| T-MATH-106488 | Mathematical Methods of Imaging | 5 CR | Rieder |

**Prerequisites**

None
# 2.117 Module: Mathematical Modelling and Simulation in Practise (MATHNM27) [M-MATH-102929]

**Responsible:** PD Dr. Gudrun Thäter  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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**Mandatory**  
| T-MATH-105889 | Mathematical Modelling and Simulation in Practise | 4 CR | Thäter |

**Prerequisites**  
None
2.118 Module: Mathematical Physics (MATHAN44) [M-MATH-103079]

**Responsible:** Prof. Dr. Dirk Hundertmark

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

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**Prerequisites**

None
### 2.119 Module: Mathematical Physics 2 [M-MATH-103274]

**Responsible:** Prof. Dr. Dirk Hundertmark  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 2 / Field Analysis  
- Complementary Field / Field Analysis  
- Mathematical Specialization  
- Additional Examinations

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**Prerequisites**  
None
2.120 Module: Mathematical Programming (WW4OR9) [M-WIWI-101473]

Responsible: Prof. Dr. Oliver Stein
Organisation: KIT Department of Economics and Management
Part of: Complementary Field / Subject Economics

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Election block: Compulsory Elective Courses (at most 2 items)

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<td>Global Optimization I</td>
<td>4,5 CR</td>
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<td>Convex Analysis</td>
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Election block: Supplementary Courses (at most 2 items)

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<td>Global Optimization II</td>
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<td>Graph Theory and Advanced Location Models</td>
<td>4,5 CR</td>
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<td>4,5 CR</td>
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<td>4,5 CR</td>
<td>Stein</td>
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<td>T-WIWI-102715</td>
<td>Operations Research in Supply Chain Management</td>
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<td>T-WIWI-110162</td>
<td>Optimization Models and Applications</td>
<td>4,5 CR</td>
<td>Sudermann-Merx</td>
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**Competence Certificate**

The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module separately.

The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

**Competence Goal**

The student

- names and describes basic notions for advanced optimization methods, in particular from continuous and mixed integer programming,
- knows the indispensable methods and models for quantitative analysis,
- models and classifies optimization problems and chooses the appropriate solution methods to solve also challenging optimization problems independently and, if necessary, with the aid of a computer,
- validates, illustrates and interprets the obtained solutions,
- identifies drawbacks of the solution methods and, if necessary, is able to makes suggestions to adapt them to practical problems.

**Prerequisites**

At least one of the courses "Mixed Integer Programming I", "Parametric Optimization", "Convex Analysis", "Nonlinear Optimization I" and "Global Optimization I" has to be taken.

**Content**

The modul focuses on theoretical foundations as well as solution algorithms for optimization problems with continuous and mixed integer decision variables.
Annotation
The lectures are partly offered irregularly. The curriculum of the next three years is available online (www.ior.kit.edu).
For the lectures of Prof. Stein a grade of 30 % of the exercise course has to be fulfilled. The description of the particular lectures is more detailed.

Workload
The total workload for this module is approximately 270 hours. For further information see German version.
### 2.121 Module: Mathematical Statistics (MATHST15) [M-MATH-102909]

**Responsible:** PD Dr. Bernhard Klar  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Stochastics  
- Mathematical Methods 2 / Field Stochastics  
- Complementary Field / Field Stochastics  
- Mathematical Specialization  
- Additional Examinations

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**Mandatory**

| T-MATH-105872 | Mathematical Statistics | 4 CR | Henze, Klar |

**Prerequisites**

none
2.122 Module: Mathematical Topics in Kinetic Theory [M-MATH-104059]

**Responsible:** Prof. Dr. Dirk Hundertmark  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 2 / Field Analysis  
- Complementary Field / Field Analysis  
- Mathematical Specialization  
- Additional Examinations

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**Mandatory**

| T-MATH-108403 | Mathematical Topics in Kinetic Theory | 4 CR | Hundertmark |

**Competence Goal**
The students are familiar with the basic questions in kinetic theory and methodical approaches to their solutions. With the acquired knowledge they are able to understand the required analytical methods and are able to apply them to the basic equations in kinetic theory.

**Prerequisites**
None

**Content**

- Boltzmann equation: Cauchy problem and properties of solutions  
- entropy and H theorem  
- equilibrium and convergence to equilibrium  
- other models of kinetic theory
### Module: Maxwell's Equations (MATHAN28) [M-MATH-102885]

**Responsible:** PD Dr. Frank Hettlich  
**Organisation:** KIT Department of Mathematics

**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Analysis  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Analysis  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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<td>Maxwell's Equations</td>
<td>8 CR</td>
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</table>

Arens, Griesmaier, Hettlich
## 2.124 Module: Medical Imaging (MATHNM15) [M-MATH-102896]

**Responsible:** Prof. Dr. Andreas Rieder  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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**Prerequisites**

None
Module: Medical Imaging Techniques I [M-ETIT-100384]

**Responsible:** Prof. Dr. Olaf Dössel

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** Complementary Field / Subject Electrical Engineering

<table>
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<th>Credits</th>
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<td>Each winter term</td>
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<td>Medical Imaging Techniques I</td>
<td>3 CR</td>
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</table>

**Competence Certificate**

Success control is carried out in the form of a written test of 120 minutes.

**Competence Goal**

Students have a thorough understanding of all methods of medical imaging with ionizing radiation. They know the physical basics, the technical solutions and the essential aspects when using imaging in medicine.

**Module grade calculation**

The module grade is the grade of the written exam.

**Prerequisites**

none

**Content**

- X-ray physics and technology of X-ray imaging
- Digital radiography, X-ray image intensifier, flat X-ray detectors
- Theory of imaging systems, modulation transfer function
- and quantum detection efficiency
- Computer tomography CT
- Ionizing radiation, dosimetry and radiation protection
- SPECT and PET

**Workload**

Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:

- Attendance time in lectures (2 h 15 appointments each) = 30 h
- Self-study (3 h 15 appointments each) = 45 h
- Preparation / post-processing = 20 h
- Total effort approx. 95 hours = 3 LP
2.126 Module: Medical Imaging Techniques II [M-ETIT-100385]

**Responsible:** Prof. Dr. Olaf Dössel  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** Complementary Field / Subject Electrical Engineering

<table>
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**Mandatory**

| T-ETIT-101931 | Medical Imaging Techniques II | 3 CR | Dössel |

**Competence Certificate**
Success control is carried out in the form of a written test of 120 minutes.

**Competence Goal**
Students have a thorough understanding of all methods of medical imaging without ionizing radiation. They know the physical basics, the technical solutions and the essential aspects when using imaging in medicine.

**Module grade calculation**
The module grade is the grade of the written exam.

**Prerequisites**
none

**Content**
- Ultrasound imaging
- Thermography
- Optical tomography
- Impedance tomography
- Imaging of bioelectric sources
- Endoscopy
- Magnetic resonance imaging
- Multi-modal imaging
- Molecular imaging

**Recommendation**
The contents of the M-ETIT-100384 module are required.

**Workload**
Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:
- Attendance time in lectures (2 h 15 appointments each) = 30 h
- Self-study (3 h 15 appointments each) = 45 h
- Preparation / post-processing = 20 h
- Total effort approx. 95 hours = 3 LP
2.127 Module: Medical Robotics (24681) [M-INFO-100820]

**Responsible:** Prof. Dr.-Ing. Torsten Kröger
Jun.-Prof. Dr. Franziska Mathis-Ullrich

**Organisation:** KIT Department of Informatics

**Part of:** Complementary Field / Subject Computer Science

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**Mandatory**

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<th>3 CR</th>
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Module: Methodical Foundations of OR (WW3OR6) [M-WIWI-101414]

**Responsible:** Prof. Dr. Oliver Stein

**Organisation:** KIT Department of Economics and Management

**Part of:** Complementary Field / Subject Economics

<table>
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**Election block: Compulsory Elective Courses (at least 1 item as well as between 4,5 and 9 credits)**

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<td>T-WIWI-102726</td>
<td>Global Optimization I</td>
<td>4,5 CR</td>
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<td>T-WIWI-103638</td>
<td>Global Optimization I and II</td>
<td>9 CR</td>
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<td>T-WIWI-102724</td>
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**Election block: Supplementary Courses ()**

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<td>4,5 CR</td>
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<td>T-WIWI-102704</td>
<td>Facility Location and Strategic Supply Chain Management</td>
<td>4,5 CR</td>
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**Competence Certificate**

The assessment is carried out as partial written exams (according to Section 4(2), 1 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module separately.

The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

**Competence Goal**

The student

- names and describes basic notions for optimization methods, in particular from nonlinear and from global optimization,
- knows the indispensable methods and models for quantitative analysis,
- models and classifies optimization problems and chooses the appropriate solution methods to solve also challenging optimization problems independently and, if necessary, with the aid of a computer,
- validates, illustrates and interprets the obtained solutions.

**Prerequisites**

At least one of the courses *Nonlinear Optimization I* [2550111] and *Global Optimization I* [2550134] has to be examined.

**Content**

The module focuses on theoretical foundations as well as solution algorithms for optimization problems with continuous decision variables. The lectures on nonlinear programming deal with local solution concepts, whereas the lectures on global optimization treat approaches for global solutions.

**Recommendation**

The courses Introduction to Operations Research I and II are helpful.

**Annotation**

The planned lectures and courses for the next three years are announced online (http://www.ior.kit.edu).

**Workload**

The total workload for this module is approximately 270 hours. For further information see German version.
2.129 Module: Methods of Signal Processing [M-ETIT-100540]

**Responsible:** Prof. Dr.-Ing. Michael Heizmann

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** Complementary Field / Subject Electrical Engineering

<table>
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<th>Credits</th>
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**Prerequisites**

none
Module: Microeconomic Theory (WW4VWL15) [M-WIWI-101500]

**Responsible:** Prof. Dr. Clemens Puppe

**Organisation:** KIT Department of Economics and Management

**Part of:** Complementary Field / Subject Economics

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**Election block: Compulsory Elective Courses (at least 9 credits)**

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<td>Incentives in Organizations</td>
<td>4,5 CR</td>
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**Competence Certificate**

The assessment is carried out as partial exams (according to Section 4(2), 1 or 2 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module separately.

The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

**Competence Goal**

Students

- are able to model practical microeconomic problems mathematically and to analyze them with respect to positive and normative questions,
- understand individual incentives and social outcomes of different institutional designs.

An example of a positive question is: which regulation policy results in which firm decisions under imperfect competition? An example of a normative question is: which voting rule has appealing properties?

**Prerequisites**

None

**Content**

The student should gain an understanding of advanced topics in economic theory, game theory and welfare economics. Core topics are, among others, strategic interactions in markets, cooperative and non-cooperative bargaining (Advanced Game Theory), allocation under asymmetric information and general equilibrium over time (Advanced Topics in Economic Theory), voting and the aggregation of preferences and judgements (Social Choice Theory).

**Workload**

The total workload for this module is approximately 270 hours. For further information see German version.
# 2.131 Module: Models of Mathematical Physics (MATHAN17) [M-MATH-102875]

**Responsible:** Prof. Dr. Wolfgang Reichel  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 2 / Field Analysis  
- Complementary Field / Field Analysis  
- Mathematical Specialization  
- Additional Examinations

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## Mandatory

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### 2.132 Module: Modern Experimental Physics I, Atoms and Cores [M-PHYS-101704]

**Responsible:** Studiendekan Physik  
**Organisation:** KIT Department of Physics  
**Part of:** Complementary Field / Subject Physics

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</table>

**Mandatory**

| T-PHYS-105132 | Modern Experimental Physics I, Atoms and Nuclei | 8 CR | Studiendekan Physik |

**Competence Certificate**

See components of this module

**Prerequisites**

none
2.133 Module: Modern Experimental Physics II, Molecules and Solid States [M-PHYS-101705]

**Responsible:** Studiendekan Physik  
**Organisation:** KIT Department of Physics  
**Part of:** Complementary Field / Subject Physics  

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**Mandatory**

| T-PHYS-105133 | Modern Experimental Physics II. Molecules and Solid States | 8 CR | Studiendekan Physik |

**Competence Certificate**
See components of this module

**Prerequisites**
none
2.134 Module: Modern Theoretical Physics I, Quantum Mechanics I [M-PHYS-103180]

**Responsible:** Studiendekan Physik

**Organisation:** KIT Department of Physics

**Part of:** Complementary Field / Subject Physics

<table>
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**Mandatory**

| T-PHYS-105134 | Modern Theoretical Physics I, Quantum Mechanics 1 | 8 CR | Studiendekan Physik |

**Competence Certificate**

oral exam

**Prerequisites**

none
2.135 Module: Modern Theoretical Physics II, Quantum Mechanics II [M-PHYS-101708]

**Responsible:** Studiendekan Physik

**Organisation:** KIT Department of Physics

**Part of:** Complementary Field / Subject Physics

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**Mandatory**

| T-PHYS-106095 | Modern Theoretical Physics II, Quantum Mechanics 2 | 6 CR | Studiendekan Physik |

**Competence Certificate**

See components of this module

**Prerequisites**

none
## 2.136 Module: Modular Forms (MATHAG23) [M-MATH-102868]

- **Responsible:** PD Dr. Stefan Kühnlein
- **Organisation:** KIT Department of Mathematics
- **Part of:**
  - Mathematical Methods 1 / Field Algebra and Geometry
  - Mathematical Methods 2 / Field Algebra and Geometry
  - Complementary Field / Field Algebra and Geometry
  - Mathematical Specialization
  - Additional Examinations

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Module: Moduli Spaces of Translation Surfaces [M-MATH-105635]

Responsible: Prof. Dr. Frank Herrlich
Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Algebra and Geometry
Mathematical Methods 2 / Field Algebra and Geometry
Complementary Field / Field Algebra and Geometry
Mathematical Specialization
Additional Examinations

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**Mandatory**

| T-MATH-105877 | Monotonicity Methods in Analysis | 3 CR | Herzog |

**Responsible:** PD Dr. Gerd Herzog

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

**Credits:** 3

**Grading scale:** Grade to a tenth

**Recurrence:** Irregular

**Duration:** 1 term

**Level:** 4

**Version:** 1
Competence Goal
The students became acquainted with multigrid and domain decomposition methods. They learn algorithms, results on convergence, and representative applications.

Prerequisites
none

Content
- The two-grid method
- Classical multigrid theory
- Additive subspace correction method
- Multiplicative subspace correction method
- Multigrid methods for saddle point problems
### Module: Network Security: Architectures and Protocols (24601) [M-INFO-100782]

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**Responsible:** Prof. Dr. Martina Zitterbart  
**Organisation:** KIT Department of Informatics  
**Part of:** Complementary Field / Subject Computer Science

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# 2.141 Module: Nonlinear Analysis [M-MATH-103539]

**Responsible:** Prof. Dr. Tobias Lamm  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Methods 1 / Field Analysis  
Mathematical Methods 2 / Field Analysis  
Complementary Field / Field Analysis  
Mathematical Specialization  
Additional Examinations

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**Prerequisites**

None
2.142 Module: Nonlinear Control Systems [M-ETIT-100371]

**Responsible:** Prof. Dr.-Ing. Sören Hohmann

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** Complementary Field / Subject Electrical Engineering

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**Prerequisites**

none
# Module: Nonlinear Evolution Equations (MATHAN19) [M-MATH-102877]

**Responsible:** Prof. Dr. Roland Schnaubelt  
**Organisation:** KIT Department of Mathematics

**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 2 / Field Analysis  
- Complementary Field / Field Analysis  
- Mathematical Specialization  
- Additional Examinations

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Frey, Schnaubelt
2.144 Module: Nonlinear Functional Analysis (MATHAN29) [M-MATH-102886]

Responsible: PD Dr. Gerd Herzog
Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Analysis
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          Complementary Field / Field Analysis
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### Prerequisites

none

### Content

- Short introduction to nonlinear contraction semigroups in Hilbert spaces and to the spaces H(curl) and H(div).
- Semilinear case:
- Quasilinear case:
  Maxwell's equations with nonlinear instantaneous material laws. Local wellposedness on the whole space via linearisation, apriori estimates and regularization. Blow-up examples. Outlook to results on domains.
## 2.146 Module: Nonlinear Maxwell Equations [M-MATH-105066]

**Responsible:** Prof. Dr. Roland Schnaubelt  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Methods 1 / Field Analysis  
Mathematical Methods 2 / Field Analysis  
Complementary Field / Field Analysis  
Mathematical Specialization  
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### Mandatory

| T-MATH-110283 | **Nonlinear Maxwell Equations** | 8 CR | Schnaubelt |

**Prerequisites**

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Module: Nonlinear Wave Equations [M-MATH-105326]

**Responsible:** Dr. Birgit Schörkhuber

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

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**Prerequisites**
None
## 2.149 Module: Nonparametric Statistics (MATHST16) [M-MATH-102910]

**Responsible:** PD Dr. Bernhard Klar  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Stochastics  
- Mathematical Methods 2 / Field Stochastics  
- Complementary Field / Field Stochastics  
- Mathematical Specialization  
- Additional Examinations

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### Prerequisites

None
2.150 Module: Numerical Analysis of Helmholtz Problems [M-MATH-105764]

**Responsible:** Dr. Barbara Verfürth

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

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**Competence Certificate**

oral examination of circa 30 minutes

**Module grade calculation**

The module grade is the grade of the final oral exam.

**Prerequisites**

none
2.151 Module: Numerical Continuation Methods (MATHNM42) [M-MATH-102944]

**Responsible:** Prof. Dr. Jens Rottmann-Matthes

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
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**Rottmann-Matthes**

**Prerequisites**

none
# Module: Numerical Linear Algebra for Scientific High Performance Computing [M-MATH-103709]

**Responsible:** Dr. Hartwig Anzt  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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**Prerequisites**
None
### 2.153 Module: Numerical Linear Algebra in Image Processing [M-MATH-104058]

**Responsible:** PD Dr. Volker Grimm  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations  

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#### Mandatory

| T-MATH-108402 | Numerical Linear Algebra in Image Processing | 6 CR | Grimm |

#### Prerequisites

None
## 2.154 Module: Numerical Methods for Differential Equations (MATHNM03) [M-MATH-102888]

### Responsible:
- Prof. Dr. Willy Dörfler
- Prof. Dr Tobias Jahnke

### Organisation:
Kit Department of Mathematics

### Part of:
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

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### Credits
- 8 CR

### Mandatory
- T-MATH-105836  
  Numerical Methods for Differential Equations  
  8 CR  
  Dörfler, Hochbruck, Jahnke, Rieder, Wieners
# 2.155 Module: Numerical Methods for Hyperbolic Equations (MATHNM28) [M-MATH-102915]

**Responsible:** Prof. Dr. Willy Dörfler  
**Organisation:** KIT Department of Mathematics

**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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**Competence Goal**

- 

**Prerequisites**

none
### 2.156 Module: Numerical Methods for Integral Equations (MATHNM29) [M-MATH-102930]

**Responsible:** PD Dr. Tilo Arens  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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**Mandatory**

| T-MATH-105901 | Numerical Methods for Integral Equations | 8 CR | Arens, Hettlich |
Module: Numerical Methods for Maxwell's Equations (MATHNM33) [M-MATH-102931]

Responsible: Prof. Dr. Marlis Hochbruck
Prof. Dr. Tobias Jahnke

Organisation: KIT Department of Mathematics

Part of:
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
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Mandatory

| T-MATH-105920 | Numerical Methods for Maxwell's Equations | 6 CR | Hochbruck, Jahnke |
Module: Numerical Methods for Time-Dependent Partial Differential Equations (MATHMMNM20) [M-MATH-102928]

Responsible: Prof. Dr. Marlis Hochbruck
Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Applied and Numerical Mathematics
Mathematical Methods 2 / Field Applied and Numerical Mathematics
Complementary Field / Field Applied and Numerical Mathematics
Mathematical Specialization
Additional Examinations

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Mandatory

T-MATH-105899 Numerical Methods for Time-Dependent Partial Differential Equations 8 CR Hochbruck, Jahnke
## 2.159 Module: Numerical Methods in Computational Electrodynamics (MATHNM13) [M-MATH-102894]

**Responsible:** Prof. Dr. Willy Dörfler  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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**Prerequisites**

- none

Dörfler, Hochbruck, Jahnke, Rieder, Wieners
## 2.160 Module: Numerical Methods in Fluid Mechanics (MATHNM34) [M-MATH-102932]

**Responsible:** Prof. Dr. Willy Dörfler  
PD Dr. Gudrun Thäter

**Organisation:** KIT Department of Mathematics

**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
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## 2.161 Module: Numerical Methods in Mathematical Finance (MATHNM18) [M-MATH-102901]

**Responsible:** Prof. Dr Tobias Jahnke  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Methods 1 / Field Applied and Numerical Mathematics  
**Complementary Field / Field Applied and Numerical Mathematics**  
**Mathematical Specialization**  
**Additional Examinations**

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**Prerequisites**

none
Module: Numerical Methods in Mathematical Finance II (MATHNM26) [M-MATH-102914]

**Responsible:** Prof. Dr. Tobias Jahnke

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
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**Mandatory**

| T-MATH-105880 | Numerical Methods in Mathematical Finance II | 8 CR | Jahnke |

**Prerequisites**

none
2.163 Module: Numerical Optimisation Methods (MATHNM25) [M-MATH-102892]

**Responsible:** Prof. Dr. Christian Wieners

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
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# Module: Numerical Simulation in Molecular Dynamics [M-MATH-105327]

**Responsible:** PD Dr. Volker Grimm  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Methods 1 / Field Applied and Numerical Mathematics  
Mathematical Methods 2 / Field Applied and Numerical Mathematics  
Complementary Field / Field Applied and Numerical Mathematics  
Mathematical Specialization  
**Additional Examinations**

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**Prerequisites**  
None
2.165 Module: Operations Research in Supply Chain Management (WW4OR11) [M-WIWI-102832]

Responsible: Prof. Dr. Stefan Nickel
Organisation: KIT Department of Economics and Management
Part of: Complementary Field / Subject Economics

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Election block: Compulsory Elective Courses (at most 2 items)

- T-WIWI-102723 Graph Theory and Advanced Location Models 4,5 CR Nickel
- T-WIWI-106200 Modeling and OR-Software: Advanced Topics 4,5 CR Nickel
- T-WIWI-102715 Operations Research in Supply Chain Management 4,5 CR Nickel

Election block: Supplementary Courses (at most 2 items)

- T-WIWI-106546 Introduction to Stochastic Optimization 4,5 CR Rebennack
- T-WIWI-102718 Discrete-Event Simulation in Production and Logistics 4,5 CR Nickel
- T-WIWI-102719 Mixed Integer Programming I 4,5 CR Stein
- T-WIWI-102720 Mixed Integer Programming II 4,5 CR Stein
- T-WIWI-110162 Optimization Models and Applications 4,5 CR Sudermann-Merx
- T-WIWI-106549 Large-scale Optimization 4,5 CR Rebennack

Competence Certificate
The assessment is carried out as partial exams (according to § 4(2), 1 of the examination regulation) of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module.

The assessment procedures are described for each course of the module separately.

The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

Competence Goal
The student

- is familiar with basic concepts and terms of Supply Chain Management,
- knows the different areas of SCM and their respective optimization problems,
- is acquainted with classical location problem models (in planes, in networks and discrete) as well as fundamental methods for distribution and transport planning, inventory planning and management,
- is able to model practical problems mathematically and estimate their complexity as well as choose and adapt appropriate solution methods.

Prerequisites
At least one of the courses "Operations Research in Supply Chain Management", "Graph Theory and Advanced Location Models", "Modeling and OR-Software: Advanced Topics" and "Special Topics of Stochastic Optimization (elective)" has to be taken.
Content
Supply Chain Management is concerned with the planning and optimization of the entire, inter-company procurement, production and distribution process for several products taking place between different business partners (suppliers, logistics service providers, dealers). The main goal is to minimize the overall costs while taking into account several constraints including the satisfaction of customer demands.

This module considers several areas of SCM. On the one hand, the determination of optimal locations within a supply chain is addressed. Strategic decisions concerning the location of facilities as production plants, distribution centers or warehouses are of high importance for the rentability of Supply Chains. Thoroughly carried out, location planning tasks allow an efficient flow of materials and lead to lower costs and increased customer service. On the other hand, the planning of material transport in the context of supply chain management represents another focus of this module. By linking transport connections and different facilities, the material source (production plant) is connected with the material sink (customer). For given material flows or shipments, it is considered how to choose the optimal (in terms of minimal costs) distribution and transportation chain from the set of possible logistics chains, which asserts the compliance of delivery times and further constraints. Furthermore, this module offers the possibility to learn about different aspects of the tactical and operational planning level in Supply Chain Management, including methods of scheduling as well as different approaches in procurement and distribution logistics. Finally, issues of warehousing and inventory management will be discussed.

Recommendation
Basic knowledge as conveyed in the module Introduction to Operations Research is assumed.

Annotation
Some lectures and courses are offered irregularly.
The planned lectures and courses for the next three years are announced online.

Workload
Total effort for 9 credits: ca. 270 hours
- Presence time: 84 hours
- Preparation/Wrap-up: 112 hours
- Examination and examination preparation: 74 hours
2.166 Module: Optical Waveguides and Fibers [M-ETIT-100506]

Responsible: Prof. Dr.-Ing. Christian Koos
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: Complementary Field / Subject Electrical Engineering

<table>
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Mandatory

| T-ETIT-101945 | Optical Waveguides and Fibers | 4 CR | Koos |

Competence Certificate

Type of Examination: Oral exam
Duration of Examination: approx. 20 minutes
Modality of Exam: The written exam is offered continuously upon individual appointment.

Competence Goal

The students

- conceive the basic principles of light-matter-interaction and wave propagation in dielectric media and can explain the origin and the implications of the Lorentz model and of Kramers-Kronig relation,
- are able to quantitatively analyze the dispersive properties of optical media using Sellmeier relations and scientific databases,
- can explain and mathematically describe the working principle of an optical slab waveguide and the formation of guided modes,
- are able to program a mode solver for a slab waveguide in Matlab,
- are familiar with the basic principle of surface plasmon polariton propagation,
- know basic structures of planar integrated waveguides and are able to model special cases with semi-analytical approximations such as the Marcatili method or the effective-index method,
- are familiar with the basic concepts of numerical mode solvers and the associated limitations,
- are familiar with state-of-the-art waveguide technologies in integrated optics and the associated fabrication methods,
- know basic concepts of of step-index fibers, graded-index fibers and microstructured fibers,
- are able to derive and solve basic relations for step-index fibers from Maxwell's equations,
- are familiar with the concept of hybrid and linearly polarized fiber modes,
- can mathematically describe signal propagation in single-mode fibers design dispersion-compensated transmission links,
- conceive the physical origin of fiber attenuation effects,
- are familiar with state-of-the-art fiber technologies and the associated fabrication methods,
- can derive models for dielectric waveguide structures using the mode expansion method,
- conceive the principles of directional couplers, multi-mode interference couplers, and waveguide gratings,
- can mathematically describe active waveguides and waveguide bends.

Module grade calculation

The module grade is the grade of the oral exam.

There is, however, a bonus system based on the problem sets that are solved during the tutorials: During the term, 3 problem sets will be collected in the tutorial and graded without prior announcement. If for each of these sets more than 70% of the problems have been solved correctly, a bonus of 0.3 grades will be granted on the final mark of the oral exam.

Prerequisites

None
Content

1. Introduction: Optical communications
2. Fundamentals of wave propagation in optics: Maxwell’s equations in optical media, wave equation and plane waves, material dispersion, Kramers-Kroig relation and Sellmeier equations, Lorentz and Drude model of refractive index, signal propagation in dispersive media.
3. Slab waveguides: Reflection from a plane dielectric boundary, slab waveguide eigenmodes, radiation modes, inter- and intramodal dispersion, metal-dielectric structures and surface plasmon polariton propagation.
4. Planar integrated waveguides: Basic structures of integrated optical waveguides, guided modes of rectangular waveguides (Marcatili method and effective-index method), basics of numerical methods for mode calculations (finite difference- and finite-element methods), waveguide technologies in integrated optics and associated fabrication methods.
5. Optical fibers: Optical fiber basics, step-index fibers (hybrid modes and LP-modes), graded-index fibers (infinitely extended parabolic profile), microstructured fibers and photonic-crystal fibers, fiber technologies and fabrication methods, signal propagation in single-mode fibers, fiber attenuation, dispersion and dispersion compensation.
6. Waveguide-based devices: Modeling of dielectric waveguide structures using mode expansion and orthogonality relations, multimode interference couplers and directional couplers, waveguide gratings, material gain and absorption in optical waveguides, bent waveguides.

Recommendation
Solid mathematical and physical background, basic knowledge of electrodynamics

Workload
Total 120 h, hereof 45 h contact hours (30 h lecture, 15 h tutorial) and 75 h homework and self-studies.

Literature
B.E.A. Saleh, M.C. Teich: Fundamentals of Photonics
G.P. Agrawal: Fiber-optic communication systems
C.-L. Chen: Foundations for guided-wave optics
Katsunari Okamoto: Fundamentals of Optical Waveguides
K. Iizuka: Elements of Photonics
### Module: Optimal Control and Estimation [M-ETIT-102310]

**Responsible:** Prof. Dr.-Ing. Sören Hohmann  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** Complementary Field / Subject Electrical Engineering

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**Prerequisites**

none
2.168 Module: Optimisation and Optimal Control for Differential Equations (MATHNM09) [M-MATH-102899]

Responsible: Prof. Dr. Christian Wieners
Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Applied and Numerical Mathematics
Mathematical Methods 2 / Field Applied and Numerical Mathematics
Complementary Field / Field Applied and Numerical Mathematics
Mathematical Specialization
Additional Examinations

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Mandatory

| T-MATH-105864 | Optimisation and Optimal Control for Differential Equations | 4 CR |

Prerequisites
none
### 2.169 Module: Optimization in Banach Spaces (MATHNM32) [M-MATH-102924]

**Responsible:** Prof. Dr. Roland Griesmaier  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Analysis  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Analysis  
- Complementary Field / Field Applied and Numerical Mathematics  
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- Additional Examinations

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**Prerequisites**

none

**Responsible:** Prof. Dr.-Ing. Sören Hohmann

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** Complementary Field / Subject Electrical Engineering

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**Mandatory**

| T-ETIT-100685 | Optimization of Dynamic Systems | 5 CR | Hohmann |

**Competence Certificate**
The assessment consists of a written exam (120 min) taking place in the recess period.

**Competence Goal**
- The students know as well the mathematical basics as the fundamental methods and algorithms to solve constraint and unconstraint nonlinear static optimization problems.
- They can solve constraint and unconstraint dynamic optimization by using the calculus of variations approach and the Dynamic Programming method.
- Also they are able to transfer dynamic optimization problem to static problems.
- The students know the mathematic relations, the pros and cons and the limits of the particular optimization methods.
- They can transfer problems from other fields of their studies in a convenient optimization problem formulation and they are able to select and implement suitable optimization algorithms for them by using common software tools.

**Module grade calculation**
The module grade is the grade of the written exam.

**Prerequisites**
none

**Content**
The module teaches the mathematical basics that are required to solve optimization problems. The first part of the lecture treats methods for solving static optimization problems. The second part of the lecture focuses on solving dynamic optimization problems by using the method of Euler-Lagrange and the Hamilton method as well as the dynamic programming approach.

**Workload**
Each credit point stands for an amount of work of 30h of the student. The amount of work includes
1. presence in lecture/exercises/tutorial(optional) (2+1 SWS: 45h1.5 LP)
2. preparation/postprocessing of lecture/exercises (90h3 LP)
3. preparation/presence in the written exam (15h0.5 LP)
## 2.171 Module: Parallel Computing [M-MATH-101338]

| Responsible: | Dr. rer. nat. Mathias Krause  
|             | Prof. Dr. Christian Wieners |
| Organisation: | KIT Department of Mathematics |
| Part of: | Mathematical Methods 1 / Field Applied and Numerical Mathematics  
|           | Mathematical Methods 2 / Field Applied and Numerical Mathematics  
|           | Complementary Field / Field Applied and Numerical Mathematics  
|           | Mathematical Specialization  
|           | Additional Examinations |

| Credits | 5 |
| Grade to a tenth | |
| Recurrence | Irregular |
| Duration | 1 term |
| Level | 4 |
| Version | 1 |

### Mandatory

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### Prerequisites

None
2.172 Module: Percolation (MATHST13) [M-MATH-102905]

Responsible: Prof. Dr. Günter Last

Organisation: KIT Department of Mathematics

Part of:
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Stochastics
- Mathematical Specialization
- Additional Examinations

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Competence Goal

The students
- are acquainted with basic models of discrete and continuum percolation,
- acquire the skills needed to use specific probabilistic and graph-theoretical methods for the analysis of these models,
- know how to work self-organised and self-reflexive.

Prerequisites
none
# 2.173 Module: Photorealistic Rendering (24682) [M-INFO-100731]

**Responsible:** Prof. Dr.-Ing. Carsten Dachsbacher  
**Organisation:** KIT Department of Informatics  
**Part of:** Complementary Field / Subject Computer Science

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### 2.174 Module: Physiology and Anatomy for Engineers I [M-ETIT-100390]

**Responsible:** Prof. Dr. Werner Nahm  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** Complementary Field / Subject Electrical Engineering

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**Mandatory**

| T-ETIT-101932 | Physiology and Anatomy for Engineers I | 3 CR | Nahm |

### Competence Certificate

Success control is carried out in the form of a written test of 60 minutes.

### Competence Goal

Basic understanding of the functions of the human body and the processes involved.

### Module grade calculation

The module grade is the grade of the written exam.

### Prerequisites

none

### Content

The lecture provides basic knowledge about the essential organ systems of humans and medical terminology. It is aimed at students of technical courses who are interested in physiological issues.

Thematic blocks of the first part (winter semester)
- Introduction - organizational levels in the body
- Basics of biochemistry in the body
- Cell structure, cell physiology, tissue
- Transport mechanisms in the body
- Neurophysiology I (nerve cell, muscle cell, the autonomic nervous system)
- Heart and circulatory system with blood and lymph
- Breathing

### Workload

Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:

- Attendance time in lectures (2 h 15 appointments each) = 30 h
- Self-study (3 h 15 appointments each) = 45 h
- Preparation / post-processing = 20 h

Total effort approx. 95 hours = 3 LP
Module: Poisson Processes (MATHST20) [M-MATH-102922]

**Responsible:** Prof. Dr. Günter Last

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Stochastics
- Mathematical Specialization
- Additional Examinations

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**Competence Certificate**
oral exam

**Competence Goal**
The students know about important properties of the Poisson process. The focus is on probabilistic methods and results which are independent of the specific phase space. The students understand the central role of the Poisson process as a specific point process and as a random measure.

**Module grade calculation**
Marking: grade of exam

**Prerequisites**
none

**Content**
- Distributional properties of Poisson processes
- The Poisson process as a particular point process
- Stationary Poisson and point processes
- Random measures and Cox processes
- Poisson cluster processes and compound Poisson processes
- The spatial Gale-Shapley algorithm
Module: Potential Theory (MATHAN20) [M-MATH-102879]

**Responsible:** Prof. Dr. Andreas Kirsch

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Analysis
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Analysis
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

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Module: Predictive Driver Assistance Systems [M-ETIT-100360]

**Responsible:** Dr. Rüdiger Walter Henn

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** Complementary Field / Subject Electrical Engineering

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**Competence Certificate**
Success is checked in the form of a written test of 60 minutes. The module grade is the grade of this written exam.

**Competence Goal**
The students got to know the sensors for environment detection of the motor vehicle and the driver assistance and safety systems based on them. Due to the broad, interfacultative material from the areas of electrics, electronics, physics, vehicle dynamics (mechanical engineering) and system technology, they are able to understand the complex relationships in the overall vehicle, to name the advantages and disadvantages of individual processes, using examples to clarify and in practice, for example to be implemented directly in industrial internships and later in work.

**Module grade calculation**
The module grade is the grade of the written exam.

**Prerequisites**
none

**Content**
The lecture first introduces the topic of “driver assistance systems”. After a definition and classification of these systems in the variety of automotive assistance systems, the assistance systems necessary for the implementation of the predictive driver assistance systems are first explained. The first part of the lecture concludes with the treatment of the necessary sensors for an all-round view of the vehicle. Afterwards, the important representatives of the predictive driver assistance systems are worked through, structured according to passive (informative), active (intervening) systems and safety systems. After considering the ergonomic requirements for driver assistance systems, the lecture closes with a view of future systems, right up to automatic vehicle guidance.

**Recommendation**
Bachelor's degree

**Workload**
Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:

- Attendance study time lecture / exercise: 30 h
- Self-study time including exam preparation: 60 h
A total of 90 h = 3 LP
Module: Probability Theory and Combinatorial Optimization (MATHST27) [M-MATH-102947]

**Responsible:** Prof. Dr. Daniel Hug

**Organisation:** KIT Department of Mathematics

**Part of:** Mathematical Methods 1 / Field Stochastics
Mathematical Methods 2 / Field Stochastics
Complementary Field / Field Stochastics
Mathematical Specialization
Additional Examinations

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**Prerequisites**

none
Module: Project Centered Software-Lab (MATHNM40) [M-MATH-102938]

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<th>PD Dr. Gudrun Thäter</th>
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Prerequisites

none
### M 2.180 Module: Random Graphs (MATHST29) [M-MATH-102951]

- **Responsible:** Dr. Matthias Schulte
- **Organisation:** KIT Department of Mathematics
- **Part of:**
  - Mathematical Methods 1 / Field Stochastics
  - Mathematical Methods 2 / Field Stochastics
  - Complementary Field / Field Stochastics
  - Mathematical Specialization
  - Additional Examinations

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**Prerequisites**

none
### 2.181 Module: Robotics I - Introduction to Robotics [M-INFO-100893]

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## 2.182 Module: Ruin Theory [M-MATH-104055]

**Responsible:** Prof. Dr. Vicky Fasen-Hartmann  
**Organisation:** KIT Department of Mathematics

Part of:  
- Mathematical Methods 1 / Field Stochastics  
- Mathematical Methods 2 / Field Stochastics  
- Complementary Field / Field Stochastics  
- Mathematical Specialization  
- Additional Examinations

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### Prerequisites

None
### Module: Scattering Theory (MATHAN26) [M-MATH-102884]

**Responsible:** PD Dr. Frank Hettlich  
**Organisation:** KIT Department of Mathematics

**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Analysis  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Analysis  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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**Mandatory**

| T-MATH-105855 | Scattering Theory | 8 CR Arens, Griesmaier, Hettlich |
## M 2.184 Module: Security (IN4INSICH) [M-INFO-100834]

**Responsible:** Prof. Dr. Jörn Müller-Quade  
**Organisation:** KIT Department of Informatics  
**Part of:** Complementary Field / Subject Computer Science

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## 2.185 Module: Selected Topics in Cryptography (24623) [M-INFO-100836]

**Responsible:** Prof. Dr. Jörn Müller-Quade  
**Organisation:** KIT Department of Informatics  
**Part of:** Complementary Field / Subject Computer Science

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**Mandatory**

| T-INFO-101373 | Selected Topics in Cryptography | 3 CR | Müller-Quade |

Mathematics Master 2016 (Master of Science (M.Sc.))  
Module Handbook as of 21/09/2021
2.186 Module: Selected Topics in Harmonic Analysis [M-MATH-104435]

Responsible: Prof. Dr. Dirk Hundertmark
Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Analysis
Mathematical Methods 2 / Field Analysis
Complementary Field / Field Analysis
Mathematical Specialization
Additional Examinations

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Mandatory

| T-MATH-109065 | Selected Topics in Harmonic Analysis | 3 CR | Hundertmark |

Competence Goal
The students are familiar with the concepts of singular integral operators and weighted estimates in Harmonic Analysis. They know the relations between the BMO space and the Muckenhoupt weights and also how to use dyadic analysis operators to obtain estimates for Calderon-Zygmund operators.

Prerequisites
None

Content
- Calderon-Zygmund and Singular Integral operators
- BMO space and Muckenhoupt weights
- Reverse Holder Inequality and Factorisation of Ap weights
- Extrapolation Theory and weighted norm inequalities for singular integral operators
### 2.187 Module: Seminar [M-MATH-102730]

**Responsible:** PD Dr. Stefan Kühnlein  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Seminar

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**Election block: Elective Seminar (1 item)**

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<th>T-MATH-105686</th>
<th>Seminar Mathematics</th>
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2.188 Module: Seminar [M-MATH-103276]

**Responsible:** PD Dr. Stefan Kühnlein  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Specialization

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**Mandatory**

| T-MATH-106541 | Seminar Mathematics | 3 CR |

**Prerequisites**

none
# 2.189 Module: Seminar 2 [M-MATH-103925]

**Responsible:** PD Dr. Stefan Kühnlein  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Seminar

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# 2.190 Module: Seminar Advanced Topics in Parallel Programming [M-INFO-101887]

**Responsible:** Prof. Dr. Achim Streit  
**Organisation:** KIT Department of Informatics  
**Part of:** Complementary Field / Subject Computer Science

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## 2.191 Module: Signals and Codes (24137) [M-INFO-100823]

**Responsible:** Prof. Dr. Jörn Müller-Quade  
**Organisation:** KIT Department of Informatics  
**Part of:** Complementary Field / Subject Computer Science

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**Mandatory**

| T-INFO-101360 | Signals and Codes | 3 CR | Müller-Quade |
# 2.192 Module: Sobolev Spaces (MATHAN37) [M-MATH-102926]

**Responsible:** Prof. Dr. Andreas Kirsch  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Analysis  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Analysis  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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2.193 Module: Spatial Stochastics (MATHST14) [M-MATH-102903]

**Responsible:** Prof. Dr. Günter Last  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
Mathematical Methods 1 / Field Stochastics  
Mathematical Methods 2 / Field Stochastics  
Complementary Field / Field Stochastics  
Mathematical Specialization  
Additional Examinations

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**Mandatory**

| T-MATH-105867 | Spatial Stochastics | 8 CR | Hug. Last |

**Competence Goal**
The students are familiar with some basic spatial stochastic processes. They do not only understand how to deal with general properties of distributions, but also know how to describe and apply specific models (Poisson process, Gaussian random fields). They know how to work self-organised and self-reflexive.

**Prerequisites**
none

**Content**
- Point processes
- Random measures
- Poisson processes
- Gibbs point processes
- Ralm distributions
- Spatial ergodic theorem
- Spectral Theory of random fields
- Gaussian fields

**Recommendation**
It is recommended to attend the following modules previously: Probability Theory
2.194 Module: Special Functions and Applications in Potential Theory [M-MATH-101335]

**Responsible:** Prof. Dr. Andreas Kirsch

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Analysis
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Analysis
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

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**Mandatory**

| T-MATH-102274 | Special Functions and Applications in Potential Theory | 5 CR | Kirsch |

**Prerequisites**

None
## 2.195 Module: Special Topics of Numerical Linear Algebra (MATHNM30) [M-MATH-102920]

**Responsible:** Prof. Dr. Marlis Hochbruck  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Applied and Numerical Mathematics  
- Mathematical Methods 2 / Field Applied and Numerical Mathematics  
- Complementary Field / Field Applied and Numerical Mathematics  
- Mathematical Specialization  
- Additional Examinations

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### Prerequisites

none
2.196 Module: Spectral Theory [M-MATH-101768]

**Responsible:** Prof. Dr. Dorothee Frey

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

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**Mandatory**

| T-MATH-103414 | Spectral Theory - Exam | 8 CR Frey, Herzog, Kunstmann, Schmoeger, Schnaubelt |

**Recommendation**

It is recommended to attend the module 'Functional Analysis' previously.
### Module: Spectral Theory of Differential Operators (MATHAN22) [M-MATH-102880]

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<th>Prof. Dr. Michael Plum</th>
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Module: Spin Manifolds, Alpha Invariant and Positive Scalar Curvature (MATHAG43) [M-MATH-102958]

**Responsible:** Prof. Dr. Wilderich Tuschmann

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementary Field / Field Algebra and Geometry
- Mathematical Specialization
- Additional Examinations

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Module: Splitting Methods (MATHNM35) [M-MATH-102933]

Responsibility: Prof. Dr Katharina Schratz

Organisation: KIT Department of Mathematics

Part of:
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

Credits
Grade to a tenth: 5

Recurrence
Each winter term

Duration
1 term

Level
4

Version
1

Mandatory

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Hochbruck, Jahnke, Schratz
2.200 Module: Splitting Methods for Evolution Equations [M-MATH-105325]

**Responsible:** Prof. Dr Tobias Jahnke

**Organisation:** KIT Department of Mathematics

**Part of:** Mathematical Methods 1 / Field Applied and Numerical Mathematics
Mathematical Methods 2 / Field Applied and Numerical Mathematics
Complementary Field / Field Applied and Numerical Mathematics
Mathematical Specialization
Additional Examinations

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**Prerequisites**

None
2.201 Module: Statistical Learning (MATHAG07) [M-MATH-105840]

**Responsible:** Prof. Dr. Daniel Hug  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Stochastics  
- Mathematical Methods 2 / Field Stochastics  
- Complementary Field / Field Stochastics  
- Mathematical Specialization  
- Additional Examinations

**Credits**
- 8  
**Grading scale**
- Grade to a tenth  
**Recurrence**
- Irregular  
**Duration**
- 1 term  
**Level**
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**Version**
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**Competence Certificate**  
The module will be completed with an oral exam (approx. 30 min).

**Competence Goal**  
The students will:
- know the fundamental principles and problems of machine learning and can relate learning methods to these principles,  
- be able to explain how certain learning methods work and can apply them,  
- be able to develop and to discuss a statistical analysis of certain learning methods,  
- be able to understand independently and to apply new learning methods.

**Module grade calculation**  
The grade of the module is the grade of the oral exam.

**Prerequisites**  
none

**Content**  
1 Classification  
1.1 Bayes classifier  
1.2 k nearest neighbour  
1.3 discrimination analysis  
1.4 Support vector machines  
2 Regression  
2.1 Lasso  
2.2 Neuronal networks  
2.3 Random forests  
3 Unsupervised learning  
3.1 Principal component analysis  
3.2 Generative networks

**Recommendation**  
The module "Introduction to Stochastics" is recommended. The module "Probability theory" is preferable.

**Workload**  
Total effort: 240 hours  
The workload consists of:
- attendance time in lectures (including the exam): 90 hours  
- self-study (including preparation and post-processing of lectures, solving of weekly exercises, preparation for the exam): 150 hours
## 2.202 Module: Stein's Method (MATHST24) [M-MATH-102946]

**Responsible:** Dr. Matthias Schulte  
**Organisation:** KIT Department of Mathematics  
**Part of:**  
- Mathematical Methods 1 / Field Stochastics  
- Mathematical Methods 2 / Field Stochastics  
- Complementary Field / Field Stochastics  
- Mathematical Specialization  
- Additional Examinations

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**Prerequisites**

none
Module: Steins Method with Applications in Statistics [M-MATH-105579]

**Responsible:** Dr. rer. nat. Bruno Ebner

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Stochastics
- Mathematical Specialization
- Additional Examinations

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**Prerequisites**

None
## Module: Stochastic Control (MATHST12) [M-MATH-102908]

### Responsible:
Prof. Dr. Nicole Bäuerle

### Organisation:
KIT Department of Mathematics

### Part of:
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Stochastics
- Mathematical Specialization
- Additional Examinations

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### Mandatory

| T-MATH-105871 | Stochastic Control | 4 CR | Bäuerle |

### Prerequisites

none
### 2.205 Module: Stochastic Differential Equations (MATHAN24) [M-MATH-102881]

**Responsible:** Prof. Dr. Dorothee Frey  
**Organisation:** KIT Department of Mathematics

**Part of:**  
- Mathematical Methods 1 / Field Analysis  
- Mathematical Methods 1 / Field Stochastics  
- Mathematical Methods 2 / Field Analysis  
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- Complementary Field / Field Stochastics  
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- Additional Examinations

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**Content**

- Brownian motion  
- Martingales and Martingal inequalities  
- Stochastic integrals and Ito's formula  
- Existence and uniqueness of solutions for systems of stochastic differential equations  
- Perturbation and stability results  
- Application to equations in financial mathematics, physics and engineering  
- Connection with diffusion equations and potential theory
### Module: Stochastic Evolution Equations (MATHAN40) [M-MATH-102942]

** Responsible:** Prof. Dr. Lutz Weis  
** Organisation:** KIT Department of Mathematics  
** Part of:**  
  - Mathematical Methods 1 / Field Analysis  
  - Mathematical Methods 1 / Field Stochastics  
  - Mathematical Methods 2 / Field Analysis  
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  - Additional Examinations

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**Prerequisites**  
none
2.207 Module: Stochastic Geometry (MATHST06) [M-MATH-102865]

**Responsible:** Prof. Dr. Daniel Hug

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Algebra and Geometry
- Complementary Field / Field Stochastics
- Mathematical Specialization
- Additional Examinations

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**Mandatory**

| T-MATH-105840 | Stochastic Geometry | 8 CR | Hug, Last |

**Competence Goal**

The students

- know the fundamental geometric models and characteristics in stochastic geometry,
- are familiar with properties of Poisson processes of geometric objects,
- know examples of applications of models of stochastic geometry,
- know how to work self-organised and self-reflexive.

**Content**

- Random Sets
- Geometric Point Processes
- Stationarity and Isotropy
- Germ Grain Models
- Boolean Models
- Foundations of Integral Geometry
- Geometric densities and characteristics
- Random Tessellations

**Recommendation**

It is recommended to attend the module 'Spatial Stochastics' previously.
Module: Stochastic Information Processing (24113) [M-INFO-100829]

**Responsible:** Prof. Dr.-Ing. Uwe Hanebeck

**Organisation:** KIT Department of Informatics

**Part of:** Complementary Field / Subject Computer Science

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M 2.209 Module: Structural Graph Theory [M-MATH-105463]

Responsible: Prof. Dr. Maria Aksenovich
Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Algebra and Geometry
Mathematical Methods 2 / Field Algebra and Geometry
Complementary Field / Field Algebra and Geometry
Mathematical Specialization
Additional Examinations

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Mandatory

| T-MATH-111004 | Structural Graph Theory | 4 CR | Aksenovich |

Competence Goal
After successful completion of the course, the participants should be able to present and analyse main results in Structural Graph Theory. They should be able to establish connections between graph minors and other graph parameters, give examples, and apply fundamental results to related problems.

Prerequisites
None

Content
The purpose of this course is to provide an introduction to some of the central results and methods of structural graph theory. Our main point of emphasis will be on graph minor theory and the concepts devised in Robertson and Seymour's intricate proof of the Graph Minor Theorem: in every infinite set of graphs there are two graphs such that one is a minor of the other.

Our second point of emphasis (time permitting) will be on Hadwiger's conjecture: that every graph with chromatic number at least \( r \) has a \( K_r \) minor. We shall survey what is known about this conjecture, including some very recent progress.

Recommendation
A solid background in the fundamentals of graph theory.
# Module: Symmetric Encryption (24629) [M-INFO-100853]

**Responsible:** Prof. Dr. Jörn Müller-Quade  
**Organisation:** KIT Department of Informatics  
**Part of:** Complementary Field / Subject Computer Science

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**Mandatory**

| T-INFO-101390 | Symmetric Encryption | 3 CR | Müller-Quade |
### 2.211 Module: Technical Optics [M-ETIT-100538]

**Responsible:** Prof. Dr. Cornelius Neumann  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** Complementary Field / Subject Electrical Engineering

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**Prerequisites**

none
Module: The Riemann Zeta Function (MATHAG45) [M-MATH-102960]

**Responsible:** Dr. Fabian Januszewski

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementary Field / Field Algebra and Geometry
- Mathematical Specialization
- Additional Examinations

**Credits:** 4

**Grading scale:** Grade to a tenth

**Recurrence:** Irregular

**Duration:** 1 term

**Language:** German

**Level:** 4

**Version:** 1

**Mandatory**

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| T-MATH-105934| The Riemann Zeta Function                  | 4 CR    | Januszewski

Mathematics Master 2016 (Master of Science (M.Sc.))
Module Handbook as of 21/09/2021
Module: Theoretical Particle Physics I, Fundamentals and Advanced Topics, with Exercises [M-PHYS-102033]

Responsible: Prof. Dr. Kirill Melnikov
Prof. Dr. Milada Margarete Mühlleitner
Prof. Dr. Ulrich Nierste
Prof. Dr. Matthias Steinhauser
Prof. Dr. Dieter Zeppenfeld

Organisation: KIT Department of Physics
Part of: Complementary Field / Subject Physics

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Mandatory

T-PHYS-102544 | Theoretical Particle Physics I, Fundamentals and Advanced Topics, with Exercises | 12 CR | Melnikov, Mühlleitner, Nierste, Steinhauser, Zeppenfeld

Competence Certificate
Oral Exam. In the MSc Physics, this module is examined together with further modules attended as part of the major in physics. The total duration of the oral exam is approx. 60 minutes.

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-PHYS-102035 - Theoretical Particle Physics I, Fundamentals and Advanced Topics, without Exercises must not have been started.
2.214 Module: Theoretical Particle Physics I, Fundamentals and Advanced Topics, without Exercises [M-PHYS-102035]

**Responsible:** Prof. Dr. Kirill Melnikov  
Prof. Dr. Milada Margarete Mühlleitner  
Prof. Dr. Ulrich Nierste  
Prof. Dr. Matthias Steinhauser  
Prof. Dr. Dieter Zeppenfeld

**Organisation:** KIT Department of Physics  
**Part of:** Complementary Field / Subject Physics

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**Mandatory**

| T-PHYS-102546 | Theoretical Particle Physics I, Fundamentals and Advanced Topics, without Exercises | 8 CR | Melnikov, Mühlleitner, Nierste, Steinhauser, Zeppenfeld |

**Competence Certificate**

Oral Exam. In the MSc Physics, this module is examined together with further modules attended as part of the major in physics. The total duration of the oral exam is approx. 60 minutes.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The module **M-PHYS-102033 - Theoretical Particle Physics I, Fundamentals and Advanced Topics, with Exercises** must not have been started.
2.215 Module: Theoretical Particle Physics II, with Exercises [M-PHYS-102046]

**Responsible:** Prof. Dr. Gudrun Heinrich  
Prof. Dr. Kirill Melnikov  
Prof. Dr. Milada Margarete Mühlleitner  
Prof. Dr. Dieter Zeppenfeld

**Organisation:** KIT Department of Physics

**Part of:** Complementary Field / Subject Physics

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**Competence Certificate**

Oral Exam. In the MSc Physics, this module is examined together with further modules attended as part of the major in physics. The total duration of the oral exam is approx. 60 minutes.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The module M-PHYS-102048 - Theoretical Particle Physics II, without Exercises must not have been started.
Module: Theoretical Particle Physics II, without Exercises [M-PHYS-102048]

**Responsible:** Prof. Dr. Gudrun Heinrich
Prof. Dr. Kirill Melnikov
Prof. Dr. Milada Margarete Mühlleitner
Prof. Dr. Dieter Zeppenfeld

**Organisation:** KIT Department of Physics

**Part of:** Complementary Field / Subject Physics

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**Competence Certificate**

Oral Exam. In the MSc Physics, this module is examined together with further modules attended as part of the major in physics. The total duration of the oral exam is approx. 60 minutes.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The module M-PHYS-102046 - Theoretical Particle Physics II, with Exercises must not have been started.
2.217 Module: Time Series Analysis (MATHST18) [M-MATH-102911]

**Responsible:** PD Dr. Bernhard Klar

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Stochastics
- Mathematical Methods 2 / Field Stochastics
- Complementary Field / Field Stochastics
- Mathematical Specialization
- Additional Examinations

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**Prerequisites**
None
Module: Topological Data Analysis [M-MATH-105487]

**Responsible:** Prof. Dr. Tobias Hartnick
Prof. Dr. Roman Sauer

**Organisation:** KIT Department of Mathematics

**Part of:** Mathematical Methods 1 / Field Algebra and Geometry
Mathematical Methods 1 / Field Analysis
Mathematical Methods 1 / Field Stochastics
Mathematical Methods 2 / Field Algebra and Geometry
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Mathematical Specialization

**Additional Examinations**

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Mathematics Master 2016 (Master of Science (M.Sc.))
Module Handbook as of 21/09/2021
Module: Topological Groups [M-MATH-105323]

**Responsible:** Dr. rer. nat. Rafael Dahmen
Prof. Dr. Wilderich Tuschmann

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Algebra and Geometry
- Mathematical Methods 2 / Field Algebra and Geometry
- Complementary Field / Field Algebra and Geometry
- Mathematical Specialization
- Additional Examinations

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**Mandatory**

| T-MATH-110802 | Topological Groups | 5 CR Dahmen, Tuschmann |

**Prerequisites**

None
### Module: Traveling Waves (MATHAN38) [M-MATH-102927]

**Responsible:** Prof. Dr. Jens Rottmann-Matthes

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 2 / Field Analysis
- Complementary Field / Field Analysis
- Mathematical Specialization
- Additional Examinations

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2.221 Module: Uncertainty Quantification [M-MATH-104054]

Responsible: Prof. Dr. Martin Frank
Organisation: KIT Department of Mathematics
Part of: Mathematical Methods 1 / Field Applied and Numerical Mathematics
Mathematical Methods 2 / Field Applied and Numerical Mathematics
Complementary Field / Field Applied and Numerical Mathematics
Mathematical Specialization
Additional Examinations

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Mandatory

| T-MATH-108399 | Uncertainty Quantification | 4 CR | Frank |

Competence Goal
After successfully taking part in the module's classes and exams, students have gained knowledge and abilities as described in the "Inhalt" section.

Specifically, students know several parametrization methods for uncertainties. Furthermore, students are able to describe the basics of several solution methods (stochastic collocation, stochastic Galerkin, Monte-Carlo). Students can explain the so-called curse of dimensionality.

Students are able to apply numerical methods to solve engineering problems formulated as algebraic or differential equations with uncertainties. They can name the advantages and disadvantages of each method. Students can judge whether specific methods are applicable to the specific problem and discuss their results with specialists and colleagues. Finally, students are able to implement the above methods in computer codes.

Prerequisites
None

Content
In this class, we learn to propagate uncertain input parameters through differential equation models, a field called Uncertainty Quantification (UQ). Given uncertain input (parameter values, initial or boundary conditions), how uncertain is the output? The first part of the course ("how to do it") gives an overview on techniques that are used. Among these are:

- Sensitivity analysis
- Monte-Carlo methods
- Spectral expansions
- Stochastic Galerkin method
- Collocation methods, sparse grids

The second part of the course ("why to do it like this") deals with the theoretical foundations of these methods. The so-called "curse of dimensionality" leads us to questions from approximation theory. We look back at the very standard numerical algorithms of interpolation and quadrature, and ask how they perform in many dimensions.

Recommendation
Numerical methods for differential equations
## 2.222 Module: Variational Methods [M-MATH-105093]

**Responsible:** Prof. Dr. Wolfgang Reichel  
**Organisation:** KIT Department of Mathematics  
**Part of:** Mathematical Methods 1 / Field Analysis  
Mathematical Methods 2 / Field Analysis  
Complementary Field / Field Analysis  
Mathematical Specialization  
Additional Examinations  

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2.223 Module: Wave Propagation in Periodic Waveguides [M-MATH-105462]

**Responsible:** Prof. Dr. Roland Griesmaier

**Organisation:** KIT Department of Mathematics

**Part of:**
- Mathematical Methods 1 / Field Analysis
- Mathematical Methods 1 / Field Applied and Numerical Mathematics
- Mathematical Methods 2 / Field Analysis
- Mathematical Methods 2 / Field Applied and Numerical Mathematics
- Complementary Field / Field Analysis
- Complementary Field / Field Applied and Numerical Mathematics
- Mathematical Specialization
- Additional Examinations

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**Prerequisites**

None
2.224 Module: Wavelets (MATHNM14) [M-MATH-102895]

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<th>Prof. Dr. Andreas Rieder</th>
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**Mandatory**

| T-MATH-105838 | Wavelets | 8 CR | Rieder |

**Prerequisites**

none
Module: Wildcard [M-MATH-103198]

**2.225 Module: Wildcard [M-MATH-103198]**

**Organisation:** University  
**Part of:** Complementary Field / Subject Mechanical Engineering

<table>
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**Election block: Wildcard (at least 1 item)**

| T-MATH-106331 | Wildcard 1 | 6 CR |

**Prerequisites**
None
### 3.1 Course: Adaptive Finite Element Methods [T-MATH-105898]

**Responsible:** Prof. Dr. Willy Dörfler  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102900 - Adaptive Finite Elemente Methods

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**Prerequisites:** none
3.2 Course: Advanced Empirical Asset Pricing [T-WIWI-110513]

**Responsible:** Jun.-Prof. Dr. Julian Thimme

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101480 - Finance 3
M-WIWI-101483 - Finance 2

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**Events**

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<td>Übung zu Advanced Empirical Asset Pricing</td>
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**Exams**

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<td>7900319</td>
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**Compentence Certificate**
The success control takes place in form of a written examination (60 min) during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4 (2), 2 SPO) may also be offered. The examination is offered every semester and can be repeated at any regular examination date.

A bonus can be acquired through successful participation in the practice. If the grade of the written examination is between 4.0 and 1.3, the bonus improves the grade by up to one grade level (0.3 or 0.4). Details will be announced in the lecture.

**Recommendation**
We strongly recommend knowledge of the basic topics in investments (bachelor course), which will be necessary to be able to follow the course. In addition, prior participation in the Asset Pricing Master course is strongly recommended.

**Annotation**
New course from winter semester 2019/2020.

*Below you will find excerpts from events related to this course:*

**Advanced Empirical Asset Pricing**
2530569, WS 21/22, 2 SWS, Language: English, Open in study portal

**Content**
In this course we will discuss the fundamentals of Asset Pricing and how to test them. Although this is an Empirical Asset Pricing course, we deal with some concepts from Asset Pricing Theory that we can test afterwards (CAPM, ICAPM, CCAPM, recursive utility). Besides, the course will cover the most important empirical methods to do so. For that purpose, we will discuss the overarching tool *Generalized Method of Moments*, and the special cases of OLS and FMB regressions. Every second week, we will meet for a programming session, in which we will look at the data to draw our own conclusions. An introduction to the software MATLAB will be given at the beginning of the course. Students should bring a laptop to these sessions. Programming skills are not required but helpful.

We start with a review of the Stochastic Discount Factor, which is already known from the course „Asset Pricing“. We then derive the CAPM and the Consumption–CAPM as special cases from the general consumption–savings optimization problem of the rational investor. In the first part of the course we discuss the CAPM and, as natural extensions, models with multiple factors. Prominent phenomena such as the value premium and momentum are discussed. In the second part of the lecture we will study extensions of Consumption–CAPM and study the implications of exotic preferences.

**Literature**

**Basisliteratur**

**zur Vertiefung/ Wiederholung**
### 3.3 Course: Advanced Game Theory [T-WIWI-102861]

**Responsible:** Prof. Dr. Karl-Martin Ehrhart  
Prof. Dr. Clemens Puppe  
Prof. Dr. Johannes Philipp Reiß

**Organisation:** KIT Department of Economics and Management

**Part of:**  
M-WIWI-101500 - Microeconomic Theory  
M-WIWI-101502 - Economic Theory and its Application in Finance  
M-WIWI-102970 - Decision and Game Theory

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**Events**

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<td>WT 21/22 2521534 Übung zu Advanced Game Theory 1 SWS Practice Online Reiß, Peters</td>
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**Exams**

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<tr>
<td>ST 2021 7900294 Advanced Game Theory</td>
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</table>

**Competence Certificate**

The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

**Prerequisites**

None

**Recommendation**

Basic knowledge of mathematics and statistics is assumed.

Below you will find excerpts from events related to this course:

- **Advanced Game Theory**  
  2521533, WS 21/22, 2 SWS, Language: English, **Open in study portal**

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Mathematics Master 2016 (Master of Science (M.Sc.))  
Module Handbook as of 21/09/2021  
286
3.4 Course: Advanced Inverse Problems: Nonlinearity and Banach Spaces [T-MATH-105927]

Responsible: Prof. Dr. Andreas Rieder
Organisation: KIT Department of Mathematics
Part of: M-MATH-102955 - Advanced Inverse Problems: Nonlinearity and Banach Spaces

<table>
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Prerequisites
none
3.5 Course: Advanced Lab Blockchain Hackathon (Master) [T-WIWI-111126]

**Responsible:** Prof. Dr. Ali Sunyaev  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101472 - Informatics

<table>
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**Events**

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<td>2512403</td>
<td><strong>Advanced Lab Blockchain Hackathon (Bachelor)</strong></td>
<td>Practical course /🖥</td>
<td>Sunyaev, Kannengießer, Sturm, Beyene</td>
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**Exams**

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<th>Code</th>
<th>Course Description</th>
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<tr>
<td>WT 21/22</td>
<td>7900141</td>
<td><strong>Advanced Lab Blockchain Hackathon (Master)</strong></td>
<td></td>
<td>Sunyaev</td>
</tr>
</tbody>
</table>

Legend: 🖥 Online, ☐ Blended (On-Site/Online), ☐ On-Site, ☒ Cancelled

**Competence Certificate**

The alternative exam assessment consists of:

- a practical work
- a presentation and
- a written seminar thesis

Practical work, presentation and written thesis are weighted according to the course.

**Prerequisites**

None
### 3.6 Course: Advanced Lab Informatics (Master) [T-WIWI-110548]

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**Type** | Examination of another type | **Credits** | 4,5 | **Grading scale** | Grade to a third | **Recurrence** | Each term | **Version** |
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#### Events

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<tr>
<td>ST 2021</td>
<td>2512205</td>
<td>Lab Realisation of innovative services (Master)</td>
<td>3</td>
<td>Practical course</td>
<td>Oberweis, Schiefer, Schüler, Toussaint</td>
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<tr>
<td>ST 2021</td>
<td>2512207</td>
<td>Lab Automation in Everyday Life (Master)</td>
<td>3</td>
<td>Practical course</td>
<td>Oberweis, Forell, Frister</td>
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<td>ST 2021</td>
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<td>Development of Sociotechnical Information Systems (Master)</td>
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#### Exams

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### Competence Certificate
The alternative exam assessment consists of:

- a practical work
- a presentation and
- a written seminar thesis

Practical work, presentation and written thesis are weighted according to the course.

### Prerequisites
None

### Annotation
The title of this course is a generic one. Specific titles and the topics of offered seminars will be announced before the start of a semester in the internet at https://portal.wiwi.kit.edu.

### Below you will find excerpts from events related to this course:

#### Lab Realisation of innovative services (Master)

- **2512205, SS 2021, 3 SWS, Language: German, Open in study portal**

**Content**
As part of the lab, the participants should work together in small groups to realize innovative services (mainly for students). Further information can be found on the ILIAS page of the lab.

**Organizational issues**
Die genauen Termine und Informationen zur Anmeldung werden auf der Veranstaltungsseite bekannt gegeben.

#### Lab Automation in Everyday Life (Master)

- **2512207, SS 2021, 3 SWS, Language: German, Open in study portal**

**Content**
As part of the lab, various topics on everyday automation are offered. During the lab, the participants will gain an insight into problem-solving oriented project work and work on a project together in small groups. Further information can be found on the ILIAS page of the lab.

**Organizational issues**
Die genauen Termine und Informationen zur Anmeldung werden auf der Veranstaltungsseite bekannt gegeben.

#### Development of Sociotechnical Information Systems (Master)

- **2512401, SS 2021, 3 SWS, Language: German/English, Open in study portal**

**Content**
The aim of the lab is to get to know the development of socio-technical information systems in different application areas. In the event framework, you should develop a suitable solution strategy for your problem alone or in group work, collect requirements, and implement a software artifact based on it (for example, web platform, mobile apps, desktop application). Another focus of the lab is on the subsequent quality assurance and documentation of the implemented software artifact. Registration information will be announced on the course page.

#### Project Lab Machine Learning

- **2512500, SS 2021, 3 SWS, Language: German/English, Open in study portal**

**Practical course (P)**
Blended (On-Site/Online)
**Content**

The lab is intended as a practical supplement to lectures such as “Machine Learning”. The theoretical basics are applied in the lab course. The aim of the lab course is that the participants work together to design, develop and evaluate a subsystem from the field of robotics and cognitive systems using one or more procedures from the field of AI/ML.

In addition to the scientific objectives involved in the investigation and application of the methods, aspects of project-specific teamwork in research (from specification to presentation of the results) are also developed in this practical course. The individual projects require the analysis of the task at hand, selection of suitable procedures, specification and implementation and evaluation of the approach taken. Finally, the chosen solution has to be documented and presented in a short presentation.

**Learning objectives:**

- Students can practically apply knowledge from the Machine Learning lecture in a selected field of current research in robotics or cognitive automobiles.
- Students master the analysis and solution of corresponding problems in a team.
- Students can evaluate, document and present their concepts and results.

**Recommendations:**

Attendance of the lecture machine learning, C/C++ knowledge, Python knowledge

**Workload:**

The workload of 4.5 credit points consists of the time spent in the lab for practical implementation of the selected solution, as well as the time spent on literature research and planning/specifying the proposed solution. In addition, a short report and a presentation of the work carried out will be prepared.

**Organizational issues**

Anmeldung und weitere Informationen sind WiWi-Portal zu finden.

Registration and further information can be found in the WiWi-portal.
Content
The internship "Security, Usability and Society" will cover topics both of usable security and privacy programming, and how to conduct user studies. This internship will be only in English. The kick-off, the presentations, and every written material to be graded must be in English. Communications with supervisors can be in German. WiWi link: https://portal.wiwi.kit.edu/ys/4629

Important dates:
Kick-off: 06.04.2021, 10:00-11:00 CET in Microsoft Teams - Link
Report + code submission: 07.09.2021, 23:59 CET
Presentation deadline: 20.09.2021, 23:59 CET
Presentation day: 24.09.2021, 09:00 CET

Topics:
Privacy Friendly apps
In this subject, students complete an app (or an extension of an app) among our Privacy-Friendly Apps. Please click the following link to know more about them: https://secuso.aifb.kit.edu/english/105.php. Students are provided with a point list of goals, containing both basic features mandatory to pass the course and more advanced ones that heighten the final grade.

• Notes 2.0

Programming Usable Security Intervention
In this subject, students develop a part of coding, an extension, or another programming task dealing with various usable security interventions, eg as an extension. Eg TORPEDO (https://secuso.aifb.kit.edu/english/TORPEDO.php) or PassSec + (https://secuso.aifb.kit.edu/english/PassSecPlus.php). Just as before, students are provided with a point list of goals, containing both basic features mandatory to pass the course and more advanced ones that heighten the final grade.

• Password Manager Enrolment Add-On
• Portfolio Graphical Recognition-Based Passwords with Gamepads
• Visualization app to explore Facebook behavioral data collection
• Authenticating on AR glasses: Implementing an authentication scheme for the Google Glass

Designing Security User studies (online studies only)
These topics are related to how to set up and conducting user studies of various types. This year, due to the Corona outbreak, we decided to conduct online studies only; otherwise, interviews and in lab studies would have been possible. At the end of the semester, the students present a report / paper and a talk in which they present their results.

• Neurotechnologies, Neuroprivacy, and User Acceptance
• Expert feedback for an anti-phishing webpage template (English only)
• “Your website has been hacked” - How to inform business owners about security issues on their webpages in more sensitive ways

Please, note that registration is not required to participate in the kick-off meeting.
This event counts towards the KASTEL certificate. Further information on how to obtain the certificate can be found on the SECUSO website https://secuso.aifb.kit.edu/Studium_und_Lehre.php.

Lab Realisation of innovative services (Master)
2512205, WS 21/22, 3 SWS, Language: German, Open in study portal

Content
As part of the lab, the participants should work together in small groups to realize innovative services (mainly for students). Further information can be found on the ILIAS page of the lab.

Organizational issues
Die genauen Termine und Informationen zur Anmeldung werden auf der Veranstaltungsseite bekannt gegeben.

Practical Course Sociotechnical Information Systems Development (Master)
2512401, WS 21/22, 3 SWS, Language: German/English, Open in study portal

Mathematics Master 2016 (Master of Science (M.Sc.))
Module Handbook as of 21/09/2021
Content
The aim of this course is to provide a practical introduction into developing socio-technical information systems, such as web platforms, mobile apps, or desktop applications. Course participants will create (individually or in groups) software solutions for specific problems from various practical domains. The course tasks comprise requirements assessment, system design, and software implementation. Furthermore, course participants will gain insights into software quality assurance methods and software documentation.

Learning objectives:
- Independent and self-organized realization of a software development project
- Evaluation and selection of suitable development tools and methods
- Application of modern software development methods
- Planning and execution of different development tasks: requirements assessment, system design, implementation, and quality assurance
- Project documentation
- Presentation of project results in an comprehensible and structured form

Practical Course Cognitive automobiles and robots (Master)
2512501, WS 21/22, 3 SWS, Language: German/English, Open in study portal

Content
The lab is intended as a practical supplement to lectures such as “Machine Learning”. The theoretical basics are applied in the lab course. The aim of the lab course is that the participants work together to design, develop and evaluate a subsystem from the field of robotics and cognitive systems using one or more procedures from the field of AI/ML.

In addition to the scientific objectives involved in the investigation and application of the methods, aspects of project-specific teamwork in research (from specification to presentation of the results) are also developed in this practical course. The individual projects require the analysis of the task at hand, selection of suitable procedures, specification and implementation and evaluation of the approach taken. Finally, the chosen solution has to be documented and presented in a short presentation.

Learning objectives:
- Students can practically apply knowledge from the Machine Learning lecture in a selected field of current research in robotics or cognitive automobiles.
- Students master the analysis and solution of corresponding problems in a team.
- Students can evaluate, document and present their concepts and results.

Recommendations:
Attendance of the lecture machine learning, C/C++ knowledge, Python knowledge

Workload:
The workload of 4.5 credit points consists of the time spent in the lab for practical implementation of the selected solution, as well as the time spent on literature research and planning/specifying the proposed solution. In addition, a short report and a presentation of the work carried out will be prepared.

Organizational issues
Anmeldung und weitere Informationen sind im WiWi-Portal zu finden.
Registration and further information can be found in the WiWi-portal.

Practical Course Security (Master)
2512557, WS 21/22, 4 SWS, Language: German, Open in study portal

Content
The lab deals with the IT security of everyday utensils. Implemented security mechanisms are first theoretically investigated and put to the test with practical attacks. Finally, countermeasures and suggestions for improvement are worked out. The lab is offered within the competence center for applied security technologies (KASTEL) and is supervised by several institutes.

The success control takes the form of a final presentation, a thesis and the handing over of the developed code.

More information on ILIAS.

Project lab Information Service Engineering (Master)
2512600, WS 21/22, 3 SWS, Language: English, Open in study portal
Content
The ISE project lab is based on the summer semester lecture "Information Service Engineering". Goal of the course is to work on a given research problem in small groups (3-4 students) related to the ISE lecture topics, i.e. Natural Language Processing, Knowledge Graphs, and Machine Learning. The solution of the given research problem requires the development of a software implementation.

The project will be worked on in teams of 3-4 students each, guided by a tutor from the teaching staff.

Required coursework includes:
- Mid term presentation (5-10 min)
- Final presentation (10-15 min)
- Course report (c. 20 pages)
- Participation and contribution of the students during the course
- Software development and delivery

Notes:
The ISE project lab can also be credited as a seminar (if necessary).

Participation will be restricted to 15 students.

Participation in the lecture "Information Service Engineering" (summer semester) is required. There are video recordings on our youtube channel.

ISE Tutor Team:
- M. Sc. Russa Biswas
- M. Sc. Genet Asefa Gesese
- M. Sc. Oleksandra Bruns
- M. Sc. Yiyi Chen
- M. Sc. Mary Ann Tan
- B. Sc. Tabea Tietz

Literature
ISE video channel on youtube: https://www.youtube.com/channel/UCjkkhNSNuXrJpMYZoeSBw6Q/
3.7 Course: Advanced Lab Security [T-WIWI-109786]

**Responsible:** Prof. Dr. Melanie Volkamer  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101472 - Informatics

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**Competence Certificate**

The alternative exam assessment consists of:

- a practical work
- a presentation and possibly
- a written seminar thesis

Practical work, presentation and written thesis are weighted according to the course.

**Prerequisites**

None

**Recommendation**

Knowledge from the lecture "Information Security" is recommended.

---

**Practical Course Security (Master)**

2512557, WS 21/22, 4 SWS, Language: German, [Open in study portal]

**Content**

The lab deals with the IT security of everyday utensils. Implemented security mechanisms are first theoretically investigated and put to the test with practical attacks. Finally, countermeasures and suggestions for improvement are worked out. The lab is offered within the competence center for applied security technologies (KASTEL) and is supervised by several institutes.

The success control takes the form of a final presentation, a thesis and the handing over of the developed code.

More information on ILIAS.
3.8 Course: Advanced Lab Security, Usability and Society [T-WIWI-108439]

Responsible: Prof. Dr. Melanie Volkamer
Organisation: KIT Department of Economics and Management
Part of: M-WIWI-101472 - Informatics

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Exams

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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
The alternative exam assessment consists of:

- a practical work
- a presentation and possibly
- a written seminar thesis

Practical work, presentation and written thesis are weighted according to the course.

Prerequisites
None

Recommendation
Knowledge from the lecture "Information Security" is recommended.

Annotation
The course is expected to be offered from winter term 2018/2019.

Contents:
In the course of the programming lab, changing topics from the field of Human Factors in Security und Privacy will be worked on.

Learning goals:
The student

- can apply the basics of information security
- is able to implement appropriate measures to achieve different protection goals
- can structure a software project in the field of information security
- can use the Human Centred Security and Privacy by Design technique to develop user-friendly software
- can explain and present technical facts and the results of the programming lab in oral and written form

Below you will find excerpts from events related to this course:
Content
The internship "Security, Usability and Society" will cover topics both of usable security and privacy programming, and how to conduct user studies. This internship will be only in English. The kick-off, the presentations, and every written material to be graded must be in English. Communications with supervisors can be in German.
WiWi portal: [https://portal.wiwi.kit.edu/ys/4628](https://portal.wiwi.kit.edu/ys/4628)

Important dates:
- **Kick-off:** 06.04.2021, 10:00-11:00 CET in Microsoft Teams - [Link](https://portal.wiwi.kit.edu/ys/4628)
- **Report + code submission:** 07.09.2021, 23:59 CET
- **Presentation deadline:** 20.09.2021, 23:59 CET
- **Presentation day:** 24.09.2021, 09:00 CET

Topics:

**Privacy Friendly apps**
In this subject, students complete an app (or an extension of an app) among our Privacy-Friendly Apps. Please click the following link to know more about them: [https://secuso.aifb.kit.edu/english/105.php](https://secuso.aifb.kit.edu/english/105.php). Students are provided with a point list of goals, containing both basic features mandatory to pass the course and more advanced ones that heighten the final grade.

- Notes 2.0

**Programming Usable Security Intervention**
In this subject, students develop a part of coding, an extension, or another programming task dealing with various usable security interventions, eg as an extension. Eg TORPEDO ([https://secuso.aifb.kit.edu/english/TORPEDO.php](https://secuso.aifb.kit.edu/english/TORPEDO.php)) or PassSec + ([https://secuso.aifb.kit.edu/english/PassSecPlus.php](https://secuso.aifb.kit.edu/english/PassSecPlus.php)). Just as before, students are provided with a point list of goals, containing both basic features mandatory to pass the course and more advanced ones that heighten the final grade.

- Password Manager Enrolment Add-On
- Portfolio Graphical Recognition-Based Passwords with Gamepads
- Visualization app to explore Facebook behavioral data collection

**Designing Security User studies (online studies only)**
These topics are related to how to set up and conducting user studies of various types. This year, due to the Corona outbreak, we decided to conduct online studies only; otherwise, interviews and in lab studies would have been possible. At the end of the semester, the students present a report / paper and a talk in which they present their results.

- Neurotechnologies, Neuroprivacy, and User Acceptance
- Expert feedback for an anti-phishing webpage template (English only)
- "Your website has been hacked" - How to inform business owners about security issues on their webpages in more sensitive ways

Please, note that registration is not required to participate in the kick-off meeting.

This event counts towards the KASTEL certificate. Further information on how to obtain the certificate can be found on the SECUSO website [https://secuso.aifb.kit.edu/Studium_und_Lehre.php](https://secuso.aifb.kit.edu/Studium_und_Lehre.php).
Content
The internship "Security, Usability and Society" will cover topics both of usable security and privacy programming, and how to conduct user studies. To reserve a place, please, register on the WiWi portal and send an email with your chosen topic, plus a back-up one, to mattia.mossano@kit.edu. Topics are assigned first-come-first-served until all of them are filled. Topics in italics have been already assigned.

Important dates:
Kick-off: 04.10.2021, 10:00-11:00 CET in Microsoft Teams - Link
Report + code submission: 06.02.2022, 23:59 CET
Presentation deadline: 06.02.2022, 23:59 CET
Presentation day: 08.02.2022

Topics:
Privacy Friendly apps
In this subject, students complete an app (or an extension of an app) among our Privacy-Friendly Apps. Please click the following link to know more about them: https://secuso.aifb.kit.edu/english/105.php. Students are provided with a point list of goals, containing both basic features mandatory to pass the course and more advanced ones that heighten the final grade.

• Notes 2.0

Programming Usable Security Intervention
In this subject, students develop a part of coding, an extension, or another programming task dealing with various usable security interventions, eg as an extension. Eg TORPEDO (https://secuso.aifb.kit.edu/english/TORPEDO.php) or PassSec + (https://secuso.aifb.kit.edu/english/PassSecPlus.php). Just as before, students are provided with a point list of goals, containing both basic features mandatory to pass the course and more advanced ones that heighten the final grade.

• Password Manager Enrolment Add-On
• Portfolio Graphical Recognition-Based Passwords with Gamepads
• Cookie Consent Manager for Websites

Designing Security User studies (online studies only)
These topics are related to how to set up and conducting user studies of various types. This year, due to the Corona outbreak, we decided to conduct online studies only; otherwise, interviews and in lab studies would have been possible. At the end of the semester, the students present a report / paper and a talk in which they present their results.

• How to display URLs to support people's ability to detect phishing (English)
• Studying the Effect of Static vs. Dynamic Phishing Detection
• How effective are QR-scanners in helping users detecting phishing emails?

Please, note that registration is not required to participate in the kick-off meeting.
This event counts towards the KASTEL certificate. Further information on how to obtain the certificate can be found on the SECUSO website https://secuso.aifb.kit.edu/Studium_und_Lehre.php.

Praktikum Security, Usability and Society (Bachelor)
2512554, WS 21/22, 3 SWS, Language: German/English, Open in study portal
Content
The internship "Security, Usability and Society" will cover topics both of usable security and privacy programming, and how to conduct user studies. To reserve a place, please, register on the WiWi portal and send an email with your chosen topic, plus a back-up one, to mattia.mossano@kit.edu. Topics are assigned first-come-first-served until all of them are filled. Topics in italics have been already assigned.

Important dates:
- Kick-off: 04.10.2021, 10:00-11:00 CET in Microsoft Teams - Link
- Report + code submission: 06.02.2022, 23:59 CET
- Presentation deadline: 06.02.2022, 23:59 CET
- Presentation day: 08.02.2022

Topics:

Privacy Friendly apps
In this subject, students complete an app (or an extension of an app) among our Privacy-Friendly Apps. Please click the following link to know more about them: https://secuso.aifb.kit.edu/english/105.php. Students are provided with a point list of goals, containing both basic features mandatory to pass the course and more advanced ones that heighten the final grade.

- Notes 2.0

Programming Usable Security Intervention
In this subject, students develop a part of coding, an extension, or another programming task dealing with various usable security interventions, eg as an extension. Eg TORPEDO (https://secuso.aifb.kit.edu/english/TORPEDO.php) or PassSec+ (https://secuso.aifb.kit.edu/english/PassSecPlus.php). Just as before, students are provided with a point list of goals, containing both basic features mandatory to pass the course and more advanced ones that heighten the final grade.

- Password Manager Enrollment Add-On
- Portfolio Graphical Recognition-Based Passwords with Gamepads
- Cookie Consent Manager for Websites

Designing Security User studies (online studies only)
These topics are related to how to set up and conducting user studies of various types. This year, due to the Corona outbreak, we decided to conduct online studies only; otherwise, interviews and in lab studies would have been possible. At the end of the semester, the students present a report / paper and a talk in which they present their results.

- How to display URLs to support people's ability to detect phishing (English)
- Studying the Effect of Static vs. Dynamic Phishing Detection
- How effective are QR-scanners in helping users detecting phishing emails?

Please, note that registration is not required to participate in the kick-off meeting.

This event counts towards the KASTEL certificate. Further information on how to obtain the certificate can be found on the SECUSO website https://secuso.aifb.kit.edu/Studium_und_Lehre.php.
3.9 Course: Advanced Lab Sociotechnical Information Systems Development (Master) [T-WIWI-111125]

**Responsible:** Prof. Dr. Ali Sunyaev

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101472 - Informatics

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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

The alternative exam assessment consists of:

- a practical work
- a presentation and
- a written seminar thesis

Practical work, presentation and written thesis are weighted according to the course.

**Prerequisites**

None

*Below you will find excerpts from events related to this course:*

### Practical Course Sociotechnical Information Systems Development (Master)

2512401, WS 21/22, 3 SWS, Language: German/English, [Open in study portal](#)

**Content**

The aim of this course is to provide a practical introduction into developing socio-technical information systems, such as web platforms, mobile apps, or desktop applications. Course participants will create (individually or in groups) software solutions for specific problems from various practical domains. The course tasks comprise requirements assessment, system design, and software implementation. Furthermore, course participants will gain insights into software quality assurance methods and software documentation.

**Learning objectives:**

- Independent and self-organized realization of a software development project
- Evaluation and selection of suitable development tools and methods
- Application of modern software development methods
- Planning and execution of different development tasks: requirements assessment, system design, implementation, and quality assurance
- Project documentation
- Presentation of project results in an comprehensible and structured form
### 3.10 Course: Advanced Stochastic Optimization [T-WIWI-106548]

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<th>Responsible:</th>
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**Type**  
Written examination

**Credits**  
4,5

**Grading scale**  
Grade to a third

**Recurrence**  
Irregular

**Version**  
1

**Competence Certificate**

The assessment consists of a written exam (60 minutes) according to Section 4(2), 1 of the examination regulation. The exam takes place in every the semester.

**Prerequisites**

None.
3.11 Course: Advanced Topics in Economic Theory [T-WIWI-102609]

**Responsible:** Prof. Dr. Kay Mitusch  
**Organisation:** KIT Department of Economics and Management  
**Part of:**  
- M-WIWI-101500 - Microeconomic Theory  
- M-WIWI-101502 - Economic Theory and its Application in Finance

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Legend:  
- Online  
- Blended (On-Site/Online)  
- On-Site  
- Cancelled

**Competence Certificate**

The assessment consists of a written exam (60min) (following §4(2), 1 of the examination regulation) at the end of the lecture period or at the beginning of the following semester.

**Prerequisites**

None

**Recommendation**

This course is designed for advanced Master students with a strong interest in economic theory and mathematical models. Bachelor students who would like to participate are free to do so, but should be aware that the level is much more advanced than in other courses of their curriculum.

**Below you will find excerpts from events related to this course:**

**Advanced Topics in Economic Theory**

2520527, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**Literature**

Die Veranstaltung wird in englischer Sprache angeboten:

The course is based on the excellent textbook "Microeconomic Theory" (Chapters 1-5, 10, 13-20) by A.Mas-Colell, M.D.Whinston, and J.R.Green.
### 3.12 Course: Algebra [T-MATH-102253]

**Responsible:** Prof. Dr. Frank Herrlich  
PD Dr. Stefan Kühnlein  

**Organisation:** KIT Department of Mathematics  

**Part of:** M-MATH-101315 - Algebra  

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**Exams**

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### 3.13 Course: Algebraic Geometry [T-MATH-103340]

**Responsible:** Prof. Dr. Frank Herrlich  
PD Dr. Stefan Kühnlein  

**Organisation:** KIT Department of Mathematics  

**Part of:** M-MATH-101724 - Algebraic Geometry

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<tr>
<td>Oral examination</td>
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<td>Grade to a third</td>
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</table>
### 3.14 Course: Algebraic Number Theory [T-MATH-103346]

**Responsible:** PD Dr. Stefan Kühnlein  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-101725 - Algebraic Number Theory

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#### Events

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<th>Algebraische Zahlentheorie</th>
<th>4 SWS</th>
<th>Lecture / 🖥</th>
<th>Kühnlein</th>
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<td>0104615</td>
<td>Übungen zu 0104610 (Algebraische Zahlentheorie)</td>
<td>2 SWS</td>
<td>Practice / 🖥</td>
<td>Kühnlein</td>
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#### Exams

| ST 2021 | 7700069 | Algebraic Number Theory | Kühnlein |

Legend: 🖥 Online, 🧬 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
3.15 Course: Algebraic Topology [T-MATH-105915]

**Responsible:** Dr. Holger Kammeyer
Prof. Dr. Roman Sauer

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102948 - Algebraic Topology

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**Prerequisites**
none
3.16 Course: Algebraic Topology II [T-MATH-105926]

**Responsible:** Prof. Dr. Roman Sauer

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102953 - Algebraic Topology II

**Type:** Written examination

**Credits:** 8

**Grading scale:** Grade to a third

**Recurrence:** Irregular

**Version:** 1

**Prerequisites**
none
### 3.17 Course: Algorithm Engineering [T-INFO-101332]

**Responsible:** Prof. Dr. Peter Sanders  
Prof. Dr. Dorothea Wagner  

**Organisation:** KIT Department of Informatics  
**Part of:** M-INFO-100795 - Algorithm Engineering

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<th>Lecture</th>
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<td>Algorithm Engineering</td>
<td>2/1</td>
<td>Lecture</td>
<td>Sanders, Witt, Seemaier</td>
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**Exams**

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<td>75514</td>
<td>Algorithm Engineering</td>
<td>Sanders</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled
### 3.18 Course: An Introduction to Periodic Elliptic Operators [T-MATH-110306]

**Responsible:** Prof. Dr. Roland Griesmaier  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-105096 - An Introduction to Periodic Elliptic Operators

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**Prerequisites**  
none
3.19 Course: Analytical and Numerical Homogenization [T-MATH-111272]

**Responsible:** Prof. Dr. Marlis Hochbruck

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105636 - Analytical and Numerical Homogenization

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**Events**

| ST 2021 | 0165700 | Analytical and Numerical Homogenization | 3 SWS | Lecture / 🖥 | Verfürth, Goffi |

**Exams**

| ST 2021 | 7700088 | Analytical and Numerical Homogenization | Verfürth |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 👤 On-Site, ✗ Cancelled

**Prerequisites**

none
3.20 Course: Applications of Topological Data Analysis [T-MATH-111290]

**Responsible:** Dr. Andreas Ott

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105651 - Applications of Topological Data Analysis

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**Exams**

| ST 2021 | 7700082 | Applications of Topological Data Analysis | Ott |

**Prerequisites**

none

Responsible: Prof. Dr. Ali Sunyaev
Organisation: KIT Department of Economics and Management
Part of: M-WIWI-101472 - Informatics

<table>
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<td>Applied Informatics - Principles of Internet Computing: Foundations for Emerging Technologies and Future Services</td>
<td>Lecture</td>
<td>2 SWS</td>
<td>Online</td>
<td>Sunyaev</td>
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<td>ST 2021</td>
<td>2511033</td>
<td>Übungen zu Angewandte Informatik - Internet Computing</td>
<td>Practice</td>
<td>1 SWS</td>
<td>Online</td>
<td>Sunyaev, Teigeler, Beyene</td>
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Exams

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<tbody>
<tr>
<td>ST 2021</td>
<td>7900025</td>
<td>Applied Informatics - Internet Computing (Registration until 12 July 2021)</td>
<td>Sunyaev</td>
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<td>WT 21/22</td>
<td>7900004</td>
<td>Applied Informatics – Principles of Internet Computing: Foundations for Emerging Technologies and Future Services</td>
<td>Sunyaev</td>
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Legend: 📚 Online, 🧩 Blended (On-Site/Online), ⚠ On-Site, ✗ Cancelled

Competence Certificate
The assessment consists of a written exam (60 min) according to Section 4(2), 1 of the examination regulation. The successful completion of the exercises is recommended for the written exam, which is offered at the end of the winter semester and at the end of the summer semester.

By successful processing the exercises a bonus can be obtained. If the grade of the written exam is at least 4.0 and at most 1.3, the bonus will improve it by one grade level (i.e. by 0.3 or 0.4).

Prerequisites
None

Annotation
Replaces from winter semester 2019/2020 T-WIWI-109445 "Applied Informatics - Internet Computing".

Below you will find excerpts from events related to this course:
Content
The lecture Applied Computer Science II provides insights into fundamental concepts and future technologies of distributed systems and Internet computing. Students should be able to select, design and apply the presented concepts and technologies. The course first introduces basic concepts of distributed systems (e.g. design of architectures for distributed systems, internet architectures, web services, middleware).

In the second part of the course, emerging technologies of Internet computing will be examined in depth. These include, among others:

- Cloud Computing
- Edge & Fog Computing
- Internet of Things
- Blockchain
- Artificial Intelligence

Learning objectives:
The student learns about basic concepts and emerging technologies of distributed systems and internet computing. Practical topics will be deepened in lab classes.

Recommendations:
Knowledge of content of the module [WI1INFO].

Workload:
The total workload for this course is approximately 135-150 hours.

Literature
Wird in der Vorlesung bekannt gegeben
### 3.22 Course: Applied Information Theory [T-ETIT-100748]

**Responsible:** Dr.-Ing. Holger Jäkel  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-100444 - Applied Information Theory

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<td>3 SWS</td>
<td>Applied Information Theory</td>
<td>Jäkel</td>
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<td>WT 21/22 2310539</td>
<td>1 SWS</td>
<td>Tutorial for 2310537 Applied Information Theory</td>
<td>Jäkel</td>
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**Prerequisites**  
none
### 3.23 Course: Aspects of Geometric Analysis [T-MATH-106461]

**Responsible:** Prof. Dr. Tobias Lamm  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103251 - Aspects of Geometric Analysis

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#### Events

| ST 2021 | 0176600 | AG Geometrische Analysis | 2 SWS | Seminar / 🖥 | Lamm |

Legend: 🖥 Online, 🌋 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

**Prerequisites**
Keine
3.24 Course: Aspects of Time Integration [T-MATH-105904]

**Responsible:** Prof. Dr. Marlis Hochbruck  
Prof. Dr. Tobias Jahnke  
Prof. Dr. Katharina Schratz

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102934 - Aspects of Time Integration

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Mathematics Master 2016 (Master of Science (M.Sc.))  
Module Handbook as of 21/09/2021
# 3.25 Course: Asset Pricing [T-WIWI-102647]

**Responsible:** Prof. Dr. Martin Ruckes  
Prof. Dr. Marliese Uhrig-Homburg  

**Organisation:** KIT Department of Economics and Management  

**Part of:**  
- M-WIWI-101480 - Finance 3  
- M-WIWI-101482 - Finance 1  
- M-WIWI-101483 - Finance 2  
- M-WIWI-101502 - Economic Theory and its Application in Finance

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**Events**

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<td>2 SWS</td>
<td>Uhrig-Homburg</td>
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<td>ST 2021</td>
<td>2530556</td>
<td>Übung zu Asset Pricing</td>
<td>1 SWS</td>
<td>Uhrig-Homburg, Reichenbacher</td>
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**Exams**

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<td>WT 21/22</td>
<td>7900056</td>
<td>Asset Pricing</td>
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<td>Uhrig-Homburg</td>
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**Competence Certificate**  
Depending on further pandemic developments, the examination will be offered either as a 60-minute written examination (written examination according to SPO § 4 Abs. 2, Pkt. 1) or as an open-book examination (alternative exam assessment according to SPO § 4 Abs. 2, Pkt. 3).

**Prerequisites**  
None

**Recommendation**  
We strongly recommend knowledge of the basic topics in investments (bachelor course), which will be necessary to be able to follow the course.

---

**Below you will find excerpts from events related to this course:**

### Asset Pricing  
2530555, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Organizational issues**  

**Literature**

**Basisliteratur**


**Zur Wiederholung/Vertiefung**

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<td>Grade to a third</td>
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**Responsible:** Prof. Dr. Jörn Müller-Quade

**Organisation:** KIT Department of Informatics

**Part of:** M-INFO-100723 - Asymmetric Encryption Schemes
3.27 Course: Asymptotic Stochastics [T-MATH-105866]

**Responsible:** Prof. Dr. Vicky Fasen-Hartmann  
Prof. Dr. Norbert Henze  
PD Dr. Bernhard Klar

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102902 - Asymptotic Stochastics

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<tr>
<td>WT 21/22</td>
<td>0118000</td>
<td>Asymptotic Stochastics</td>
<td>4</td>
<td>Lecture</td>
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<td>WT 21/22</td>
<td>0118100</td>
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<td>2</td>
<td>Practice</td>
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**Prerequisites**

none
3.28 Course: Auction Theory [T-WIWI-102613]

**Responsible:** Prof. Dr. Karl-Martin Ehrhart  
**Organisation:** KIT Department of Economics and Management  
**Part of:**  
M-WIWI-101500 - Microeconomic Theory  
M-WIWI-102970 - Decision and Game Theory

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<td>2520408</td>
<td>Auktionstheorie</td>
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<td>Lecture</td>
<td>Ehrhart</td>
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<td>WT 21/22</td>
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<td>Übungen zu Auktionstheorie</td>
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**Exams**

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**Competence Certificate**

The assessment of this course is a written examination (following §4(2), 1 SPO) of 60 mins. The exam is offered each semester.

**Prerequisites**

None

Below you will find excerpts from events related to this course:

**Auktionstheorie**

2520408, WS 21/22, 2 SWS, [Open in study portal](#)

**Literature**

- Ehrhart, K.-M. und S. Seifert: Auktionstheorie, Skript zur Vorlesung, KIT, 2011
- Ausubel, L.M. und P. Cramton: Demand Reduction and Inefficiency in Multi-Unit Auctions, University of Maryland, 1999
3.29 Course: Banach Algebras [T-MATH-105886]

**Responsible:** PD Dr. Gerd Herzog  
Dr. Christoph Schmoeger

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102913 - Banach Algebras

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**Prerequisites**  
none
3.30 Course: Batteries and Fuel Cells [T-ETIT-100983]

Responsible: Dr.-Ing. Andre Weber
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-ETIT-100532 - Batteries and Fuel Cells

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Events

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<td>WT 21/22</td>
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<td>Batteries and Fuel Cells</td>
<td>2 SWS</td>
<td>Lecture</td>
<td>Krewer</td>
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<td>WT 21/22</td>
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<td>Batteries and Fuel Cells (Exercise to 2304207)</td>
<td>1 SWS</td>
<td>Practice</td>
<td>Krewer, Mitarbeiter*innen</td>
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Prerequisites
none

Below you will find excerpts from events related to this course:

Batteries and Fuel Cells
2304207, WS 21/22, 2 SWS, Language: German, Open in study portal

Lecture (V)

Content
The lecture provides a practical insight into the current application areas and research topics of fuel cells and batteries. It deals with the design and functionality of electrochemical energy conversion and storage devices and provides knowledge about materials, cell designs, measurement methods, data analysis and modelling. The lecture and most slides are in German.
### 3.31 Course: Bifurcation Theory [T-MATH-106487]

**Responsible:** Dr. Rainer Mandel  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103259 - Bifurcation Theory

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<td>Grade to a third</td>
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**Prerequisites**  
None
3.32 Course: Blockchains & Cryptofinance [T-WIWI-108880]

**Responsible:**
- Dr. Philipp Schuster
- Prof. Dr. Marliese Uhlig-Homburg

**Organisation:**
KIT Department of Economics and Management

**Part of:**
- M-WIWI-101480 - Finance 3
- M-WIWI-101483 - Finance 2

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**Exams**

| ST 2021  | 7900260 | Blockchains & Cryptofinance (second attempt only) | Uhrig-Homburg |

**Competence Certificate**
The examination is offered for the last time in winter semester 20/21 for first-time writers and then again for second attempts. The assessment consists of a written exam (75 min).
A bonus can be acquired through successful participation in the practice. If the grade of the written examination is between 4.0 and 1.3, the bonus improves the grade by up to one grade level (0.3 or 0.4). Details will be announced in the lecture.
Depending on further pandemic developments, the examination will be offered as an open-book examination (alternative exam assessment according to SPO § 4 Abs. 2, Pkt. 3).

**Prerequisites**
None

**Recommendation**
None

**Annotation**
The lecture is currently not offered.
3 COURSES

3.33 Course: Bond Markets [T-WIWI-110995]

- **Responsible:** Prof. Dr. Marliese Uhrig-Homburg
- **Organisation:** KIT Department of Economics and Management
- **Part of:**
  - M-WIWI-101480 - Finance 3
  - M-WIWI-101483 - Finance 2

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**Events**

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<td>Bond Markets</td>
<td>3 SWS</td>
<td>Lecture / Practice (VÜ) Uhrig-Homburg, Mitarbeiter</td>
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**Exams**

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<td>7900280</td>
<td>Bond Markets</td>
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<td>Uhrig-Homburg</td>
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**Competence Certificate**

The assessment consists of a written exam (75min.) A bonus can be earned through successful participation in the tutorial sessions.

If the grade of the written examination is between 4.0 and 1.3, the bonus improves the grade by up to one level (0.3 or 0.4). The examination is offered in each semester and can be repeated at any regular examination date.

Depending on further pandemic developments, the examination will be offered as an open-book examination (alternative exam assessment according to SPO § 4 Abs. 2, Pkt. 3).

**Annotation**

This course will be held in English.

Below you will find excerpts from events related to this course:

**V** Bond Markets

2530560, WS 21/22, 3 SWS, Language: English, Open in study portal

**Content**

The lecture “Bond Markets” deals with the national and international bond markets, which are an important source of financing for companies, as well as for the public sector. After an overview of the most important bond markets, different yield definitions are discussed. Based on this, the concept of the yield curve is presented. In addition, the theoretical and empirical relationships between ratings, default probabilities and spreads are analyzed. The focus will then be on questions regarding the valuation, measurement, management and control of credit risks.

The total workload for this course is approximately 135 hours (4.5 credits).

The assessment consists of a written exam (75min.) (according to §4(2), 1 SPO). A bonus can be earned through successful participation in the tutorial sessions. If the grade of the written examination is between 4.0 and 1.3, the bonus improves the grade by up to one level (0.3 or 0.4). The examination is offered in each semester and can be repeated at any regular examination date.

Students deepen their knowledge of national and international bond markets. They gain knowledge of the traded instruments and their key figures for describing default risk such as ratings, default probabilities or credit spreads.

**Organizational issues**

Blockveranstaltung: Do 14:00-19:00 Uhr, Fr 9:45-17:15 Uhr
21./22.10., 04./05.11., 18./19.11.
3.34 Course: Bond Markets - Models & Derivatives [T-WIWI-110997]

**Responsible:** Prof. Dr. Marliese Uhrig-Homburg

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101480 - Finance 3
- M-WIWI-101483 - Finance 2

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**Events**

| WT 21/22 | 2530565 | Bond Markets - Models & Derivatives | 2 SWS | Lecture / Practice (VÜ) | Grauer, Uhrig-Homburg |

**Competence Certificate**
The assessment of success consists in equal parts of a written thesis and an oral exam including a discussion of one's own work. The main examination is offered once a year, re-examinations every semester.

**Recommendation**
Knowledge of "Bond Markets" and "Derivatives" courses is very helpful.

**Annotation**
This course will be held in English.

Below you will find excerpts from events related to this course:

**Content**

- **Competence Certificate:** The assessment of success consists in equal parts of a written thesis and an oral exam (according to §4(2), 3 SPO) including a discussion of one's own work. The main examination is offered once a year, re-examinations every semester.

- **Competence Goal:** Students deepen their knowledge of national and international bond markets. They are able to apply the knowledge they have gained about traded instruments and common valuation models for pricing derivative financial instruments.

- **Prerequisites:**

- **Content:** The lecture "Bond Markets – Models & Derivatives" deepens the content of the lecture "Bond Markets". The modelling of the dynamics of yield curves and the management of credit risks forms the theoretical foundation for the valuation of interest rate and credit derivatives to be discussed. In this course, students deal intensively with selected topics and acquire the relevant knowledge on their own.

- **Recommendation:** Knowledge of "Bond Markets" and "Derivatives" courses is very helpful.

- **Workload:** The total workload for this course is approximately 90 hours (3.0 credits).

**Organizational issues**
Blockveranstaltung, Kickoff am 03.12.21, Präsentation am 11.02.22
Competence Certificate
The assessment consists of an empirical case study with written elaboration and presentation. The main examination is offered once a year, re-examinations every semester.

Recommendation
Knowledge of the "Bond Markets" course is very helpful.

Annotation
This course will be held in English.

Below you will find excerpts from events related to this course:

Content
- Competence Certificate: The assessment consists of an empirical case study with written elaboration and presentation (according to §4(2), 3 SPO). The main examination is offered once a year, re-examinations every semester.
- Competence Goal: The students apply various methods in practice within the framework of a project-related case study. They are able to deal with empirical data and analyze them in a targeted manner.
- Content: The course "Bond Markets – Tools & Applications" includes a hands-on project in the field of national and international bond markets. Using empirical datasets, the students have to apply practical methods in order to analyze the data in a targeted manner.
- Recommendation: Knowledge of the "Bond Markets" course is very helpful.
- Workload: The total workload for this course is approximately 45 hours (1.5 credits).

Organizational issues
Blockveranstaltung, Kickoff am 21./22.10.21 in der Blockveranstaltung Bond Markets (Ort tba), Präsentation am 03.12.21 Seminarraum 320 Geb. 09.21
3.36 Course: Bott Periodicity [T-MATH-108905]

**Responsible:** Prof. Dr. Wilderich Tuschmann

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-104349 - Bott Periodicity

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**Prerequisites**

none
3.37 Course: Boundary and Eigenvalue Problems [T-MATH-105833]

**Responsible:**
- Prof. Dr. Dorothee Frey
- Prof. Dr. Dirk Hundertmark
- Prof. Dr. Tobias Lamm
- Prof. Dr. Michael Plum
- Prof. Dr. Wolfgang Reichel
- Prof. Dr. Roland Schnaubelt

**Organisation:**
- KIT Department of Mathematics

**Part of:**
- M-MATH-102871 - Boundary and Eigenvalue Problems

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**Exams**

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<th>Plum, Reichel, Liao</th>
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Legend: 📱 Online, 🗼 Blended (On-Site/Online), 🗼 On-Site, ✗ Cancelled
### 3.38 Course: Boundary Element Methods [T-MATH-109851]

**Responsible:** PD Dr. Tilo Arens  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103540 - Boundary Element Methods

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**Prerequisites**

none
**Course: Boundary Value Problems for Nonlinear Differential Equations**

**[T-MATH-105847]**

**Responsible:** Prof. Dr. Michael Plum  
Prof. Dr. Wolfgang Reichel

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102876 - Boundary value problems for nonlinear differential equations

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Mathematics Master 2016 (Master of Science (M.Sc.))
Module Handbook as of 21/09/2021
3.40 Course: Brownian Motion [T-MATH-105868]

**Responsible:** Prof. Dr. Nicole Bäuerle
Prof. Dr. Vicky Fasen-Hartmann
Prof. Dr. Günter Last

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102904 - Brownian Motion

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Prerequisites

none
# 3.41 Course: Business Process Modelling [T-WIWI-102697]

**Responsible:** Prof. Dr. Andreas Oberweis  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101472 - Informatics

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## Events

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<td>Each winter term</td>
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## Exams

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<td>Each winter term</td>
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Legends: 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ☠ Cancelled

## Competence Certificate

The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation in the first week after lecture period.

## Prerequisites

None

## Below you will find excerpts from events related to this course:

### Business Process Modelling

**2511210, WS 21/22, 2 SWS, Language: German, Open in study portal**

**Lecture (V)**

**Content**

The proper modeling of relevant aspects of business processes is essential for an efficient and effective design and implementation of processes. This lecture presents different classes of modeling languages and discusses the respective advantages and disadvantages of using actual application scenarios. For that simulative and analytical methods for process analysis are introduced. In the accompanying exercise the use of process modeling tools is practiced.

**Learning objectives:**

Students

- describe goals of business process modeling and apply different modeling languages,
- choose the appropriate modeling language according to a given context,
- use suitable tools for modeling business processes,
- apply methods for analysing and assessing process models to evaluate specific quality characteristics of the process model.

**Recommendations:**

Knowledge of course Applied Informatics I - Modelling is expected.

**Workload:**

- Lecture 30h
- Exercise 15h
- Preparation of lecture 24h
- Preparation of exercises 25h
- Exam preparation 40h
- Exam 1h
Literature


Weitere Literatur wird in der Vorlesung bekannt gegeben.
### 3.42 Course: Business Strategies of Banks [T-WIWI-102626]

- **Responsible:** Prof. Dr. Wolfgang Müller
- **Organisation:** KIT Department of Economics and Management
- **Part of:**
  - M-WIWI-101480 - Finance 3
  - M-WIWI-101483 - Finance 2

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#### Exams

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<td>WT 21/22</td>
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<td>Müller, Ruckes</td>
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#### Literature

Weiterführende Literatur:

- Ein Skript wird im Verlauf der Veranstaltung kapitelweise ausgeteilt.
- Hartmann-Wendels, Thomas; Pfingsten, Andreas; Weber, Martin; 2014, Bankbetriebslehre, 6. Auflage, Springer

#### Organizational issues

Die Veranstaltung findet nur statt, wenn sie in Präsenz stattfinden kann.

Termine und Räume laut Ankündigung am Institut.

#### Literature

Weiterführende Literatur:

- Ein Skript wird im Verlauf der Veranstaltung kapitelweise ausgeteilt.
- Hartmann-Wendels, Thomas; Pfingsten, Andreas; Weber, Martin; 2014, Bankbetriebslehre, 6. Auflage, Springer
3.43 Course: CAT(0) Cubical Complexes [T-MATH-106118]

- **Responsible:** Prof. Dr. Petra Schwer
- **Organisation:** KIT Department of Mathematics
- **Part of:** M-MATH-103083 - CAT(0) cubical complexes

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### Course: Classical Methods for Partial Differential Equations [T-MATH-105832]

**Responsible:** Prof. Dr. Dorothee Frey  
Prof. Dr. Dirk Hundertmark  
Prof. Dr. Tobias Lamm  
Prof. Dr. Michael Plum  
Prof. Dr. Wolfgang Reichel  
Prof. Dr. Roland Schnaubelt  

**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102870 – Classical Methods for Partial Differential Equations

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3.45 Course: Combinatorics [T-MATH-105916]

**Responsible:** Prof. Dr. Maria Aksenovich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102950 - Combinatorics

**Type:** Written examination  
**Credits:** 8  
**Grading scale:** Grade to a third  
**Recurrence:** Irregular  
**Version:** 1

**Prerequisites**
none
3.46 Course: Communication Engineering I [T-ETIT-101936]

**Responsible:** Prof. Dr.-Ing. Laurent Schmalen  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-102103 - Communication Engineering I

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<td>Communication Engineering I</td>
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**Prerequisites**

none
3.47 Course: Communications Engineering II [T-ETIT-110697]

**Responsible:** Dr.-Ing. Holger Jäkel
Prof. Dr.-Ing. Laurent Schmalen

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** M-ETIT-105274 - Communications Engineering II

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Legend: 🖥 Online, 🇨Interpolator Blended (On-Site/Online), 📞 On-Site, ❌ Cancelled

**Competence Certificate**
The assessment will be carried out in the form of a written exam of 120 minutes. The module grade is the grade of the written exam.

**Prerequisites**
Knowledge of basic engineering mathematics including integral transformations and probability theory as well as basic knowledge of communications engineering.

**Recommendation**
Previous visit to the lecture “Communications Engineering I”, “Probability Theory” and “Signals and Systems” is recommended.
3.48 Course: Commutative Algebra [T-MATH-108398]

**Responsible:** Prof. Dr. Frank Herrlich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-104053 - Commutative Algebra

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**Prerequisites**
none
### 3.49 Course: Comparison Geometry [T-MATH-105917]

**Responsible:** Prof. Dr. Wilderich Tuschmann  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102940 - Comparison Geometry

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**Prerequisites**

Keine
3.50 Course: Comparison of Numerical Integrators for Nonlinear Dispersive Equations [T-MATH-109040]

**Responsible:** Prof. Dr Katharina Schratz

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-104426 - Comparison of Numerical Integrators for Nonlinear Dispersive Equations

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**Prerequisites**
none
3.51 Course: Complex Analysis [T-MATH-105849]

**Responsible:**
PD Dr. Gerd Herzog  
Prof. Dr. Michael Plum  
Prof. Dr. Wolfgang Reichel  
Dr. Christoph Schmoeger  
Prof. Dr. Roland Schnaubelt

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102878 - Complex Analysis

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### 3.52 Course: Compressive Sensing [T-MATH-105894]

- **Responsible:** Prof. Dr. Andreas Rieder
- **Organisation:** KIT Department of Mathematics
- **Part of:** M-MATH-102935 - Compressive Sensing

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Grade to a third

Recurrence
Each winter term

Version
3

Competence Certificate
The assessment consists of a written exam (60 min) (according to §4(2), 1 of the examination regulation). By successful completion of the exercises (§4 (2), 3 SPO 2007 respectively §4 (3) SPO 2015) a bonus can be obtained. If the grade of the written exam is at least 4.0 and at most 1.3, the bonus will improve it by one grade level (i.e. by 0.3 or 0.4). The bonus only applies to the first and second exam of the semester in which it was obtained.

Prerequisites
None

Annotation
The credits have been changed to 5 starting summer term 2016.

Below you will find excerpts from events related to this course:

**Computational Economics**

Examining complex economic problems with classic analytical methods usually requires making numerous simplifying assumptions, for example that agents behave rationally or homogeneously. Recently, widespread availability of computing power gave rise to a new field in economic research that allows the modeling of heterogeneity and forms of bounded rationality: Computational Economics. Within this new discipline, computer based simulation models are used for analyzing complex economic systems. In short, an artificial world is created which captures all relevant aspects of the problem under consideration. Given all exogenous and endogenous factors, the modelled economy evolves over time and different scenarios can be analyzed. Thus, the model can serve as a virtual testbed for hypothesis verification and falsification.

**Learning objectives:**
The student

  - understands the methods of Computational Economics and applies them on practical issues,
  - evaluates agent models considering bounded rational behaviour and learning algorithms,
  - analyses agent models based on mathematical basics,
  - knows the benefits and disadvantages of the different models and how to use them,
  - examines and argues the results of a simulation with adequate statistical methods,
  - is able to support the chosen solutions with arguments and can explain them.
Literature


Weiterführende Literatur:

3.54 Course: Computational Geometry [T-INFO-104429]

**Responsible:** Prof. Dr. Dorothea Wagner  
**Organisation:** KIT Department of Informatics  
**Part of:** M-INFO-102110 - Computational Geometry

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**Events**

| WT 21/22 | 2400083 | Computational Geometry | 4 SWS | Lecture / Practice | Bläsius, Wilhelm |

Legend: ⚡ Online, 💫 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

Below you will find excerpts from events related to this course:

**Computational Geometry**
2400083, WS 21/22, 4 SWS, Language: German, Open in study portal

**Organizational issues**
nur Masterstudiengang Informatik
### 3.55 Course: Computer-Assisted Analytical Methods for Boundary and Eigenvalue Problems [T-MATH-105854]

**Responsible:** Prof. Dr. Michael Plum  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102883 - Computer-Assisted Analytical Methods for Boundary and Eigenvalue Problems

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3.56 Course: Continuous Time Finance [T-MATH-105930]

**Responsible:** Prof. Dr. Nicole Bäuerle
Prof. Dr. Vicky Fasen-Hartmann

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102860 - Continuous Time Finance

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<th>Lecture / 🖥</th>
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**Exams**

| ST 2021 | 7700066 | Continuous Time Finance          | Fasen-Hartmann |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
3.57 Course: Control Theory [T-MATH-105909]

**Responsible:** Prof. Dr. Roland Schnaubelt  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102941 - Control Theory

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**Prerequisites**  
none
3.58 Course: Convex Analysis [T-WIWI-102856]

**Responsible:** Prof. Dr. Oliver Stein  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101473 - Mathematical Programming

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**Events**

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Legend: 🖥️ Online, ☐ Blended (On-Site/Online), 🗽 On-Site, ☒ Cancelled

**Competence Certificate**

The assessment of the lecture is a written examination (60 minutes) according to §4(2), 1 of the examination regulation. The successful completion of the exercises is required for admission to the written exam. The examination is held in the semester of the lecture and in the following semester.

**Prerequisites**

None

**Recommendation**

It is strongly recommended to visit at least one lecture from the Bachelor program of this chair before attending this course.

**Annotation**

The lecture is offered irregularly. The curriculum of the next three years is available online (www.ior.kit.edu).

**Below you will find excerpts from events related to this course:**

**Konvexe Analysis**

2550120, SS 2021, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

Online

**Content**

Convex Analysis deals with properties of convex functions and convex sets, amongst others with respect to the minimization of convex functions over convex sets. That the involved functions are not necessarily assumed to be differentiable allows a number of applications which are not covered by techniques from smooth optimization, e.g. approximation problems with respect to the Manhattan or maximum norms, classification problems or the theory of statistical estimates. The lecture develops along another, geometrically intuitive example, where a nonsmooth obstacle set is to be described by a single smooth convex constraint such that minimal and maximal distances to the obstacle can be computed. The lecture is structured as follows:

- Introduction to entropic smoothing and convexity
- Global error bounds
- Smoothness properties of convex functions
- The convex subdifferential
- Global Lipschitz continuity
- Descent directions and stationarity conditions

**Remark:**

Prior to the attendance of this lecture, it is strongly recommend to acquire basic knowledge on optimization problems in one of the lectures "Global Optimization I and II" and "Nonlinear Optimization I and II".

**Learning objectives:**

The student

- knows and understands the fundamentals of convex analysis,
- is able to choose, design and apply modern techniques of convex analysis in practice.
Literature

### Course: Convex Geometry [T-MATH-105831]

**Responsible:** Prof. Dr. Daniel Hug  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102864 - Convex Geometry

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**Legend:** 📘 Online, 📘 Blended (On-Site/Online), 📘 On-Site, ✗ Cancelled
### Course: Corporate Financial Policy [T-WIWI-102622]

**Responsible:** Prof. Dr. Martin Ruckes

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101480 - Finance 3
- M-WIWI-101483 - Finance 2
- M-WIWI-101502 - Economic Theory and its Application in Finance

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<td>Ruckes, Hoang</td>
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**Exams**

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**Competence Certificate**

The assessment of this course is a written examination (following §4(2), 1 SPO) of 60 mins. The exam is offered each semester.

**Prerequisites**

None

**Below you will find excerpts from events related to this course:**

**Corporate Financial Policy**

2530214, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**Content**

The course develops the foundations for the management and financing of firms in imperfect markets.

The course covers the following topics:

- Measures of good corporate governance
- Corporate finance
- Liquidity management
- Executive compensation and incentives
- Corporate takeovers

**Learning outcomes:** The students

- are able to explain the importance of information asymmetry for the contract design of firms,
- are capable to evaluate measures for the reduction of information asymmetry,
- are in the position to analyze contracts with regard to their incentive and communication effects.
3.61 Course: Corporate Risk Management [T-WIWI-109050]

**Responsible:** Prof. Dr. Martin Ruckes

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101480 - Finance 3
- M-WIWI-101483 - Finance 2
- M-WIWI-101502 - Economic Theory and its Application in Finance

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**Competence Certificate**

The assessment consists of a written exam (60 min.) according to § 4 paragraph 2 Nr. 1 of the examination regulation. The exam is offered each semester. If there are only a small number of participants registered for the exam, we reserve the right to hold an oral examination instead of a written one.

**Prerequisites**

None

**Recommendation**

None

**Annotation**

The course will be held again in the summer term 2023 at the earliest. Please pay attention to the announcements on our website.
3.62 Course: Credit Risk [T-WIWI-102645]

**Responsible:** Prof. Dr. Marliese Uhrig-Homburg

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101480 - Finance 3
- M-WIWI-101483 - Finance 2

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**Competence Certificate**
The examination is offered for first-time writers for the last time in the winter semester 2020/21 and (only) for repeaters in the summer semester 2021.

The assessment consists of a written exam (75 min.) according to § 4 paragraph 2 Nr. 1 of the examination regulation. The examination is offered every semester and can be repeated at every regular examination date. A bonus can be acquired through successful participation in the practice. If the grade of the written examination is between 4.0 and 1.3, the bonus improves the grade by up to one grade level (0.3 or 0.4). Details will be announced in the lecture.

**Prerequisites**
None

**Recommendation**
Knowledge from the course “Derivatives” is very helpful.

**Annotation**
The course will no longer be offered from winter semester 2020/21.
3.63 Course: Critical Information Infrastructures [T-WIWI-109248]

**Responsible:** Prof. Dr. Ali Sunyaev

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101472 - Informatics

<table>
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<td>1 SWS</td>
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**Exams**

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<th>Instructor(s)</th>
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<tr>
<td>ST 2021</td>
<td>7900061</td>
<td>Critical Information Infrastructures</td>
<td>Sunyaev</td>
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<tr>
<td>WT 21/22</td>
<td>7900067</td>
<td>Critical Information Infrastructures</td>
<td>Sunyaev</td>
</tr>
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</table>

**Competence Certificate**

The alternative exam assessment consists of

- the preparation of a written elaboration as well as
- an oral examination as part of a presentation of the work.

Details of the grades will be announced at the beginning of the course.

The examination is only offered to first-time students in the winter semester, but can be repeated in the following summer semester.

**Prerequisites**

None.

**Annotation**


*Below you will find excerpts from events related to this course:*

**Critical Information Infrastructures**

2511400, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)
Content
The course critical information infrastructures (CII) introduces students to the world of complex sociotechnical systems that permeate societies on a global scale. Students will learn to handle the complexities involved in the design, development, operation, and evaluation of critical information infrastructures. In the beginning of the course, critical information infrastructures will be introduced on a general level.

The following sessions will focus on an in-depth exploration of selected cases that represent current challenges in research and practice. Students will work (in a group of 4) on a selected topic and have to write a course paper. Students can choose a topic from a variety of topics. To answer the research questions, students can use literature reviews but also interviews, surveys, programming tasks, and other research methods.

There will be a short introduction to the topics for the course paper in the following topic areas. In addition, it will be possible to propose your own topics as a group in the topic areas:

- Distributed Ledger Technology
- Critical Cloud Services
- Health Information Infrastructures
- Vehicular Fog Computing
- Information Privacy
- Trustworthy Artificial Intelligence

Since we offer topics in this course that also correspond to the research interests in our research group, there may be the opportunity to work on the topics in more depth in the course of a final thesis.

Learning objectives:
Students know concepts and technologies relevant for the design and reliable operation of critical information infrastructures and can leverage them to develop solutions for real-world challenges.

Notes:
The number of participants is limited to 24 students. Please register via the WiWi portal: https://portal.wiwi.kit.edu/ys/5035

The registration will be opened from August 17, 2021 until October 1, 2021.

Please make sure that you are available at the following dates if you want to take the course:

- 21.10.2021, Noon–01:30 pm: 1. Introduction & Topic Area Presentations
- 04.11.2021, Noon–01:30 pm: 3. Critical Information Infrastructure Landscape
- 11.11.2021, Noon–01:30 pm: 4. Research on Information Systems & Group Assignment
- 10.12.2021, 10:00 am–06:00 pm: Interim Presentation (estimated)
- 28.01.2022, 10:00 am–06:00 pm: Final Presentation (estimated)

Further information on the course structure will be announced in the first session. Depending on the number of participants the individual sessions can have a shorter duration.

The meetings will take place online via MS Teams, as currently planned. We will provide a link to join the team if your registration was approved. Interim and final presentation may take a hybrid or real-life form.

If you have any questions regarding course registration, please contact lins@kit.edu or dehling@kit.edu
3.64 Course: Database Systems and XML [T-WIWI-102661]

Responsible:  Prof. Dr. Andreas Oberweis
Organisation:  KIT Department of Economics and Management
Part of:  M-WIWI-101472 - Informatics

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Exams

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</table>

Competence Certificate

The assessment consists of a written exam (60 minutes) (following §4(2) of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date. Depending on the respective pandemic situation, the exam may be offered as an open book exam (alternative exam assessment, following §4(2), 3 of the examination regulation).

Prerequisites

None

Below you will find excerpts from events related to this course:

Database Systems and XML

2511202, WS 21/22, 2 SWS, Language: German, Open in study portal

Lecture (V)

Content

Databases are a proven technology for managing large amounts of data. The oldest database model, the hierarchical model, was replaced by different models such as the relational or the object-oriented data model. The hierarchical model became particularly more important with the emergence of the extensible Markup Language XML. XML is a data format for structured, semi-structured, and unstructured data. In order to store XML documents consistently and reliably, databases or extensions of existing data base systems are required. Among other things, this lecture covers the data model of XML, concepts of XML query languages, aspects of storage of XML documents, and XML-oriented database systems.

Learning objectives:

Students

- know the basics of XML and generate XML documents,
- are able to use XML database systems and to formulate queries to XML documents,
- know to assess the use of XML in operational practice in different application contexts.

Workload:

- Lecture 30h
- Exercise 15h
- Preparation of lecture 24h
- Preparation of exercises 25h
- Exam preparation 40h
- Exam 1h
Literature

- W. Kazakos, A. Schmidt, P. Tomchyk: Datenbanken und XML. Springer-Verlag 2002
- G. Vossen: Datenbankmodelle, Datenbanksprachen und Datenbankmanagementsysteme. Oldenbourg 2008

Weitere Literatur wird in der Vorlesung bekannt gegeben.
3.65 Course: Derivatives [T-WIWI-102643]

**Responsible:** Prof. Dr. Marliese Uhrig-Homburg

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101480 - Finance 3
- M-WIWI-101482 - Finance 1
- M-WIWI-101483 - Finance 2

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<td>Übung zu Derivate</td>
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<td>Practice</td>
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**Exams**

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Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗽 On-Site, ✗ Cancelled

**Competence Certificate**
Depending on further pandemic developments, the examination will be offered either as a 60-minute written examination (written examination according to SPO § 4 Abs. 2, Pkt. 1) or as an open-book examination (alternative exam assessment according to SPO § 4 Abs. 2, Pkt. 3).

**Prerequisites**
None

**Recommendation**
None

*Below you will find excerpts from events related to this course:*

**Derivatives**

2530550, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Organizational issues**

*Veranstaltungskonzept umfasst vollständige Aufzeichnungen von Vorlesung und Übung. Ergänzend bieten wir zweiwöchig freiwillige Live-Fragerunden zum fachlichen und organisatorischen Austausch an.*

**Literature**


**Weiterführende Literatur:**

3.66 Course: Designtheory with Applications in Statistics [T-MATH-106122]

**Responsible:** Dr. rer. nat. Bruno Ebner
Dr. Martin Folkers

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-103087 - Designtheory with Applications in Statistics

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<td>Grade to a third</td>
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# 3.67 Course: Differential Geometry [T-MATH-102275]

**Responsible:** Dr. Sebastian Grensing  
Prof. Dr. Enrico Leuzinger  
Prof. Dr. Wilderich Tuschmann

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-101317 - Differential Geometry

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<td>Lecture</td>
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<td>Tutorial for 0100300 (Differential Geometry)</td>
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**Exams**

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Legend: 💻 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
3.68 Course: Digital Health [T-WIWI-109246]

**Responsible:** Prof. Dr. Ali Sunyaev  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101472 - Informatics

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<td>WT 21/22</td>
<td>7900068</td>
<td>Digital Health</td>
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**Competence Certificate**
Alternative exam assessment (written elaboration, presentation, peer review, oral participation) according to §4(2),3 of the examination regulation. Details of the grading will be announced at the beginning of the course. The examination is only offered to first-time writers in the winter semester, but can be repeated in the following summer semester.

**Prerequisites**
None.

*Below you will find excerpts from events related to this course:*

**Digital Health**

2511402, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)
Content
The master course Digital Health introduces master students to the subject of digitization in health care. Students will learn about the theoretical foundations and practical implications of various topics surrounding the digitization in health care, including health information systems, telematics, big health care data, and patient-centered health care.

After an introduction to the challenge of digitization in health care, the following sessions will focus on an in-depth exploration of selected cases that represent current challenges in research and practice. Students will work (in a group of 3-4) on a selected topic and have to write a course paper. Students can choose a topic from a variety of topics. To answer the research questions, students can use literature reviews but also interviews, surveys, programming tasks, and other research methods are possible.

There will be a short introduction to the topics for the course paper in the following topic areas. In addition, it will be possible to propose your own topics as a group in the topic areas:

- Mobile Health (mHealth) / Gamification
- Distributed Ledger Technology / Blockchain
- Artificial Intelligence / Machine Learning
- Genomics / Biomedical Data

Since we offer topics in this course that also correspond to the research interests in our research group, there may be the opportunity to work on the topics in more depth in the course of a final thesis.

Learning objectives:
Students know about the challenges of digitization in health care and can leverage relevant concepts and technologies to address these challenges. Students learn to work in teams and critically discuss digital health topics with fellow students, researchers, and practitioners.

Notes:
The number of participants is limited to 30 students. Please register here. The registration will be opened from September 7, 2021 until October 12, 2021.

Please make sure that you are available at the following dates if you want to take the course:

- 21.10.2021, 16:00–17:30 - 1. Introduction to Digital Health
- 28.10.2021, 16:00–17:30 - 2. Topic Area Presentation #1
- 04.11.2021, 16:00–17:30 - 3. Topic Area Presentation #2
- 11.11.2021, 16:00–17:30 - 4. Guest Lecture
- 10.02.2022, 10:00–17:00 - Final Presentation

Further information on the course structure will be announced in the first session. Depending on the number of participants the individual sessions can have a shorter duration.

The meetings will take place online via MS Teams. We will provide a link to join the team if your registration was approved.

If you have any questions regarding course registration, please contact scott.thiebes@kit.edu or manuel.schmidt-kraepelin@kit.edu
### 3.69 Course: Digital Signatures [T-INFO-101280]

**Responsible:** Prof. Dr. Dennis Hofheinz  
**Organisation:** KIT Department of Informatics  
**Part of:** M-INFO-100743 - Digital Signatures

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### 3.70 Course: Digital Technology [T-ETIT-101918]

**Responsible:** Prof. Dr.-Ing. Jürgen Becker  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-102102 - Digital Technology

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**Exams**

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**Legend:** 🖥 Online, 🚩 Blended (On-Site/Online), 🗣 On-Site, ☠️ Cancelled

**Prerequisites**

none
3.71 Course: Discrete Dynamical Systems [T-MATH-110952]

**Responsible:** PD Dr. Gerd Herzog

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105432 - Discrete Dynamical Systems

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**Prerequisites**
none
### 3.72 Course: Discrete Time Finance [T-MATH-105839]

**Responsible:** Prof. Dr. Nicole Bäuerle  
Prof. Dr. Vicky Fasen-Hartmann

**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102919 - Discrete Time Finance

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**Exams**

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**Prerequisites**

none
### 3.73 Course: Discrete-Event Simulation in Production and Logistics [T-WIWI-102718]

**Responsible:** Prof. Dr. Stefan Nickel  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-102832 - Operations Research in Supply Chain Management

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<th>3 SWS</th>
<th>Lecture</th>
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**Exams**

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<th>Spieckermann</th>
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**Legend:** Online, Blended (On-Site/Online), On-Site, Cancelled

### Competence Certificate

The assessment consists of a written paper and an oral exam of about 30-40 min (alternative exam assessment).

### Prerequisites

None

### Recommendation

Basic knowledge as conveyed in the module "Introduction to Operations Research" is assumed.

### Annotation

Due to capacity restrictions, registration before course start is required. For further information see the webpage of the course.

The course is planned to be held every summer term.

The planned lectures and courses for the next three years are announced online.

---

**Below you will find excerpts from events related to this course:**

### Ereignisdiskrete Simulation in Produktion und Logistik

**2550488, SS 2021, 3 SWS, Language: German, Open in study portal**

**Lecture (V) Online**

### Content

Simulation of production and logistics systems is an interdisciplinary subject connecting expert knowledge from production management and operations research with mathematics/statistics as well as computer science and software engineering. With completion of this course, students know statistical foundations of discrete simulation, are able to classify and apply related software applications, and know the relation between simulation and optimization as well as a number of application examples. Furthermore, students are enabled to structure simulation studies and are aware of specific project scheduling issues.

### Literature

3.74 Course: Dispersive Equations [T-MATH-109001]

**Responsible:** Prof. Dr. Wolfgang Reichel

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-104425 - Dispersive Equations

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**Prerequisites**

none
3.75 Course: Distributed Discrete Event Systems [T-ETIT-100960]

**Responsible:** Prof. Dr.-Ing. Michael Heizmann

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** M-ETIT-100361 - Distributed Discrete Event Systems

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<td>Lecture / 📱</td>
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**Legend:** 📱 Online, 🗺️ Blended (On-Site/Online), 🖇 On-Site, ✗ Cancelled

**Prerequisites**

none
3.76 Course: Dynamic Macroeconomics [T-WIWI-109194]

**Responsible:** Prof. Dr. Johannes Brumm

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101496 - Growth and Agglomeration

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Legend: 📱 Online, 🎤 Blended (On-Site/Online), 📝 On-Site, ✗ Cancelled

**Competence Certificate**

The assessment consists of a oral exam (30 min.).

**Prerequisites**

None.

*Below you will find excerpts from events related to this course:*

**V** Dynamic Macroeconomics

2560402, WS 21/22, 2 SWS, Language: English, Open in study portal

**Literature**

Literatur und Skripte werden in der Veranstaltung angegeben.
# 3.77 Course: Dynamical Systems [T-MATH-106114]

**Responsible:** Prof. Dr. Jens Rottmann-Matthes  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103080 - Dynamical Systems

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**Prerequisites**
none
3.78 Course: Efficient Energy Systems and Electric Mobility [T-WIWI-102793]

**Responsible:** PD Dr. Patrick Jochem

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101452 - Energy Economics and Technology

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**Events**

| ST 2021 | 2581006 | Efficient Energy Systems and Electric Mobility | 2 SWS | Lecture / Online | Jochem |

**Exams**

| ST 2021 | 7981006 | Efficient Energy Systems and Electric Mobility | Fichtner |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ CANCELLED

**Competence Certificate**
The assessment consists of a written exam (60 minutes) (following §4(2) of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date. Depending on the respective pandemic situation, the exam may be offered as an open book exam (alternative exam assessment, following §4(2), 3 of the examination regulation).

**Prerequisites**
None

**Recommendation**
None

Below you will find excerpts from events related to this course:

---

**Efficient Energy Systems and Electric Mobility**

Lecture (V) Online

**Content**

This lecture series combines two of the most central topics in the field of energy economics at present, namely energy efficiency and electric mobility. The objective of the lecture is to provide an introduction and overview to these two subject areas, including theoretical as well as practical aspects, such as the technologies, political framework conditions and broader implications of these for national and international energy systems.

- Understand the concept of energy efficiency as applied to specific systems
- Obtain an overview of the current trends in energy efficiency
- Be able to determine and evaluate alternative methods of energy efficiency improvement
- Overview of technical and economical stylized facts on electric mobility
- Judging economical, ecological and social impacts through electric mobility

**Organizational issues**

Freitag 09:45-11:15 Uhr

**Literature**

Wird in der Vorlesung bekanntgegeben.
3.79 Course: eFinance: Information Systems for Securities Trading [T-WIWI-110797]

**Responsible:** Prof. Dr. Christof Weinhardt

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101480 - Finance 3
- M-WIWI-101483 - Finance 2

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<th>Weinhardt, Notheisen</th>
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<td>1 SWS</td>
<td>Practice</td>
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**Competence Certificate**

Success is monitored by means of ongoing elaborations and presentations of tasks and an examination (60 minutes) at the end of the lecture period. The scoring scheme for the overall evaluation will be announced at the beginning of the course.

**Annotation**

The course "eFinance: Information Systems for Securities Trading" covers different actors and their function in the securities industry in-depth, highlighting key trends in modern financial markets, such as Distributed Ledger Technology, Sustainable Finance, and Artificial Intelligence. Security prices evolve through a large number of bilateral trades, performed by market participants that have specific, well-regulated and institutionalized roles. Market microstructure is the subfield of financial economics that studies the price formation process. This process is significantly impacted by regulation and driven by technological innovation. Using the lens of theoretical economic models, this course reviews insights concerning the strategic trading behaviour of individual market participants, and models are brought market data. Analytical tools and empirical methods of market microstructure help to understand many puzzling phenomena in securities markets.

**Below you will find excerpts from events related to this course:**

**Literature**


**Weiterführende Literatur:**

3.80 Course: Eigenvalue Problems in Complicated Domains [T-MATH-106497]

**Responsible:** Dr. Andrii Khrabustovskyi

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-103262 - Eigenvalue Problems in Complicated Domains

**Type**
- Oral examination

**Credits** 4

**Grading scale**
- Grade to a third

**Recurrence**
- Once

**Version** 1

**Prerequisites**
- Keine
### Course: Electromagnetics and Numerical Calculation of Fields [T-ETIT-100640]

**Responsible:** Prof. Dr.-Ing. Thomas Zwick  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-100386 - Electromagnetics and Numerical Calculation of Fields

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**Competence Certificate**  
Success control is carried out in the form of a written test of 120 minutes.

**Prerequisites**  
none

**Recommendation**  
Fundamentals of electromagnetic field theory.
### 3.82 Course: Emerging Trends in Digital Health [T-WIWI-110144]

**Responsible:** Prof. Dr. Ali Sunyaev  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101472 - Informatics

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**Legend:** 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ⌚ Cancelled

**Competence Certificate**  
The alternative exam assessment consists of a final thesis.

**Prerequisites**  
None.

**Annotation**  
The course is usually held as a block course.
### 3.83 Course: Emerging Trends in Internet Technologies [T-WIWI-110143]

**Responsible:** Prof. Dr. Ali Sunyaev  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101472 - Informatics

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**Exams**

| ST 2021 | 7900128 | Seminar Emerging Trends in Internet Technologies (Master)   |       | Sunyaev     |

Legend: 📲 Online, 🔄 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

The alternative exam assessment consists of a final thesis.

**Prerequisites**

None.

**Annotation**

The course is usually held as a block course.
3.84 Course: Energy and Environment [T-WIWI-102650]

**Responsible:** Ute Karl

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101452 - Energy Economics and Technology

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**Competence Certificate**

The assessment consists of a written exam (60 minutes) (following §4(2) of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date. Depending on the respective pandemic situation, the exam may be offered as an open book exam (alternative exam assessment, following §4(2), 3 of the examination regulation).

**Prerequisites**

None.

**Below you will find excerpts from events related to this course:**

**Energy and Environment**

2581003, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V) Online**

**Content**

The lecture focuses on the environmental impacts arising from fossil fuels use and on the methods for the evaluation of such impacts. The first part of the lecture describes the environmental impacts of air pollutants and greenhouse gases as well as technical measures for emission control. The second part covers methods of impact assessment and their use in environmental communication as well as methods for the scientific support of emission control strategies.

The topics include:

- Fundamentals of energy conversion
- Formation of air pollutants during combustion
- Technical measures to control emissions from fossil-fuel combustion processes
- External effects of energy supply (life cycle analyses of selected energy systems)
- Environmental communication on energy services (e.g. electricity labelling, carbon footprint)
- Integrated Assessment Modelling to support the European Clean Air Strategy
- Cost-effectiveness analyses and cost-benefit analyses for emission control strategies
- Monetary valuation of external effects (external costs)

**Literature**

Die Literaturhinweise sind in den Vorlesungsunterlagen enthalten (vgl. ILIAS)
3.85 Course: Energy Systems Analysis [T-WIWI-102830]

**Responsible:** Dr. Armin Ardone
Prof. Dr. Wolf Fichtner

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101452 - Energy Economics and Technology

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**Exams**

**Competence Certificate**
The assessment consists of a written exam (60 minutes) (following §4(2) of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date. Depending on the respective pandemic situation, the exam may be offered as an open book exam (alternative exam assessment, following §4(2), 3 of the examination regulation).

**Prerequisites**
None

**Recommendation**
None

**Annotation**
Since 2011 the lecture is offered in winter term. Exams can still be taken in summer term.

**Below you will find excerpts from events related to this course:**

**Energy Systems Analysis**
2581002, WS 21/22, 2 SWS, Language: English, [Open in study portal]

**Content**
1. Overview and classification of energy systems modelling approaches
2. Usage of scenario techniques for energy systems analysis
3. Unit commitment of power plants
4. Interdependencies in energy economics
5. Scenario-based decision making in the energy sector
6. Visualisation and GIS techniques for decision support in the energy sector

**Learning goals:**
The student

- has the ability to understand and critically reflect the methods of energy system analysis, the possibilities of its application in the energy industry and the limits and weaknesses of this approach
- can use select methods of the energy system analysis by her-/himself

**Organizational issues**
Bitte Institutsaushang beachten.
Literature
Weiterführende Literatur:

3.86 Course: Evolution Equations [T-MATH-105844]

**Responsible:**  
Prof. Dr. Dorothee Frey  
apl. Prof. Dr. Peer Kunstmann  
Prof. Dr. Roland Schnaubelt  

**Organisation:**  
KIT Department of Mathematics

**Part of:**  
M-MATH-102872 - Evolution Equations

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3.87 Course: Experimental Economics [T-WIWI-102614]

**Responsible:** Prof. Dr. Christof Weinhardt  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-102970 - Decision and Game Theory

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**Competence Certificate**  
The assessment consists of a written exam (60 min) (according to §4(2), 1 of the examination regulations). By successful completion of the exercises (§4 (2), 3 SPO 2007 respectively §4 (3) SPO 2015) a bonus can be obtained. If the grade of the written exam is at least 4.0 and at most 1.3, the bonus will improve it by one grade level (i.e. by 0.3 or 0.4).

**Prerequisites**  
None

**Below you will find excerpts from events related to this course:**

**Experimental Economics**  
2540489, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Literature**

- Strategische Spiele; S. Berninghaus, K.-M. Ehrhart, W. Güth; Springer Verlag, 2. Aufl. 2006.
- Experimental Methods: A Primer for Economists; D. Friedman, S. Sunder; Cambridge University Press, 1994.
Course: Exponential Integrators [T-MATH-107475]

**Responsible:** Prof. Dr. Marlis Hochbruck

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-103700 - Exponential Integrators

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<td>3 SWS</td>
<td>Lecture</td>
<td>Dörich, Leibold</td>
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<td>1 SWS</td>
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<td>Dörich, Leibold</td>
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</table>

**Prerequisites**

none
3.89 Course: Extremal Graph Theory [T-MATH-105931]

**Responsible:** Prof. Dr. Maria Aksenovich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102957 - Extremal Graph Theory

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Mathematics Master 2016 (Master of Science (M.Sc.))
Module Handbook as of 21/09/2021
3.90 Course: Extreme Value Theory [T-MATH-105908]

**Responsible:** Prof. Dr. Vicky Fasen-Hartmann
Prof. Dr. Norbert Henze

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102939 - Extreme Value Theory

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### 3.91 Course: Facility Location and Strategic Supply Chain Management [T-WWI-102704]

**Responsible:** Prof. Dr. Stefan Nickel  
**Organisation:** KIT Department of Economics and Management  
**Part of:**  
- M-WIWI-101413 - Applications of Operations Research  
- M-WIWI-101414 - Methodical Foundations of OR

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#### Events

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#### Exams

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**Legend:** 🖥 Online, 🕭 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

### Competence Certificate

The assessment consists of a written exam (60 min) according to Section 4 (2), 1 of the examination regulation. The exam takes place in every semester. Prerequisite for admission to examination is the successful completion of the online assessments.

### Prerequisites

Prerequisite for admission to examination is the successful completion of the online assessments.

### Recommendation

None

### Annotation

The lecture is held in every winter term. The planned lectures and courses for the next three years are announced online.

Below you will find excerpts from events related to this course:

### Literature

**Weiterführende Literatur:**

- Love, Morris, Wesolowsky: Facilities Location: Models and Methods, North Holland, 1988  
3.92 Course: Financial Analysis [T-WIWI-102900]

**Responsible:** Dr. Torsten Luedecke  
**Organisation:** KIT Department of Economics and Management  
**Part of:**  
- M-WIWI-101480 - Finance 3  
- M-WIWI-101483 - Finance 2

**Events**

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<td>WT 21/22</td>
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</table>

**Competence Certificate**

See German version.

**Prerequisites**

None

**Recommendation**

Basic knowledge in corporate finance, accounting, and valuation is required.

Below you will find excerpts from events related to this course:

**Financial Analysis**  
2530205, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**Literature**

3.93 Course: Financial Intermediation [T-WIWI-102623]

Responsible: Prof. Dr. Martin Ruckes
Organisation: KIT Department of Economics and Management
Part of:
- M-WIWI-101480 - Finance 3
- M-WIWI-101483 - Finance 2
- M-WIWI-101502 - Economic Theory and its Application in Finance

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Events
- WT 21/22 2530232 Financial Intermediation 2 SWS Lecture Ruckes
- WT 21/22 2530233 Übung zu Finanzintermediation 1 SWS Practice Ruckes, Benz

Exams
- ST 2021 7900078 Financial Intermediation Ruckes
- WT 21/22 7900063 Financial Intermediation Ruckes

Competence Certificate
The assessment of this course is a written examination (following §4(2), 1 SPO) of 60 mins.
The exam is offered each semester.

Prerequisites
None

Recommendation
None

Below you will find excerpts from events related to this course:

Financial Intermediation
2530232, WS 21/22, 2 SWS, Language: German, Open in study portal

Literature
Weiterführende Literatur:
### 3.94 Course: Finite Element Methods [T-MATH-105857]

**Responsible:**  Prof. Dr. Willy Dörfler  
Prof. Dr. Marlis Hochbruck  
Prof. Dr Tobias Jahnke  
Prof. Dr. Andreas Rieder  
Prof. Dr. Christian Wieners  

**Organisation:**  KIT Department of Mathematics  

**Part of:**  M-MATH-102891 - Finite Element Methods  

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**Events**

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<td>0110310</td>
<td>Tutorial for 0110300 (Finite Element Methods)</td>
<td>2 SWS</td>
<td>Practice</td>
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## 3.95 Course: Finite Group Schemes [T-MATH-106486]

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<th>Dr. Fabian Januszewski</th>
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Mathematics Master 2016 (Master of Science (M.Sc.))
Module Handbook as of 21/09/2021
3.96 Course: Fixed Income Securities [T-WIWI-102644]

**Responsible:** Prof. Dr. Marliese Uhrig-Homburg

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101480 - Finance 3
- M-WIWI-101483 - Finance 2

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<td>see Annotations</td>
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**Competence Certificate**
The examination is offered for first-time writers for the last time in the winter semester 2020/21 and (only) for repeaters in the summer semester 2021.

The assessment takes place in the form of a written examination (75 minutes) according to §4(2), 1 SPO. The examination takes place during the semester break. The examination is offered every semester and can be repeated at any regular examination date. A bonus can be acquired through successful participation in the exercises. If the grade of the written examination is between 4.0 and 1.3, the bonus improves the grade by up to one grade level (0.3 or 0.4). Details will be announced in the lecture.

**Prerequisites**
None

**Recommendation**
Knowledge from the course "Derivatives" is very helpful.

**Annotation**
The course will no longer be offered from winter semester 2020/21.
### 3.97 Course: Forecasting: Theory and Practice [T-MATH-105928]

**Responsible:** Prof. Dr. Tilmann Gneiting  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102956 - Forecasting: Theory and Practice

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#### Events

| ST 2021 | 0178000 | Forecasting: Theory and Practice II | 2 SWS | Lecture / 🖥 | Gneiting |
| ST 2021 | 0178010 | Tutorial for 0178010 (Forecasting: Theory and Practice II) | 1 SWS | Practice / 🖥 | Gneiting |

#### Exams

| ST 2021 | 7700010 | Forecasting: Theory and Practice | Gneiting |

Legend: 🖥 Online, 📚 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
# 3.98 Course: Formal Systems [T-INFO-101336]

**Responsible:** Prof. Dr. Bernhard Beckert  
**Organisation:** KIT Department of Informatics  
**Part of:** M-INFO-100799 - Formal Systems

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## Events

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## Exams

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<td>Beckert</td>
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<td>Formal Systems</td>
<td>Beckert</td>
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**Responsible:** Prof. Dr. Christian Wieners

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-103527 - Foundations of Continuum Mechanics

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**Prerequisites**

none
3.100 Course: Fourier Analysis [T-MATH-105845]

**Responsible:** Prof. Dr. Roland Schnaubelt

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102873 - Fourier Analysis

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3.101 Course: Fourier Analysis and its Applications to PDEs [T-MATH-109850]

**Responsible:** Jun.-Prof. Dr. Xian Liao  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-104827 - Fourier Analysis and its Applications to PDEs

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**Prerequisites**  
none
3.102 Course: Fractal Geometry [T-MATH-111296]

**Responsible:** PD Dr. Steffen Winter  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-105649 - Fractal Geometry

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**Exams**

| ST 2021 | 7700111 | Fractal Geometry | Winter |

**Prerequisites**  
none
3.103 Course: Functional Analysis [T-MATH-102255]

**Responsible:**
- Prof. Dr. Dorothee Frey
- PD Dr. Gerd Herzog
- Prof. Dr. Dirk Hundertmark
- Prof. Dr. Tobias Lamm
- Prof. Dr. Michael Plum
- Prof. Dr. Wolfgang Reichel
- Dr. Christoph Schmoeger
- Prof. Dr. Roland Schnaubelt

**Organisation:**
KIT Department of Mathematics

**Part of:**
M-MATH-101320 - Functional Analysis

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**Exams**

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**3.104 Course: Functions of Matrices [T-MATH-105906]**

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<tr>
<td><strong>Part of</strong></td>
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**Type**  
Oral examination

**Credits**  
8

**Grading scale**  
Grade to a third

**Version**  
1

**Prerequisites**  
none
3.105 Course: Functions of Operators [T-MATH-105905]

Organisation: KIT Department of Mathematics
Part of: M-MATH-102936 - Functions of Operators

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**3.106 Course: Fuzzy Sets [T-INFO-101376]**

**Responsible:** Prof. Dr.-Ing. Uwe Hanebeck  
**Organisation:** KIT Department of Informatics  
**Part of:** M-INFO-100839 - Fuzzy Sets

<table>
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Legend: 🖥️ Online, 🧩 Blended (On-Site/Online), ⚺ On-Site, ⚹ Cancelled

**Below you will find excerpts from events related to this course:**

**V Fuzzy Sets**  
24611, SS 2021, 3 SWS, Language: German, Open in study portal  

**Content**

In this module, the fundamental theory and practical applications of fuzzy sets are communicated. The course copes with fuzzy arithmetics, fuzzy logic, fuzzy relations, and fuzzy deduction. The representation of fuzzy sets and their properties are the theoretical foundation. Based on this theory, arithmetic and logical operations are axiomatically derived and analyzed. Furthermore, it is shown how arbitrary functions and relations are transferred into fuzzy sets. An application of the logic part of the module, fuzzy deduction, shows different approaches to applying rule-based systems on fuzzy sets. The final part of the curse treats the problem of fuzzy control.

**Literature**

Hilfreiche Quellen werden im Skript und in den Vorlesungsfolien genannt.
### 3.107 Course: Generalized Regression Models [T-MATH-105870]

**Responsible:** Prof. Dr. Norbert Henze  
PD Dr. Bernhard Klar

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102906 - Generalized Regression Models

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Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
3.108 Course: Geometric Analysis [T-MATH-105892]

**Responsible:** Prof. Dr. Tobias Lamm

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102923 - Geometric Analysis

<table>
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<td>Grade to a third</td>
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**Prerequisites**

none
3.109 Course: Geometric Group Theory [T-MATH-105842]

**Responsible:**  
Prof. Dr. Frank Herrlich  
Prof. Dr. Enrico Leuzinger  
Dr. Gabriele Link  
Prof. Dr. Roman Sauer  
Prof. Dr. Wilderich Tuschmann

**Organisation:**  
KIT Department of Mathematics

**Part of:**  
M-MATH-102867 - Geometric Group Theory

<table>
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**Exams**

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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled
### 3.110 Course: Geometric Group Theory II [T-MATH-105875]

| Responsible: | Prof. Dr. Frank Herrlich  
|              | Prof. Dr. Enrico Leuzinger  
|              | Prof. Dr. Roman Sauer  
| Organisation: | KIT Department of Mathematics  
| Part of: | M-MATH-102869 - Geometric Group Theory II  

| Type       | Oral examination  
| Credits    | 8  
| Grading scale | Grade to a third  
| Version    | 1  

Mathematics Master 2016 (Master of Science (M.Sc.))  
Module Handbook as of 21/09/2021
3.111 Course: Geometric Numerical Integration [T-MATH-105919]

**Responsible:** Prof. Dr. Marlis Hochbruck
Prof. Dr Tobias Jahnke

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102921 - Geometric Numerical Integration

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**Prerequisites**

none
### 3.112 Course: Geometry of Schemes [T-MATH-105841]

**Responsible:**  
Prof. Dr. Frank Herrlich  
PD Dr. Stefan Kühnlein

**Organisation:**  
KIT Department of Mathematics

**Part of:**  
M-MATH-102866 - Geometry of Schemes

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<td>Oral examination</td>
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<td>Grade to a third</td>
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</table>
3.113 Course: Global Differential Geometry [T-MATH-105885]

**Responsible:** Dr. Sebastian Grensing  
Prof. Dr. Wilderich Tuschmann

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102912 - Global Differential Geometry

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<td>Grade to a third</td>
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**Prerequisites**

none
**3.114 Course: Global Optimization I [T-WIWI-102726]**

**Responsible:** Prof. Dr. Oliver Stein

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101413 - Applications of Operations Research
- M-WIWI-101414 - Methodical Foundations of OR
- M-WIWI-101473 - Mathematical Programming

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<th>Version</th>
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<td>Each summer term</td>
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**Events**

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<td>German</td>
<td>Stein</td>
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**Exams**

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<th>Language</th>
<th>Location</th>
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<tbody>
<tr>
<td>ST 2021</td>
<td>Global Optimization I</td>
<td></td>
<td>Lecture / Online</td>
<td></td>
<td>Stein</td>
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</table>

**Competence Certificate**

Success is in the form of a written examination (60 min.) (according to § 4(2), 1 SPO). The successful completion of the exercises is required for admission to the written exam.

The exam is offered in the lecture of semester and the following semester.

The success check can be done also with the success control for "Global optimization II". In this case, the duration of the written exam is 120 min.

**Prerequisites**

None

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-WIWI-103638 - Global Optimization I and II must not have been started.

**Recommendation**

None

**Annotation**

Part I and II of the lecture are held consecutively in the same semester.

*Below you will find excerpts from events related to this course:*

**Globale Optimierung I**

<table>
<thead>
<tr>
<th>Event Code</th>
<th>Course</th>
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<td>2550134</td>
<td>Globale Optimierung I</td>
<td>2 SWS</td>
<td>Lecture / Online</td>
<td>German</td>
<td>Online</td>
</tr>
</tbody>
</table>
Content
In many optimization problems from economics, engineering and natural sciences, solution algorithms are only able to efficiently identify local optimizers, while it is much harder to find globally optimal points. This corresponds to the fact that by local search it is easy to find the summit of the closest mountain, but that the search for the summit of Mount Everest is rather elaborate.

The lecture treats methods for global optimization of convex functions under convex constraints. It is structured as follows:

- Introduction, examples, and terminology
- Existence results for optimal points
- Optimality in convex optimization
- Duality, bounds, and constraint qualifications
- Algorithms (Kelley's cutting plane method, Frank-Wolfe method, primal-dual interior point methods)

The lecture is accompanied by exercises which, amongst others, offers the opportunity to implement and to test some of the methods on practically relevant examples.

Remark:
The treatment of nonconvex optimization problems forms the contents of the lecture “Global Optimization II”. The lectures "Global Optimization I" and "Global Optimization II" are held consecutively in the same semester.

Learning objectives:
The student

- knows and understands the fundamentals of deterministic global optimization in the convex case,
- is able to choose, design and apply modern techniques of deterministic global optimization in the convex case in practice.

Literature

Weiterführende Literatur:

- W. Alt, Numerische Verfahren der konvexen, nichtglatten Optimierung, Teubner, 2004
- C.A. Floudas, Deterministic Global Optimization, Kluwer, 2000
3.115 Course: Global Optimization I and II [T-WIWI-103638]

**Responsible:** Prof. Dr. Oliver Stein

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101414 - Methodical Foundations of OR
- M-WIWI-101473 - Mathematical Programming

<table>
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**Events**

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<th>Globale Optimierung I</th>
<th>2 SWS</th>
<th>Lecture / 🖥</th>
<th>Stein</th>
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<tr>
<td>ST 2021</td>
<td>2550135</td>
<td>Übung zu Globale Optimierung I und II</td>
<td>2 SWS</td>
<td>Practice / 🖥</td>
<td>Stein, Schwarze, Beck</td>
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<td>ST 2021</td>
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<td>Globale Optimierung II</td>
<td>2 SWS</td>
<td>Lecture / 🖥</td>
<td>Stein</td>
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</table>

**Exams**

| ST 2021 | 7900272_SS2021_HK | Global Optimization I and II | Stein |

Legend: 🖥 Online, 🎧 Blended (On-Site/Online), ☑ On-Site, ✗ Cancelled

**Competence Certificate**

The assessment of the lecture is a written examination (120 minutes) according to §4(2), 1 of the examination regulation. The successful completion of the exercises is required for admission to the written exam.

The examination is held in the semester of the lecture and in the following semester.

**Prerequisites**

None

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-WIWI-102726 - Global Optimization I must not have been started.
2. The course T-WIWI-102727 - Global Optimization II must not have been started.

**Recommendation**

None

**Annotation**

Part I and II of the lecture are held consecutively in the same semester.

*Below you will find excerpts from events related to this course:*

<table>
<thead>
<tr>
<th>Globale Optimierung I</th>
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<tbody>
<tr>
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</table>
Content
In many optimization problems from economics, engineering and natural sciences, solution algorithms are only able to efficiently identify local optimizers, while it is much harder to find globally optimal points. This corresponds to the fact that by local search it is easy to find the summit of the closest mountain, but that the search for the summit of Mount Everest is rather elaborate.

The lecture treats methods for global optimization of convex functions under convex constraints. It is structured as follows:

- Introduction, examples, and terminology
- Existence results for optimal points
- Optimality in convex optimization
- Duality, bounds, and constraint qualifications
- Algorithms (Kelley's cutting plane method, Frank-Wolfe method, primal-dual interior point methods)

The lecture is accompanied by exercises which, amongst others, offers the opportunity to implement and to test some of the methods on practically relevant examples.

Remark:
The treatment of nonconvex optimization problems forms the contents of the lecture "Global Optimization II". The lectures "Global Optimization I" and "Global Optimization II" are held consecutively in the same semester.

Learning objectives:
The student

- knows and understands the fundamentals of deterministic global optimization in the convex case,
- is able to choose, design and apply modern techniques of deterministic global optimization in the convex case in practice.

Literature

Weiterführende Literature:
- W. Alt, Numerische Verfahren der konvexen, nichtglatten Optimierung, Teubner, 2004
- C.A. Floudas, Deterministic Global Optimization, Kluwer, 2000

Content
In many optimization problems from economics, engineering and natural sciences, solution algorithms are only able to efficiently identify local optimizers, while it is much harder to find globally optimal points. This corresponds to the fact that by local search it is easy to find the summit of the closest mountain, but that the search for the summit of Mount Everest is rather elaborate.

The lecture treats methods for global optimization of nonconvex functions under nonconvex constraints. It is structured as follows:

- Introduction and examples
- Convex relaxation
- Interval arithmetic
- Convex relaxation via alphaBB method
- Branch-and-bound methods
- Lipschitz optimization

The lecture is accompanied by exercises which, amongst others, offers the opportunity to implement and to test some of the methods on practically relevant examples.

Remark:
The treatment of convex optimization problems forms the contents of the lecture "Global Optimization I". The lectures "Global Optimization I" and "Global Optimization II" are held consecutively in the same semester.

Learning objectives:
The student

- knows and understands the fundamentals of deterministic global optimization in the nonconvex case,
- is able to choose, design and apply modern techniques of deterministic global optimization in the nonconvex case in practice.

Globale Optimierung II
2550136, SS 2021, 2 SWS, Language: German, Open in study portal

Lecture (V)
Online
Literature

Weiterführende Literatur:

- W. Alt, Numerische Verfahren der konvexen, nichtglatten Optimierung, Teubner, 2004
- C.A. Floudas, Deterministic Global Optimization, Kluwer, 2000
### 3.116 Course: Global Optimization II [T-WIWI-102727]

<table>
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<th>Prof. Dr. Oliver Stein</th>
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<td>KIT Department of Economics and Management</td>
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<tr>
<td>Part of</td>
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#### Events

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<th>Lecture / 🖥</th>
<th>Stein</th>
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#### Exams

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<th>Stein</th>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 📚 On-Site, ✗ Cancelled

**Competence Certificate**

The assessment of the lecture is a written examination (60 minutes) according to §4(2), 1 of the examination regulation. The successful completion of the exercises is required for admission to the written exam.

The examination is held in the semester of the lecture and in the following semester.

The examination can also be combined with the examination of “Global optimization I”. In this case, the duration of the written examination takes 120 minutes.

**Prerequisites**

None

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-WIWI-103638 - Global Optimization I and II must not have been started.

**Annotation**

Part I and II of the lecture are held consecutively in the same semester.

*Below you will find excerpts from events related to this course:*

#### Globale Optimierung II

<table>
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Content
In many optimization problems from economics, engineering and natural sciences, solution algorithms are only able to efficiently identify local optimizers, while it is much harder to find globally optimal points. This corresponds to the fact that by local search it is easy to find the summit of the closest mountain, but that the search for the summit of Mount Everest is rather elaborate.

The lecture treats methods for global optimization of nonconvex functions under nonconvex constraints. It is structured as follows:

- Introduction and examples
- Convex relaxation
- Interval arithmetic
- Convex relaxation via alphaBB method
- Branch-and-bound methods
- Lipschitz optimization

The lecture is accompanied by exercises which, amongst others, offers the opportunity to implement and to test some of the methods on practically relevant examples.

Remark:
The treatment of convex optimization problems forms the contents of the lecture "Global Optimization I". The lectures "Global Optimization I" and "Global Optimization II" are held consecutively in the same semester.

Learning objectives:
The student

- knows and understands the fundamentals of deterministic global optimization in the nonconvex case,
- is able to choose, design and apply modern techniques of deterministic global optimization in the nonconvex case in practice.

Literature

Weiterführende Literatur:

- W. Alt, Numerische Verfahren der konvexen, nichtglatten Optimierung, Teubner, 2004
- C.A. Floudas, Deterministic Global Optimization, Kluwer, 2000
### 3.117 Course: Graph Theory [T-MATH-102273]

**Responsible:** Prof. Dr. Maria Aksenovich  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-101336 - Graph Theory

<table>
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#### Events

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<th>Course/Activity</th>
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**Prerequisites**  
None
Course: Graph Theory and Advanced Location Models [T-WIWI-102723]

Responsible: Prof. Dr. Stefan Nickel
Organisation: KIT Department of Economics and Management
Part of: M-WIWI-101473 - Mathematical Programming
M-WIWI-102832 - Operations Research in Supply Chain Management

<table>
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Competence Certificate
The assessment is a 60 minutes written examination (according to §4(2), 1 of the examination regulation).
The examination is held in the term of the lecture and the following lecture.

Prerequisites
None

Recommendation
Basic knowledge as conveyed in the module "Introduction to Operations Research" is assumed.

Annotation
The course is offered irregularly. Planned lectures for the next three years can be found in the internet at http://dolior.kit.edu/english/Courses.php.
3.119 Course: Group Actions in Riemannian Geometry [T-MATH-105925]

**Responsible:** Prof. Dr. Wilderich Tuschmann

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102954 - Group Actions in Riemannian Geometry

<table>
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**Prerequisites**
none
3.120 Course: Growth and Development [T-WIWI-111318]

**Responsible:** Prof. Dr. Ingrid Ott

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101496 - Growth and Agglomeration

<table>
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<th>Version</th>
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<td>4,5</td>
<td>Grade to a third</td>
<td>Each winter term</td>
<td>1</td>
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</table>

**Competence Certificate**
Depending on further pandemic developments, the examination will be offered either as an open-book examination or as a 60-minute written examination.

**Prerequisites**
None

**Recommendation**
Basic knowledge of micro- and macroeconomics is assumed, as taught in the courses Economics I [2600012], and Economics II [2600014]. In addition, an interest in quantitative-mathematical modeling is required.

**Annotation**
Due to the research semester of Prof. Dr. Ingrid Ott, the course will not be offered in the winter semester 2021/22. The exam will take place. Preparation materials can be found in ILIAS.
### 3.121 Course: Harmonic Analysis [T-MATH-111289]

**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-105324 - Harmonic Analysis

<table>
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**Exams**

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<th>7700081</th>
<th>Harmonic Analysis</th>
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Course: Harmonic Analysis for Dispersive Equations [T-MATH-107071]

**Responsible:** apl. Prof. Dr. Peer Kunstmann

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-103545 - Harmonic Analysis for Dispersive Equations

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**Prerequisites**
none
3.123 Course: Heat Economy [T-WIWI-102695]

**Responsible:** Prof. Dr. Wolf Fichtner

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101452 - Energy Economics and Technology

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**Events**

| ST 2021 | 2581001 | Heat Economy | 2 SWS | Lecture / 🖥 | Fichtner |

**Exams**

| ST 2021 | 7981001 | Heat Economy | Fichtner |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🏡 On-Site, ✗ Cancelled

**Competence Certificate**

The lecture will be suspended in summer semester 2021. The assessment consists of a written (60 minutes) or oral exam (30 minutes) (following §4(2) of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date. Depending on the respective pandemic situation, the exam may be offered as an open book exam (alternative exam assessment, following §4(2), 3 of the examination regulation).

**Prerequisites**

None.

**Recommendation**

None

**Annotation**

See German version.

Below you will find excerpts from events related to this course:

**Heat Economy**

2581001, SS 2021, 2 SWS, Language: German, [Open in study portal](#)

**Organizational issues**

Seminarraum Standort West Mittwoch: 08:00 - 09:30
3.124 Course: Homogeneous and Symmetric Spaces [T-MATH-110282]

**Responsible:** Prof. Dr. Enrico Leuzinger

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105067 - Homogeneous and Symmetric Spaces

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**Prerequisites**
none
3.125 Course: Homotopy Theory [T-MATH-105933]

**Responsible:** Prof. Dr. Roman Sauer

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102959 - Homotopy Theory

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**Responsible:** Prof. Dr.-Ing. Tamim Asfour  
Hon.-Prof. Dr. Uwe Spetzger

**Organisation:** KIT Department of Informatics

**Part of:** M-INFO-100725 - Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy

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<td>Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy</td>
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#### Exams

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<td>Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ☑ Cancelled
3.127 Course: Human Factors in Security and Privacy [T-WIWI-109270]

**Responsible:** Prof. Dr. Melanie Volkamer

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101472 - Informatics

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**Exams**

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**Competence Certificate**

The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation or an oral exam (30 min) following §4, Abs. 2, 2 of the examination regulation. Only those who have successfully participated in the exercises and the lecture will be admitted to the examination.

The exam takes place every semester and can be repeated at every regular examination date.

**Prerequisites**

Both need to be done:

- Pass Quiz on Paper for Graphical Passwords
- Presentation of Results Exercise 2

+ 9 of the following 11 need to be done:

- Submit ILIAS certificate until Oct 24
- Pass Quiz on InfoSec Lecture
- Active participation exercise 1 Part 1 - Evaluation and analyses methods
- Pass Quiz Paper Discussion 1 - User Behaviour and motivation theories
- Active participation exercise 1 Part 2
- Pass Quiz Paper Discussion 2 - User Behaviour and motivation theories
- Pass Quiz Paper Discussion 3 - Security Awareness
- Active participation exercise 1 Part 3
- Pass Quiz Paper Discussion 4 - Graphical Authentication
- Pass Quiz Paper Discussion 5 - Shoulder Surfing Authentication
- Active participation exercise 2

**Recommendation**

The prior attendance of the lecture "Information Security" is strongly recommended.

**Annotation**

The lecture will not be offered in winter semester 2020/21.

Some lectures are in English, some in German.

*Below you will find excerpts from events related to this course:*
Literature

- Security and Usability: Designing Secure Systems that People Can Use von Lorrie Faith Cranor und Simson Garfinkel. 2005
### 3.128 Course: Human-Machine-Interaction in Anthropomatics: Basics [T-INFO-101361]

**Responsible:** Prof. Dr.-Ing. Jürgen Beyerer  
Dr. Jürgen Geisler  

**Organisation:** KIT Department of Informatics  

**Part of:** M-INFO-100824 - Human-Machine-Interaction in Anthropomatics: Basics  

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<td>Human-Machine-Interaction in Anthropomatics: Basics</td>
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**Exams**

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<td>Beyerer, Geisler</td>
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<td>7500017</td>
<td>Human-Machine-Interaction in Anthropomatics: Basics</td>
<td>Beyerer, van der Camp</td>
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</table>
3.129 Course: Incentives in Organizations [T-WIWI-105781]

Responsible: Prof. Dr. Petra Nieken
Organisation: KIT Department of Economics and Management
Part of: M-WIWI-101500 - Microeconomic Theory

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Events

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<td>2573004</td>
<td>2 SWS</td>
<td>Übung zu Incentives in Organizations</td>
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Exams

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Legend: 📧 Online, 🎬 Blended (On-Site/Online), ⬇️ On-Site, ✗ Cancelled

Competence Certificate

The assessment of this course is a written examination (60 min). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date. In case of a small number of registrations, we might offer an oral exam instead of a written exam.

Prerequisites

None

Recommendation

Knowledge of microeconomics, game theory, and statistics is assumed.

Below you will find excerpts from events related to this course:

Incentives in Organizations

2573003, SS 2021, 2 SWS, Language: English, Open in study portal

Lecture (V) Online
Content
The students acquire profound knowledge about the design and the impact of different incentive and compensation systems. Topics covered are, for instance, performance based compensation, team work, intrinsic motivation, multitasking, and subjective performance evaluations. We will use microeconomic or behavioral models as well as empirical data to analyze incentive systems. We will investigate several widely used compensation schemes and their relationship with corporate strategy. Students will learn to develop practical implications which are based on the acquired knowledge of this course.

Aim
The student
• develops a strategic understanding about incentives systems and how they work.
• analyzes models from personnel economics.
• understands how econometric methods can be used to analyze performance and compensation data.
• knows incentive schemes that are used in companies and is able to evaluate them critically.
• can develop practical implications which are based on theoretical models and empirical data from companies.
• understands the challenges of managing incentive and compensation systems and their relationship with corporate strategy.

Workload
The total workload for this course is: approximately 135 hours.
Lecture: 32 hours
Preparation of lecture: 52 hours
Exam preparation: 51 hours

Literature
Slides, Additional case studies and research papers will be announced in the lecture.
Literature (complementary):
Behavioral Game Theory, Camerer, Russel Sage Foundation, 2003
Introduction to Econometrics, Wooldridge, Andover, 2014
Econometric Analysis of Cross Section and Panel Data, Wooldridge, MIT Press, 2010

Organizational issues
There are recordings of the lecture contents. There will be live sessions on selected lecture dates. These will be announced at the start of the lecture time.
3.130 Course: Information Service Engineering [T-WIWI-106423]

**Responsible:** Prof. Dr. Harald Sack

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101472 - Informatics

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<td>Each summer term</td>
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<td>Lecture / 🖥</td>
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<td>ST 2021 2511607</td>
<td>Exercises to Information Service Engineering</td>
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**Exams**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation or an oral exam (20 min) following §4, Abs. 2, 2 of the examination regulation.

The exam takes place every semester and can be repeated at every regular examination date.

**Prerequisites**

None

**Below you will find excerpts from events related to this course:**

**Information Service Engineering**

2511606, SS 2021, 2 SWS, Language: English, Open in study portal
Content
- Information, Natural Language and the Web
  - Natural Language Processing
    - NLP and Basic Linguistic Knowledge
    - NLP Applications, Techniques & Challenges
    - Evaluation, Precision and Recall
    - Regular Expressions and Automata
    - Tokenization
    - Language Model and N-Grams
    - Part-of-Speech Tagging

- Knowledge Graphs
  - Knowledge Representations and Ontologies
  - Resource Description Framework (RDF) as simple Data Model
  - Creating new Models with RDFS
  - Querying RDF(S) with SPARQL
  - More Expressivity via Web Ontology Language (OWL)
  - From Linked Data to Knowledge Graphs
  - Wikipedia, DBpedia, and Wikidata
  - Knowledge Graph Programming

- Basic Machine Learning
  - Machine Learning Fundamentals
  - Evaluation and Generalization Problems
  - Linear Regression
  - Decision Trees
  - Unsupervised Learning
  - Neural Networks and Deep Learning

- ISE Applications
  - From Data to Knowledge
  - Data Mining, Information Visualization and Knowledge Discovery
  - Semantic Search
  - Exploratory Search
  - Semantic Recommender Systems

Learning objectives:
- The students know the fundamentals and measures of information theory and are able to apply those in the context of Information Service Engineering.
- The students have basic skills of natural language processing and are enabled to apply natural language processing technology to solve and evaluate simple text analysis tasks.
- The students have fundamental skills of knowledge representation with ontologies as well as basic knowledge of Semantic Web and Linked Data technologies. The students are able to apply these skills for simple representation and analysis tasks.
- The students have fundamental skills of information retrieval and are enabled to conduct and to evaluate simple information retrieval tasks.
- The students apply their skills of natural language processing, Linked Data engineering, and Information Retrieval to conduct and evaluate simple knowledge mining tasks.
- The students know the fundamentals of recommender systems as well as of semantic and exploratory search.

Literature
3.131 Course: Information Technology I [T-ETIT-109300]

**Responsible:** Prof. Dr.-Ing. Eric Sax  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-104539 - Information Technology

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**Exams**

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Legend: 🏫 Online, 🧩 Blended (On-Site/Online), 🕛 On-Site, ✗ Cancelled

**Competence Certificate**

Einer schriftlichen Prüfung nach im Umfang von 120 Minuten zu den Lehrveranstaltungen Vorlesung, Übung.
### 3.132 Course: Information Technology I - Practical Course [T-ETIT-109301]

**Responsible:** Prof. Dr.-Ing. Eric Sax  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-104539 - Information Technology

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**

Einer Erfolgskontrolle in Form von Projektdokumentationen und Kontrolle des Quellcodes im Rahmen der Lehrveranstaltung Praktikum.
3.133 Course: Information Technology II and Automation Technology [T-ETIT-109319]

Responsible: Prof. Dr.-Ing. Eric Sax
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-ETIT-104547 - Information Technology II and Automation Technology

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Exams

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Legend: 🌐 Online, 🧩 Blended (On-Site/Online), ⚽ On-Site, ✗ Cancelled

Competence Certificate

Einer schriftlichen Prüfung nach im Umfang von 120 Minuten zu den Lehrveranstaltungen Vorlesung, Übung.
# 3.134 Course: Integral Equations [T-MATH-105834]

**Responsible:** PD Dr. Tilo Arens  
Prof. Dr. Roland Griesmaier  
PD Dr. Frank Hettlich  

**Organisation:** KIT Department of Mathematics  

**Part of:** M-MATH-102874 - Integral Equations

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**Events**

| ST 2021 | 0160510 | Übungen zu 0160500 (Numerische Methoden für Integralgleichungen) | 2 SWS | Practice / 🖥 | Arens |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗿 On-Site, ✗ Cancelled
3.135 Course: International Finance [T-WIWI-102646]

**Responsible:** Prof. Dr. Marliese Uhrig-Homburg

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101480 - Finance 3
- M-WIWI-101483 - Finance 2

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**Events**

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<th>2 SWS</th>
<th>Lecture / 🖥 Online</th>
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<th>7900097</th>
<th>International Finance</th>
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**Exam Information**

Legend: 🖥 Online, 🧱 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
Depending on further pandemic developments, the examination will be offered either as a 60-minute written examination (written examination according to SPO § 4 Abs. 2, Pkt. 1) or as an open-book examination (alternative exam assessment according to SPO § 4 Abs. 2, Pkt. 3).

**Prerequisites**
None

**Recommendation**
None

**Annotation**
The course is offered as a 14-day or block course.

Below you will find excerpts from events related to this course:

**International Finance**
2530570, SS 2021, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
Online

**Organizational issues**
nach dem 21.04. nach Absprache

**Literature**
Weiterführende Literatur:
3.136 Course: Internet Seminar for Evolution Equations [T-MATH-105890]

**Responsible:** Prof. Dr. Dorothee Frey
apl. Prof. Dr. Peer Kunstmann
Prof. Dr. Roland Schnaubelt

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102918 - Internet seminar for evolution equations

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**Events**

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**Prerequisites**
none
### 3.137 Course: Introduction into Particulate Flows [T-MATH-105911]

**Responsible:** Prof. Dr. Willy Dörfler  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102943 - Introduction into Particulate Flows

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**Prerequisites**
none
### 3.138 Course: Introduction to Aperiodic Order [T-MATH-110811]

**Responsible:** Prof. Dr. Tobias Hartnick  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-105331 - Introduction to Aperiodic Order

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**Prerequisites**  
none
3.139 Course: Introduction to Fluid Dynamics [T-MATH-111297]

**Responsible:** Prof. Dr. Wolfgang Reichel

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105650 - Introduction to Fluid Dynamics

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**Exams**

| ST 2021 | 7700107 | Introduction to Fluid Dynamics | Zillinger |

**Prerequisites**
none
Course: Introduction to Geometric Measure Theory [T-MATH-105918]

**Responsible:** PD Dr. Steffen Winter

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102949 - Introduction to Geometric Measure Theory

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**Prerequisites**

none
3.141 Course: Introduction to Homogeneous Dynamics [T-MATH-110323]

**Responsible:** Prof. Dr. Tobias Hartnick

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105101 - Introduction to Homogeneous Dynamics

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**Prerequisites**
none
3.142 Course: Introduction to Kinetic Equations [T-MATH-111721]

**Responsible:** Dr. Christian Zillinger

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105837 - Introduction to Kinetic Equations

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**Competence Certificate**
oral examination of circa 30 minutes

**Prerequisites**
none

**Recommendation**
The course "Classical Methods for Partial Differential Equations" should be studied beforehand.
# 3.143 Course: Introduction to Kinetic Theory [T-MATH-108013]

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<th>Prof. Dr. Martin Frank</th>
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<tr>
<td>Organisation</td>
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<tr>
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**Prerequisites**
none
3.144 Course: Introduction to Matlab and Numerical Algorithms [T-MATH-105913]

**Responsible:** Dr. Daniel Weiß
Prof. Dr. Christian Wieners

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102945 - Introduction to Matlab and Numerical Algorithms

**Type**
Written examination

**Credits**
5

**Grading scale**
Grade to a third

**Version**
1

**Prerequisites**
none
3.145 Course: Introduction to Microlocal Analysis [T-MATH-111722]

Responsibility: Jun.-Prof. Dr. Xian Liao
Organisation: KIT Department of Mathematics
Part of: M-MATH-105838 - Introduction to Microlocal Analysis

<table>
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<td>Irregular</td>
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**Competence Certificate**
oral examination of circa 30 minutes

**Prerequisites**
none

**Recommendation**
The courses "Classical Methods for Partial Differential Equations" and "Functional Analysis" should be studied beforehand.
### 3.146 Course: Introduction to Python [T-MATH-106119]

**Responsible:** Dr. Daniel Weiß  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103053 - Key Competences  

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#### Events

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<th>0169000</th>
<th>Einführung in Python</th>
<th>1 SWS</th>
<th>Lecture / 🖥</th>
<th>Weiß</th>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
Course: Introduction to Scientific Computing [T-MATH-105837]

**Responsible:** Prof. Dr. Willy Dörfler  
Prof. Dr. Marlis Hochbruck  
Prof. Dr. Tobias Jahnke  
Prof. Dr. Andreas Rieder  
Prof. Dr. Christian Wieners

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102889 - Introduction to Scientific Computing

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**Events**

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<th>Version</th>
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<td>Dörfler, Sukhova</td>
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<td>0165000</td>
<td>Einführung in das Wissenschaftliche Rechnen</td>
<td>3 SWS</td>
<td>Dörfler, Sukhova</td>
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<td>Practical course / 📲</td>
<td>3 SWS</td>
<td>Dörfler</td>
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<td>Praktikum zu 0165000 (Einführung in das Wissenschaftliche Rechnen)</td>
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**Exams**

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<th>Version</th>
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<td>Dörfler</td>
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<td>7700089</td>
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Legend: 📲 Online, 🌱 Blended (On-Site/Online), 🗓 On-Site, ❌ Cancelled
Course: Introduction to Stochastic Optimization [T-WIWI-106546]

**Responsible:** Prof. Dr. Steffen Rebennack  
**Organisation:** KIT Department of Economics and Management  
**Part of:**  
- M-WIWI-101414 - Methodical Foundations of OR  
- M-WIWI-102832 - Operations Research in Supply Chain Management

**Type**  
- Examination of another type

**Credits**  
4,5

**Grading scale**  
Grade to a third

**Recurrence**  
Each summer term

**Version**  
2

**Events**

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<td>2</td>
<td>Lecture</td>
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<td>1</td>
<td>Practice</td>
<td>Rebennack, Sinske</td>
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<td>ST 2021</td>
<td>2550474</td>
<td>Rechnerübung zur Einführung in die Stochastische Optimierung</td>
<td>2</td>
<td>Practice</td>
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**Exams**

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<td>Introduction to Stochastic Optimization</td>
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**Legend:** 🖥 Online, 🧬 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Alternative exam assessment (open book exam). The exam takes place in every semester.

**Prerequisites**

None.
3.149 Course: Inverse Problems [T-MATH-105835]

**Responsible:** PD Dr. Tilo Arens
Prof. Dr. Roland Griesmaier
PD Dr. Frank Hettlich
Prof. Dr. Andreas Rieder

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102890 - Inverse Problems

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<td>Tutorial for 0105100 (Inverse Problems)</td>
<td>2 SWS</td>
<td>Practice</td>
<td>Rieder</td>
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### 3.150 Course: Key Moments in Geometry [T-MATH-108401]

**Responsible:** Prof. Dr. Wilderich Tuschmann  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-104057 - Key Moments in Geometry

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**Prerequisites**  
none
3.151 Course: Knowledge Discovery [T-WIWI-102666]

**Responsible:** Michael Färber

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101472 - Informatics

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**Events**

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<th>Lectures</th>
<th>Practice</th>
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<th>Time of preparation and postprocessing</th>
<th>Time of Examination</th>
<th>Exam Preperation</th>
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<td>WT 21/22</td>
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<td>Exercises to Knowledge Discovery</td>
<td>1 SWS</td>
<td>Practice</td>
<td>Färber, Saier</td>
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**Exams**

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<th>Lectures</th>
<th>Practice</th>
<th>Time of presentness</th>
<th>Time of preparation and postprocessing</th>
<th>Time of Examination</th>
<th>Exam Preperation</th>
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<td>Färber</td>
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**Competence Certificate**

The assessment consists of an 1h written exam following §4, Abs. 2, 1 of the examination regulation. Students can be awarded a bonus on their final grade if they successfully complete special assignments.

**Prerequisites**

None

Below you will find excerpts from events related to this course:

**Knowledge Discovery**

2511302, WS 21/22, 2 SWS, Language: English, Open in study portal

**Content**

The lecture gives an overview of approaches of machine learning and data mining for knowledge acquisition from large data sets. These are examined especially with respect to algorithms, applicability to different data representations and the use in real application scenarios. Knowledge Discovery is an established research area with a large community that investigates methods for discovering patterns and regularities in large amounts of data, including unstructured text. A variety of methods exist to extract patterns and provide previously unknown insights. This information can be predictive or descriptive.

The lecture gives an overview of Knowledge Discovery. Specific techniques and methods, challenges and current and future research topics in this research area will be taught.

Contents of the lecture cover the entire machine learning and data mining process with topics on supervised and unsupervised learning and empirical evaluation. Covered learning methods range from classical approaches like decision trees, support vector machines and neural networks to selected approaches from current research. Learning problems considered include feature vector-based learning and text mining.

**Learning objectives:**

Students

- know fundamentals of Machine Learning, Data Mining and Knowledge Discovery.
- are able to design, train and evaluate adaptive systems.
- conduct Knowledge Discovery projects in regards to algorithms, representations and applications.

**Workload:**

- The total workload for this course is approximately 135 hours
- Time of presentness: 45 hours
- Time of preparation and postprocessing: 60 hours
- Exam and exam preperation: 30 hours
Literature

- M. Berhold, D. Hand (eds). Intelligent Data Analysis - An Introduction. 2003
- P. Tan, M. Steinbach, V. Kumar: Introduction to Data Mining, 2005, Addison Wesley

Exercises to Knowledge Discovery

2511303, WS 21/22, 1 SWS, Language: English, Open in study portal

Content

The exercises are based on the lecture Knowledge Discovery. Several exercises are covered, which take up and discuss in detail the topics covered in the lecture Knowledge Discovery. Practical examples are demonstrated to the students to enable a knowledge transfer of the theoretical aspects learned into practical application.

Contents of the lecture cover the entire machine learning and data mining process with topics on monitored and unsupervised learning processes and empirical evaluation. The learning methods covered range from classical approaches like decision trees, support vector machines and neural networks to selected approaches from current research. Learning problems considered include feature vector-based learning and text mining.

Learning objectives:

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Literature

- M. Berhold, D. Hand (eds). Intelligent Data Analysis - An Introduction. 2003
- P. Tan, M. Steinbach, V. Kumar: Introduction to Data Mining, 2005, Addison Wesley
### 3.152 Course: L2-Invariants [T-MATH-105924]

**Responsible:** Dr. Holger Kammeyer  
Prof. Dr. Roman Sauer  

**Organisation:** KIT Department of Mathematics  

**Part of:** M-MATH-102952 - L2-Invariants

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**Prerequisites**

none
3.153 Course: Large-scale Optimization [T-WIWI-106549]

**Responsible:** Prof. Dr. Steffen Rebennack

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101473 - Mathematical Programming
- M-WIWI-102832 - Operations Research in Supply Chain Management

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### Events

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<td>2 SWS</td>
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<td>1 SWS</td>
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### Exams

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**Competence Certificate**
Alternative exam assessment (open book exam). The exam takes place in every semester.

**Prerequisites**
None.
3.154 Course: Lie Groups and Lie Algebras [T-MATH-108799]

**Responsible:** Prof. Dr. Enrico Leuzinger

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-104261 - Lie Groups and Lie Algebras

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### 3.155 Course: Lie-Algebras (Linear Algebra 3) [T-MATH-111723]

**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-105839 - Lie-Algebras (Linear Algebra 3)

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**Prerequisites:**
none
3.156 Course: Linear Electronic Networks [T-ETIT-101917]

**Responsible:** Prof. Dr. Olaf Dössel  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-101845 - Linear Electronic Networks

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<td>Linear Electric Circuits (Tutorial to 2305256)</td>
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**Exams**

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**Competence Certificate**

The content of the course Linear Electrical Networks (7 CP) will be checked in a written exam lasting 120 minutes. If the exam is passed, students can receive a grade bonus of up to 0.4 grade points if two project tasks have been successfully completed during the semester. The processing of the project tasks is evidenced by the submission of documentation or the project code.

**Prerequisites**

none
### 3.157 Course: Localization of Mobile Agents [T-INFO-101377]

**Responsible:** Prof. Dr.-Ing. Uwe Hanebeck  
**Organisation:** KIT Department of Informatics  
**Part of:** M-INFO-100840 - Localization of Mobile Agents

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Legends: 🖥 Online, 🧩 Blended (On-Site/Online), 🔵 On-Site, ⌱ Cancelled

Below you will find excerpts from events related to this course:

#### Localization of Mobile Agents

**24613, SS 2021, 3 SWS, Language: German, Open in study portal**

**Content**

This module provides a systematic introduction into the topic of localization methods. In order to facilitate understanding, the module is divided into four main topics. Dead reckoning treats the instantaneous determination of a vehicle's position based on dynamic parameters like velocity or steering angle. Localization with the help of measurements of known landmarks is part of static localization. In addition to the closed-form solutions for particular measurements (distances and angles), the least squares method for fusion arbitrary measurements is also introduced. Dynamic localization treats the combination of dead reckoning and static localization. The central part of the lecture is the derivation of the Kalman filter, which has been successfully applied in several practical applications. Finally, simultaneous localization and mapping (SLAM) is introduced, which allows localization in case of (partly) unknown landmark positions.

**Organizational issues**

Prüfungsterminvorschläge und das Verfahren dazu sind auf der Webseite der Vorlesung zu finden.

**Literature**

Grundlegende Kenntnisse der linearen Algebra und Stochastik sind hilfreich.
3.158 Course: Machine Learning 1 - Basic Methods [T-WIWI-106340]

**Responsible:** Prof. Dr.-Ing. Johann Marius Zöllner  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101472 - Informatics

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<td>1 SWS</td>
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**Exams**

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</table>

**Competence Certificate**

Depending on further pandemic developments, the exam will be offered either as an open-book exam, or as a written exam (60 min):

The exam takes place every semester and can be repeated at every regular examination date.

**Prerequisites**

None.

Below you will find excerpts from events related to this course:

### Machine Learning 1 - Fundamental Methods

**2511500, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)**

**Lecture (V)**

**Content**

The field of knowledge acquisition and machine learning is a rapidly expanding field of knowledge and the subject of numerous research and development projects. The acquisition of knowledge can take place in different ways. Thus a system can benefit from experiences already made, it can be trained, or it draws conclusions from extensive background knowledge.

The lecture covers symbolic learning methods such as inductive learning (learning from examples, learning by observation), deductive learning (explanation-based learning) and learning from analogies, as well as sub-symbolic techniques such as neural networks, support vector machines and genetic algorithms. The lecture introduces the basic principles and structures of learning systems and examines the algorithms developed so far. The structure and operation of learning systems is presented and explained with some examples, especially from the fields of robotics and image processing.

**Learning objectives:**

- Students acquire knowledge of the fundamental methods in the field of machine learning.
- Students can classify, formally describe and evaluate methods of machine learning.
- Students can use their knowledge to select suitable models and methods for selected problems in the field of machine learning.
Literature
Die Foliensätze sind als PDF verfügbar

Weiterführende Literatur

- Artificial Intelligence: A Modern Approach - Peter Norvig and Stuart J. Russell
- Machine Learning - Tom Mitchell
- Pattern Recognition and Machine Learning - Christopher M. Bishop
- Reinforcement Learning: An Introduction - Richard S. Sutton and Andrew G. Barto
- Deep Learning - Ian Goodfellow, Yoshua Bengio, Aaron Courville

Weitere (spezifische) Literatur zu einzelnen Themen wird in der Vorlesung angegeben.
Course: Machine Learning 2 – Advanced Methods [T-WIWI-106341]

Responsibility: Prof. Dr.-Ing. Johann Marius Zöllner
Organisation: KIT Department of Economics and Management
Part of: M-WIWI-101472 - Informatics

Type
Written examination

Credits
4,5

Grading scale
Grade to a third

Recurrence
Each summer term

Version
2

Events

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Exams

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Legend: 📚 Online, 🧩 Blended (On-Site/Online), 🏃️ On-Site, ✗ Canceled

Competence Certificate
Depending on further pandemic developments, the exam will be offered either as an open-book exam, or as a written exam (60 min).

The exam takes place every semester and can be repeated at every regular examination date.

Prerequisites
None.

Below you will find excerpts from events related to this course:

Machine Learning 2 - Advanced methods
2511502, SS 2021, 2 SWS, Language: German, Open in study portal

Lecture (V) Online

Content
The subject area of machine intelligence and, in particular, machine learning, taking into account real challenges of complex application domains, is a rapidly expanding field of knowledge and the subject of numerous research and development projects.

The lecture "Machine Learning 2" deals with advanced methods of machine learning such as semi-supervised and active learning, deep neural networks (deep learning), pulsed networks, hierarchical approaches, e.g. As well as dynamic, probabilistic relational methods. Another focus is the embedding and application of machine learning methods in real systems.

The lecture introduces the latest basic principles as well as extended basic structures and elucidates previously developed algorithms. The structure and the mode of operation of the methods and methods are presented and explained by means of some application scenarios, especially in the field of technical (sub) autonomous systems (robotics, neurorobotics, image processing, etc.).

Learning objectives:

- Students understand extended concepts of machine learning and their possible applications.
- Students can classify, formally describe and evaluate methods of machine learning.
- In detail, methods of machine learning can be embedded and applied in complex decision and inference systems.
- Students can use their knowledge to select suitable models and methods of machine learning for existing problems in the field of machine intelligence.

Recommendations:
Attending the lecture Machine Learning 1 or a comparable lecture is very helpful in understanding this lecture.
Literature
Die Foliensätze sind als PDF verfügbar

Weiterführende Literatur

- Artificial Intelligence: A Modern Approach - Peter Norvig and Stuart J. Russell
- Machine Learning - Tom Mitchell
- Pattern Recognition and Machine Learning - Christopher M. Bishop
- Reinforcement Learning: An Introduction - Richard S. Sutton and Andrew G. Barto
- Deep Learning - Ian Goodfellow, Yoshua Bengio, Aaron Courville

Weitere (spezifische) Literatur zu einzelnen Themen wird in der Vorlesung angegeben.
3.160 Course: Management of IT-Projects [T-WIWI-102667]

**Responsible:** Dr. Roland Schätzle  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101472 - Informatics

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<th>2 SWS</th>
<th>Lecture / 🖥</th>
<th>Schätzle</th>
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<tr>
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<td>1 SWS</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**

The assessment takes place in the form of a written examination (exam) in the amount of 60 minutes. The examination is offered every semester and can be repeated at any regular examination date.

Prerequisite for the participation in the examination is the successful participation in the exercise, which takes place in the summer semester, starting from summer semester 2020. The number of participants in the exercise is limited.

The exact details will be announced in the lecture.

**Prerequisites**

Prerequisite for the participation in the examination is the successful participation in the exercise, which takes place in the summer semester, starting from summer semester 2020. The number of participants in the exercise is limited.

**Below you will find excerpts from events related to this course:**

**Management of IT-Projects**

2511214, SS 2021, 2 SWS, Language: German, [Open in study portal]
Content
The lecture deals with the general framework, impact factors and methods for planning, handling, and controlling of IT projects. Especially following topics are addressed:

- project environment
- project organisation
- project planning including the following items:
  - plan of the project structure
  - flow chart
  - project schedule
  - plan of resources
- effort estimation
- project infrastructure
- project controlling
- risk management
- feasibility studies
- decision processes, conduct of negotiations, time management.

Learning objectives:
Students

- explain the terminology of IT project management and typical used methods for planning, handling and controlling,
- apply methods appropriate to current project phases and project contexts,
- consider organisational and social impact factors.

Recommendations:
Knowledge from the lecture Software Engineering is helpful.

Workload:

- Lecture 30h
- Exercise 15h
- Preparation of lecture 24h
- Preparation of exercises 25h
- Exam preparation 40h
- Exam 1h

Literature

- B. Hindel, K. Hörmann, M. Müller, J. Schmied. Basiswissen Software-Projektmanagement. dpunkt.verlag 2004

Content
The general conditions, influencing factors and methods in the planning, execution and control of IT projects are dealt with. In particular, the following topics will be dealt with: Project environment, project organization, project structure plan, effort estimation, project infrastructure, project control, decision-making processes, negotiation, time management. The lecture is accompanied by exercises in the form of tutorials. The date of the exercise will be announced later.
3.161 Course: Markov Decision Processes [T-MATH-105921]

**Responsible:** Prof. Dr. Nicole Bäuerle

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102907 - Markov Decision Processes

<table>
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**Exams**

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Legend: 🖥 Online, 🙆 Blended (On-Site/Online), 🗠 On-Site, ✗ Cancelled

**Prerequisites**

none
3.162 Course: Master Thesis [T-MATH-105878]

**Responsible:** Dr. Sebastian Grensing  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102917 - Master Thesis

**Final Thesis**  
This course represents a final thesis. The following periods have been supplied:

- **Submission deadline** 6 months  
- **Maximum extension period** 3 months  
- **Correction period** 8 weeks
3.163 Course: Mathematical Methods in Signal and Image Processing [T-MATH-105862]

Responsible: Prof. Dr. Andreas Rieder
Organisation: KIT Department of Mathematics
Part of: M-MATH-102897 - Mathematical Methods in Signal and Image Processing

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Prerequisites
none
### 3.164 Course: Mathematical Methods of Imaging [T-MATH-106488]

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**Responsible:** Prof. Dr. Andreas Rieder  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103260 - Mathematical Methods of Imaging

#### Events

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**Legend:** 🔄 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

**Prerequisites**
None
3.165 Course: Mathematical Modelling and Simulation in Practise [T-MATH-105889]

**Responsible:** PD Dr. Gudrun Thäter

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102929 - Mathematical Modelling and Simulation in Practise

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Below you will find excerpts from events related to this course:

**Mathematical Modelling and Simulation**

0109400, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)
### 3.166 Course: Mathematical Physics [T-MATH-106113]

**Responsible:** Prof. Dr. Dirk Hundertmark  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103079 - Mathematical Physics

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<td>4 SWS</td>
<td>Lecture</td>
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**Prerequisites**

none
3.167 Course: Mathematical Physics 2 [T-MATH-106526]

Responsible: Prof. Dr. Dirk Hundertmark
Organisation: KIT Department of Mathematics
Part of: M-MATH-103274 - Mathematical Physics 2

<table>
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Prerequisites

none
3.168 Course: Mathematical Statistics [T-MATH-105872]

**Responsible:** Prof. Dr. Norbert Henze  
PD Dr. Bernhard Klar

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102909 - Mathematical Statistics

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**Prerequisites**

none
3.169 Course: Mathematical Topics in Kinetic Theory [T-MATH-108403]

**Responsible:** Prof. Dr. Dirk Hundertmark  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-104059 - Mathematical Topics in Kinetic Theory

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**Prerequisites**
none
3.170 Course: Mathematics for High Dimensional Statistics [T-WIWI-111247]

**Responsible:** Prof. Dr. Oliver Grothe  
**Organisation:** KIT Department of Economics and Management

### Events

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### Exams

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**Competence Certificate**

The assessment consists of an oral exam (30 min.) taking place in the recess period.

**Prerequisites**

None

**Recommendation**

Basic knowledge of mathematics and statistics is assumed. Knowledge in multivariate statistics is an advantage, but not necessary for the course.

**Below you will find excerpts from events related to this course:**

### Mathematische Grundlagen hochdimensionaler Statistik

**2550562, SS 2021, 2 SWS, Open in study portal**

**Content**

The lecture focuses on modelling statistical objects (random vectors, random matrices and random graphs) in high dimensions. It deals with concentration inequalities that limit the fluctuations of such objects as well as complexity measures for quantities and functions. The theory is transferred to well-known and widespread applications such as neighbourhood detection in networks, statistical learning theory and LASSO.

**Learning objectives:**

Students are able to

- name and justify statistical properties of high-dimensional objects (vectors, matrices, functions).
- describe and explain differences in the behaviour between low- and high-dimensional random objects.
- name procedures for assess uncertainties in statistical models and apply them in simple examples.
- decide well-founded which modeling of high-dimensional structures is best suited in a specific situation.
- transform data into lower dimensions and quantify approximation errors.
- understand basic proofs in high-dimensional statistics using examples.
- develop, implement and evaluate smaller simulations in a programming language of their choice.
3.171 Course: Maxwell's Equations [T-MATH-105856]

**Responsible:** PD Dr. Tilo Arens  
Prof. Dr. Roland Griesmaier  
PD Dr. Frank Hettlich

**Organisation:** KIT Department of Mathematics

**Part of:**  
M-MATH-102885 - Maxwell's Equations

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3.172 Course: Medical Imaging [T-MATH-105861]

**Responsible:** Prof. Dr. Andreas Rieder  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102896 - Medical Imaging

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**Prerequisites**  
none
### 3.173 Course: Medical Imaging Techniques I [T-ETIT-101930]

**Responsible:** Prof. Dr. Olaf Dössel  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-100384 - Medical Imaging Techniques I

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<td>2 SWS</td>
<td>Each winter term</td>
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**Competence Certificate**  
Success control is carried out in the form of a written test of 120 minutes.

**Prerequisites**  
None
# 3.174 Course: Medical Imaging Techniques II [T-ETIT-101931]

**Responsible:** Prof. Dr. Olaf Dössel  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-100385 - Medical Imaging Techniques II

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### Events

| ST 2021 | 2305262 | Medical Imaging Techniques II | 2 SWS | Lecture / Online | Dössel |

| Exams    | ST 2021 | 7305262 | Medical Imaging Techniques II | Dössel |

**Legend:**  
- Online,  
- Blended (On-Site/Online),  
- On-Site,  
- Cancelled

### Competence Certificate

Success control is carried out in the form of a written test of 120 minutes.

### Prerequisites

none

### Recommendation

The contents of the M-ETIT-100384 module are required.
### 3.175 Course: Medical Robotics [T-INFO-101357]

**Responsible:** Prof. Dr.-Ing. Torsten Kröger  
Jun.-Prof. Dr. Franziska Mathis-Ullrich  

**Organisation:** KIT Department of Informatics  

**Part of:** M-INFO-100820 - Medical Robotics

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
### 3.176 Course: Methods of Signal Processing [T-ETIT-100694]

**Responsible:** Prof. Dr.-Ing. Michael Heizmann  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-100540 - Methods of Signal Processing

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<td>WT 21/22</td>
<td>2302115</td>
<td>Methods of Signal Processing (Tutorial to 2302113)</td>
<td>1+1 SWS</td>
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#### Exams

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

**Prerequisites**

none
### 3.177 Course: Mixed Integer Programming I [T-WIWI-102719]

**Responsible:** Prof. Dr. Oliver Stein  
**Organisation:** KIT Department of Economics and Management  
**Part of:**  
- M-WIWI-101473 - Mathematical Programming  
- M-WIWI-102832 - Operations Research in Supply Chain Management  

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<td>WT 21/22</td>
<td>2550138</td>
<td>Mixed-integer Programming I</td>
<td>2</td>
<td>Lecture</td>
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<td>2550139</td>
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<td>Practice</td>
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##### Competence Certificate

The assessment of the lecture is a written examination (60 minutes) according to §4(2), 1 of the examination regulation. The successful completion of the exercises is required for admission to the written exam.  
The examination is held in the semester of the lecture and in the following semester.  
The examination can also be combined with the examination of Mixed Integer Programming II [25140]. In this case, the duration of the written examination takes 120 minutes.

##### Prerequisites

None

##### Recommendation

It is strongly recommended to visit at least one lecture from the Bachelor program of this chair before attending this course.

##### Annotation

The lecture is offered irregularly. The curriculum of the next three years is available online (kop.ior.kit.edu).

---

**Below you will find excerpts from events related to this course:**

**Mixed-integer Programming I**  
2550138, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)
Content
Many optimization problems from economics, engineering and natural sciences are modeled with continuous as well as with discrete variables. Examples are the energy minimal design of a chemical process in which several reactors may be switched on or off, portfolio optimization with limitations on the number of securities, the choice of locations to serve customers at minimum cost, and the optimal design of vote allocations in election procedures. For the algorithmic identification of optimal points of such problems an interaction of ideas from discrete as well as continuous optimization is necessary.

The lecture focusses on mixed-integer linear optimization problems and is structured as follows:

- Introduction, solvability, and basic concepts
- LP relaxation and error bounds for roundings
- Branch-and-bound method
- Gomory's cutting plane method
- Benders decomposition

The lecture is accompanied by exercises which, amongst others, offers the opportunity to implement and to test some of the methods on practically relevant examples.

Remark:
The treatment of mixed-integer nonlinear optimization problems forms the contents of the lecture "Mixed-integer Programming II".

Learning objectives:
The student

- knows and understands the fundamentals of linear mixed integer programming,
- is able to choose, design and apply modern techniques of linear mixed integer programming in practice.

Literature

- J. Kallrath: Gemischt-ganzzahlige Optimierung, Vieweg, 2002
- D. Li, X. Sun: Nonlinear Integer Programming, Springer, 2006
3.178 Course: Mixed Integer Programming II [T-WIWI-102720]

**Responsible:** Prof. Dr. Oliver Stein

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101473 - Mathematical Programming
- M-WIWI-102832 - Operations Research in Supply Chain Management

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**Competence Certificate**
The assessment of the lecture is a written examination (60 minutes) according to §4(2), 1 of the examination regulation. The successful completion of the exercises is required for admission to the written exam.
The examination is held in the semester of the lecture and in the following semester.
The examination can also be combined with the examination of Mixed Integer Programming I [2550138]. In this case, the duration of the written examination takes 120 minutes.

**Prerequisites**
None

**Recommendation**
It is strongly recommended to visit at least one lecture from the Bachelor program of this chair before attending this course.

**Annotation**
The lecture is offered irregularly. The curriculum of the next three years is available online (kop.ior.kit.edu).
### 3.179 Course: Modeling and OR-Software: Advanced Topics [T-WIWI-106200]

**Responsible:** Prof. Dr. Stefan Nickel  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-102832 - Operations Research in Supply Chain Management

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#### Events

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<th>Recurrence</th>
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<td>WT 21/22</td>
<td>2550490</td>
<td>Modellieren und OR-Software: Fortgeschrittene Themen</td>
<td>3 SWS</td>
<td>Practical course /</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**
The assessment is a 120 minutes examination, including a written and a practical part (according to §4(2), 1 of the examination regulation).

The examination is held in the term of the software laboratory and the following term.

**Prerequisites**
None.

**Recommendation**
Basic knowledge as conveyed in the module *Introduction to Operations Research* is assumed.
Successful completion of the course *Modeling and OR-Software: Introduction*.

**Annotation**
Due to capacity restrictions, registration before course start is required. For further information see the webpage of the course.

The lecture is held in every term. The planned lectures and courses for the next three years are announced online.

*Below you will find excerpts from events related to this course:*

**Modellieren und OR-Software: Fortgeschrittene Themen**  
2550490, WS 21/22, 3 SWS, Language: German, [Open in study portal](http://go.wiwi.kit.edu/OR_Bewerbung)

**Content**
The advanced course is designated for Master students that already attended the introductory course or gained equivalent experience elsewhere, e.g. during a seminar or bachelor thesis. We will work on advanced topics and methods in OR, among others cutting planes, column generation and constraint programming. The Software used for the exercises is IBM ILOG CPLEX Optimization Studio. The associated modelling programming languages are OPL and ILOG Script.

**Organizational issues**
Steine genau Terme werden auf der Homepage bekannt gegeben
Link zur Bewerbung: [http://go.wiwi.kit.edu/OR_Bewerbung](http://go.wiwi.kit.edu/OR_Bewerbung)
01.09.2021 09:00 - 25.09.2021 23:55

**Responsible:** Prof. Dr. Stefan Nickel

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101413 - Applications of Operations Research

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**Events**

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<tbody>
<tr>
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<td>Modellieren und OR-Software: Einführung</td>
<td>3 SWS</td>
<td>Practical course / Online</td>
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**Exams**

| ST 2021 7900153 | Modeling and OR-Software: Introduction | Nickel |

Legend: 🌐 Online, 🧩 Blended (On-Site/Online), 🗂 On-Site, ✗ Cancelled

**Competence Certificate**

The assessment is a 120 minutes examination, including a written and a practical part (according to §4(2), 1 of the examination regulation).

The examination is held in the term of the software laboratory and the following term.

**Prerequisites**

None

**Recommendation**


**Annotation**

Due to capacity restrictions, registration before course start is required. For further information see the webpage of the course.

The lecture is offered in every term. The planned lectures and courses for the next three years are announced online.

*Below you will find excerpts from events related to this course:*

**Modellieren und OR-Software: Einführung**

2550490, SS 2021, 3 SWS, Language: German, [Open in study portal](#)

**Content**

After an introduction to general concepts of modelling tools (implementation, data handling, result interpretation, ...), the software IBM ILOG CPLEX Optimization Studio and the corresponding modeling language OPL will be discussed which can be used to solve OR problems on a computer-aided basis. Subsequently, a broad range of exercises will be discussed. The main goals of the exercises from literature and practical applications are to learn the process of modeling optimization problems as linear or mixed-integer programs, to efficiently utilize the presented tools for solving these optimization problems and to implement heuristic solution procedures for mixed-integer programs.
### 3.181 Course: Models of Mathematical Physics [T-MATH-105846]

| Responsible          | Prof. Dr. Dirk Hundertmark  
|                      | Prof. Dr. Michael Plum        
|                      | Prof. Dr. Wolfgang Reichel    
| Organisation         | KIT Department of Mathematics 
| Part of              | M-MATH-102875 - Models of Mathematical Physics 

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3.182 Course: Modern Experimental Physics I, Atoms and Nuclei [T-PHYS-105132]

**Responsible:** Studiendekan Physik

**Organisation:** KIT Department of Physics

**Part of:** M-PHYS-101704 - Modern Experimental Physics I, Atoms and Cores

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<td>Each summer term</td>
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**Events**

| ST 2021 | 4010041 | Moderne Experimentalphysik I (Physik IV, Atome und Kerne) | 4 SWS | Lecture / 🖥 | Hunger |
| ST 2021 | 4010042 | Übungen zu Moderne Experimentalphysik I | 2 SWS | Practice / 🖥 | Hunger, Grammel, Pallmann |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**

Oral exam, approx. 45 min

**Prerequisites**

Successful completion of the exercises

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-PHYS-102313 - Modern Experimental Physics I, Atoms and Nuclei, Prerequisite must have been passed.
3.183 Course: Modern Experimental Physics II. Molecules and Solid States [T-PHYS-105133]

**Responsible:** Studiendekan Physik

**Organisation:** KIT Department of Physics

**Part of:** M-PHYS-101705 - Modern Experimental Physics II, Molecules and Solid States

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**Events**

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<td>4010051</td>
<td>Moderne Experimentalphysik II (Physik V, Moleküle und Festkörper)</td>
<td>4</td>
<td>Lecture</td>
<td>Wernsdorfer</td>
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<td>4010052</td>
<td>Übungen zu Moderne Experimentalphysik II</td>
<td>2</td>
<td>Practice</td>
<td>Wernsdorfer, Haghighirad</td>
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**Competence Certificate**

Oral exam, approx. 45 min

**Prerequisites**

Successful completion of the exercises

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-PHYS-102314 - Modern Experimental Physics II, Molecules and Solid States, prerequisite must have been passed.
3.184 Course: Modern Theoretical Physics I, Quantum Mechanics 1 [T-PHYS-105134]

**Responsible:** Studiendekan Physik

**Organisation:** KIT Department of Physics

**Part of:** M-PHYS-103180 - Modern Theoretical Physics I, Quantum Mechanics I

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**Exams**

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**Legend:** 📚 Online, 🎓 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Oral exam, approx. 45 min

**Prerequisites**

none
3.185 Course: Modern Theoretical Physics II, Quantum Mechanics 2 [T-PHYS-106095]

**Responsible:** Studiendekan Physik

**Organisation:** KIT Department of Physics

**Part of:** M-PHYS-101708 - Modern Theoretical Physics II, Quantum Mechanics II

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**Competence Certificate**

Oral exam, approx. 45 min

**Prerequisites**

none
3.186 Course: Modular Forms [T-MATH-105843]

**Responsible:** PD Dr. Stefan Kühnlein

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102868 - Modular Forms

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3.187 Course: Moduli Spaces of Translation Surfaces [T-MATH-111271]

Organisation: KIT Department of Mathematics
Part of: M-MATH-105635 - Moduli Spaces of Translation Surfaces

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Exams

| ST 2021 | 7700100 | Moduli Spaces of Translation Surfaces | Herrlich |

Prerequisites

none
3.188 Course: Monotonicity Methods in Analysis [T-MATH-105877]

Responsible: PD Dr. Gerd Herzog
Organisation: KIT Department of Mathematics
Part of: M-MATH-102887 - Monotonicity Methods in Analysis

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<td>Grade to a third</td>
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### 3.189 Course: Multicriteria Optimization [T-WIWI-111587]

**Responsible:** Prof. Dr. Oliver Stein  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101473 - Mathematical Programming

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**Competence Certificate**
The assessment of the lecture is a written examination (60 minutes) according to §4(2), 1 of the examination regulation. The successful completion of the exercises is required for admission to the written exam. The examination is held in the semester of the lecture and in the following semester.

**Prerequisites**
None

**Recommendation**
It is strongly recommended to visit at least one lecture from the Bachelor program of this chair before attending this course.

**Annotation**
The course is offered every second winter semester (starting WiSe 22/23). The curriculum of the next three years is available online (www.ior.kit.edu).
3.190 Course: Multigrid and Domain Decomposition Methods [T-MATH-105863]

**Responsible:** Prof. Dr. Christian Wieners

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102898 - Multigrid and Domain Decomposition Methods

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**Competence Certificate**
Mündliche Prüfung im Umfang von ca. 20 Minuten.

**Prerequisites**
none
### 3.191 Course: Multivariate Statistical Methods [T-WIWI-103124]

**Responsible:** Prof. Dr. Oliver Grothe  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101473 - Mathematical Programming

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#### Events

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<td>2 SWS</td>
<td>Multivariate Verfahren</td>
<td>Lecture / 🚄</td>
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<td>ST 2021 2550555</td>
<td>2 SWS</td>
<td>Übung zu Multivariate Verfahren</td>
<td>Practice / 🚄</td>
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#### Exams

| ST 2021 7900351 | Multivariate Statistical Methods | Grothe |

**Legend:** 🚄 Online, 🔄 Blended (On-Site/Online), 🖥 On-Site, ❌ Cancelled

### Competence Certificate

Depending on further pandemic developments, the examination will be offered either as a 60-minute written examination (written examination according to SPO § 4 Abs. 2, Pkt. 1) or as an open-book examination (alternative exam assessment according to SPO § 4 Abs. 2, Pkt. 3).

A bonus program can improve the grade by one grade level (i.e. by 0.3 or 0.4).

The exam is offered every semester. Re-examinations are offered only for repeaters.

### Prerequisites

None

### Recommendation

The course covers highly advanced statistical methods with a quantitative focus. Hence, participants are necessarily expected to have advanced statistical knowledge, e.g. acquired in the course "Advanced Statistics". Without this, participation in the course is not advised.

Previous attendance of the course Analysis of Multivariate Data is recommended. Alternatively, the script can be provided to interested students.

### Below you will find excerpts from events related to this course:

#### Multivariate Verfahren

<table>
<thead>
<tr>
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<th>Lecture (V)</th>
<th>Online</th>
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#### Literature

Skript zur Vorlesung
3.192 Course: Nature-Inspired Optimization Methods [T-WIWI-102679]

**Responsible:** PD Dr. Pradyumn Kumar Shukla  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101472 - Informatics

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### Events

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<th>2 SWS</th>
<th>Lecture / Online</th>
<th>Shukla</th>
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<tr>
<td>ST 2021</td>
<td>2511107</td>
<td>Übungen zu Nature-Inspired Optimization Methods</td>
<td>1 SWS</td>
<td>Practice / Online</td>
<td>Shukla</td>
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### Exams

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<th>Nature-Inspired Optimization Methods (Registration until 12 July 2021)</th>
<th>Shukla</th>
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<td>WT 21/22</td>
<td>7900016</td>
<td>Nature-Inspired Optimisation Methods</td>
<td>Shukla</td>
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**Legend:** 📺 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

### Competence Certificate

The assessment consists of a written exam (60 min) (according to Section 4(2), 1 of the examination regulation) and an additional written examination called "bonus exam", 60 min (accoding Section 4(2), 3 of the examination regulation) or a selection of exercises. The bonus exam may be split into several shorter written tests.

The grade of this course is the achieved grade in the written examination. If this grade is at least 4.0 and at most 1.3, a passed bonus exam will improve it by one grade level (i.e. by 0.3 or 0.4).

### Prerequisites

None

### Below you will find excerpts from events related to this course:

**Nature-Inspired Optimization Methods**  
2511106, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**Content**

Many optimization problems are too complex to be solved to optimality. A promising alternative is to use stochastic heuristics, based on some fundamental principles observed in nature. Examples include evolutionary algorithms, ant algorithms, or simulated annealing. These methods are widely applicable and have proven very powerful in practice. During the course, such optimization methods based on natural principles are presented, analyzed and compared. Since the algorithms are usually quite computational intensive, possibilities for parallelization are also investigated.

**Learning objectives:**

Students learn:

- Different nature-inspired methods: local search, simulated annealing, tabu search, evolutionary algorithms, ant colony optimization, particle swarm optimization
- Different aspects and limitation of the methods
- Applications of such methods
- Multi-objective optimization methods
- Constraint handling methods
- Different aspects in parallelization and computing platforms
Literature

**Responsible:** Prof. Dr. Martina Zitterbart

**Organisation:** KIT Department of Informatics

**Part of:** M-INFO-100782 - Network Security: Architectures and Protocols

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**Exams**

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Legend: 🖥️ Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled
3.194 Course: Nonlinear Analysis [T-MATH-107065]

**Responsible:** Prof. Dr. Tobias Lamm  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103539 - Nonlinear Analysis

**Type**  
Oral examination

**Credits**  
8

**Grading scale**  
Grade to a third

**Recurrence**  
Irregular

**Version**  
1

**Prerequisites**  
none
3.195 Course: Nonlinear Control Systems [T-ETIT-100980]

**Responsible:** Dr.-Ing. Mathias Kluwe

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** M-ETIT-100371 - Nonlinear Control Systems

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**Events**

| ST 2021 | 2303173 | Nichtlineare Regelungssysteme | 2 SWS | Lecture / 🖥 | Kluwe |

**Exams**

| ST 2021 | 7303173 | Nonlinear Control Systems | Kluwe |

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 👤 On-Site, ✗ Cancelled

**Prerequisites**

none
3.196 Course: Nonlinear Evolution Equations [T-MATH-105848]

**Responsible:** Prof. Dr. Dorothee Frey
Prof. Dr. Roland Schnaubelt

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102877 - Nonlinear Evolution Equations

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</table>
Course: Nonlinear Functional Analysis [T-MATH-105876]

**Responsible:** PD Dr. Gerd Herzog  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102886 - Nonlinear Functional Analysis

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Course: Nonlinear Maxwell Equations [T-MATH-106484]

Responsibility: Prof. Dr. Roland Schnaubelt
Organisation: KIT Department of Mathematics
Part of: M-MATH-103257 - Nonlinear Maxwell Equations

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Prerequisites
Keine
3.199 Course: Nonlinear Maxwell Equations [T-MATH-110283]

**Responsible:** Prof. Dr. Roland Schnaubelt

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105066 - Nonlinear Maxwell Equations

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**Prerequisites**
none
3.200 Course: Nonlinear Optimization I [T-WIWI-102724]

**Responsible:** Prof. Dr. Oliver Stein

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101414 - Methodical Foundations of OR
- M-WIWI-101473 - Mathematical Programming

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**Events**

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<td>2 SWS</td>
<td>Lecture</td>
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<td>WT 21/22</td>
<td>Exercises Nonlinear Optimization I + II</td>
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<td>Practice</td>
<td>Stein, Beck, Schwarze, Neumann</td>
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**Exams**

<table>
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<tr>
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<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
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<tr>
<td>ST 2021</td>
<td>Nonlinear Optimization I</td>
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**Competence Certificate**

The assessment consists of a written exam (60 minutes) according to Section 4(2), 1 of the examination regulation. The successful completion of the exercises is required for admission to the written exam. The exam takes place in the semester of the lecture and in the following semester. The examination can also be combined with the examination of Nonlinear Optimization II [2550113]. In this case, the duration of the written examination takes 120 minutes.

**Prerequisites**

The module component exam T-WIWI-103637 "Nonlinear Optimization I and II" may not be selected.

**Annotation**

Part I and II of the lecture are held consecutively in the same semester.

Below you will find excerpts from events related to this course:

**Nonlinear Optimization I**

2550111, WS 21/22, 2 SWS, Language: German, [Open in study portal]

**Content**

The lecture treats the minimization of smooth nonlinear functions without constraints. For such problems, which occur very often in economics, engineering, and natural sciences, optimality conditions are derived and, based on them, solution algorithms are developed. The lecture is structured as follows:

- Introduction, examples, and terminology
- Existence results for optimal points
- First and second order optimality conditions
- Algorithms (line search, steepest descent method, variable metric methods, Newton method, Quasi Newton methods, CG method, trust region method)

The lecture is accompanied by exercises which, amongst others, offers the opportunity to implement and to test some of the methods on practically relevant examples.

**Remark:**

The treatment of optimization problems with constraints forms the contents of the lecture "Nonlinear Optimization II". The lectures "Nonlinear Optimization I" and "Nonlinear Optimization II" are held consecutively in the same semester.

**Learning objectives:**

The student

- knows and understands fundamentals of unconstrained nonlinear optimization,
- is able to choose, design and apply modern techniques of unconstrained nonlinear optimization in practice.
Literature
O. Stein, Grundzüge der Nichtlinearen Optimierung, SpringerSpektrum, 2018

Weiterführende Literatur:
- W. Alt, Nichtlineare Optimierung, Vieweg, 2002
- M.S. Bazaraa, H.D. Sherali, C.M. Shetty, Nonlinear Programming, Wiley, 1993
3.201 Course: Nonlinear Optimization I and II [T-WIWI-103637]

**Responsible:** Prof. Dr. Oliver Stein

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101414 - Methodical Foundations of OR
- M-WIWI-101473 - Mathematical Programming

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**Events**

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<td>Nonlinear Optimization I</td>
<td>2 SWS</td>
<td>Lecture</td>
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<td>WT 21/22</td>
<td>2550112</td>
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<td>Practice</td>
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<td>2 SWS</td>
<td>Lecture</td>
<td>Stein</td>
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**Exams**

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<th>Grade to a third</th>
<th>Recurrence</th>
<th>Version</th>
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**Competence Certificate**

The assessment consists of a written exam (120 minutes) according to Section 4(2), 1 of the examination regulation. The successful completion of the exercises is required for admission to the written exam.

The exam takes place in the semester of the lecture and in the following semester.

**Prerequisites**

None.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-WIWI-102724 - Nonlinear Optimization I must not have been started.
2. The course T-WIWI-102725 - Nonlinear Optimization II must not have been started.

**Annotation**

Part I and II of the lecture are held consecutively in the same semester.

Below you will find excerpts from events related to this course:

**Nonlinear Optimization I**

2550111, WS 21/22, 2 SWS, Language: German, Open in study portal

Lecture (V)
Content
The lecture treats the minimization of smooth nonlinear functions without constraints. For such problems, which occur very often in economics, engineering, and natural sciences, optimality conditions are derived and, based on them, solution algorithms are developed. The lecture is structured as follows:

- Introduction, examples, and terminology
- Existence results for optimal points
- First and second order optimality conditions
- Algorithms (line search, steepest descent method, variable metric methods, Newton method, Quasi Newton methods, CG method, trust region method)

The lecture is accompanied by exercises which, amongst others, offers the opportunity to implement and to test some of the methods on practically relevant examples.

Remark:
The treatment of optimization problems with constraints forms the contents of the lecture "Nonlinear Optimization II". The lectures "Nonlinear Optimization I" and "Nonlinear Optimization II" are held consecutively in the same semester.

Learning objectives:
The student
- knows and understands fundamentals of unconstrained nonlinear optimization,
- is able to choose, design and apply modern techniques of unconstrained nonlinear optimization in practice.

Literature
O. Stein, Grundzüge der Nichtlinearen Optimierung, SpringerSpektrum, 2018

Weiterführende Literatur:
- W. Alt, Nichtlineare Optimierung, Vieweg, 2002
- M.S. Bazaraa, H.D. Sherali, C.M. Shetty, Nonlinear Programming, Wiley, 1993

V Nonlinear Optimization II
2550113, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
The lecture treats the minimization of smooth nonlinear functions under nonlinear constraints. For such problems, which occur very often in economics, engineering, and natural sciences, optimality conditions are derived and, based on them, solution algorithms are developed. The lecture is structured as follows:

- Topology and first order approximations of the feasible set
- Theorems of the alternative, first and second order optimality conditions
- Algorithms (penalty method, multiplier method, barrier method, interior point method, SQP method, quadratic optimization)

The lecture is accompanied by exercises which, amongst others, offers the opportunity to implement and to test some of the methods on practically relevant examples.

Remark:
The treatment of optimization problems without constraints forms the contents of the lecture "Nonlinear Optimization I". The lectures "Nonlinear Optimization I" and "Nonlinear Optimization II" are held consecutively in the same semester.

Learning objectives:
The student
- knows and understands fundamentals of constrained nonlinear optimization,
- is able to choose, design and apply modern techniques of constrained nonlinear optimization in practice.
Literature
O. Stein, Grundzüge der Nichtlinearen Optimierung, SpringerSpektrum, 2018

Weiterführende Literatur:

- W. Alt, Nichtlineare Optimierung, Vieweg, 2002
- M.S. Bazaraa, H.D. Sherali, C.M. Shetty, Nonlinear Programming, Wiley, 1993
3.202 Course: Nonlinear Optimization II [T-WIWI-102725]

**Responsible:** Prof. Dr. Oliver Stein

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101414 - Methodical Foundations of OR
- M-WIWI-101473 - Mathematical Programming

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<td>Practice</td>
<td>Stein, Beck, Schwarze, Neumann</td>
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<tr>
<td>WT 21/22</td>
<td>2550113</td>
<td>Nonlinear Optimization II</td>
<td>2 SWS</td>
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<td>Lecture</td>
<td>Stein</td>
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**Exams**

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<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Instructor(s)</th>
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<td>Nonlinear Optimization II</td>
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<td>Stein</td>
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</table>

**Competence Certificate**

The assessment consists of a written exam (60 minutes) according to Section 4(2), 1 of the examination regulation. The successful completion of the exercises is required for admission to the written exam.

The exam takes place in the semester of the lecture and in the following semester.

The exam can also be combined with the examination of Nonlinear Optimization I [2550111]. In this case, the duration of the written exam takes 120 minutes.

**Prerequisites**

None.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-WIWI-103637 - Nonlinear Optimization I and II must not have been started.

**Annotation**

Part I and II of the lecture are held consecutively in the same semester.

_Below you will find excerpts from events related to this course:_

**Nonlinear Optimization II**

2550113, WS 21/22, 2 SWS, Language: German, Open in study portal
# Course: Nonlinear Optimization II [T-WIWI-102725]

## Content

The lecture treats the minimization of smooth nonlinear functions under nonlinear constraints. For such problems, which occur very often in economics, engineering, and natural sciences, optimality conditions are derived and, based on them, solution algorithms are developed. The lecture is structured as follows:

- Topology and first order approximations of the feasible set
- Theorems of the alternative, first and second order optimality conditions
- Algorithms (penalty method, multiplier method, barrier method, interior point method, SQP method, quadratic optimization)

The lecture is accompanied by exercises which, amongst others, offers the opportunity to implement and to test some of the methods on practically relevant examples.

### Remark:

The treatment of optimization problems without constraints forms the contents of the lecture "Nonlinear Optimization I". The lectures "Nonlinear Optimization I" and "Nonlinear Optimization II" are held consecutively in the same semester.

### Learning objectives:

The student

- knows and understands fundamentals of constrained nonlinear optimization,
- is able to choose, design and apply modern techniques of constrained nonlinear optimization in practice.

### Literature

O. Stein, Grundzüge der Nichtlinearen Optimierung, SpringerSpektrum, 2018

Weiterführende Literatur:

- W. Alt, Nichtlineare Optimierung, Vieweg, 2002
- M.S. Bazaraa, H.D. Sherali, C.M. Shetty, Nonlinear Programming, Wiley, 1993
3.203 Course: Nonlinear Schroedinger and Wave Equations [T-MATH-106121]

**Responsible:** Prof. Dr. Lutz Weis

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-103086 - Nonlinear Schroedinger and Wave Equations

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<td>Grade to a third</td>
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3.204 Course: Nonlinear Wave Equations [T-MATH-110806]

**Responsible:** Dr. Birgit Schörkhuber

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105326 - Nonlinear Wave Equations

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**Prerequisites**
none
# 3.205 Course: Nonparametric Statistics [T-MATH-105873]

**Responsible:** Prof. Dr. Norbert Henze  
PD Dr. Bernhard Klar  

**Organisation:** KIT Department of Mathematics  

**Part of:** M-MATH-102910 - Nonparametric Statistics

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**Events**

| ST 2021 | 0165600 | Nichtparametrische Statistik | 2 SWS | Lecture / Online | Müller-Harknett |

**Exams**

| ST 2021 | 7700080 | Nonparametric Statistics | Müller-Harknett |

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
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<th><strong>3.206 Course: Numerical Analysis of Helmholtz Problems [T-MATH-111514]</strong></th>
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<tr>
<td><strong>Responsible:</strong> Dr. Barbara Verfürth</td>
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<tr>
<td><strong>Organisation:</strong> KIT Department of Mathematics</td>
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<td><strong>Part of:</strong> M-MATH-105764 - Numerical Analysis of Helmholtz Problems</td>
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<th><strong>Expansion</strong></th>
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3.207 Course: Numerical Continuation Methods [T-MATH-105912]

**Responsible:** Prof. Dr. Jens Rottmann-Matthes  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102944 - Numerical Continuation Methods

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**Prerequisites**

none
### 3.208 Course: Numerical Linear Algebra for Scientific High Performance Computing [T-MATH-107497]

**Responsible:** Dr. Hartwig Anzt  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103709 - Numerical Linear Algebra for Scientific High Performance Computing

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**Events**

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**Exams**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**

*none*
3.209 Course: Numerical Linear Algebra in Image Processing [T-MATH-108402]

**Responsible:** PD Dr. Volker Grimm

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-104058 - Numerical Linear Algebra in Image Processing

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**Prerequisites**

none
### 3.210 Course: Numerical Methods for Differential Equations [T-MATH-105836]

**Responsible:**
- Prof. Dr. Willy Dörfler
- Prof. Dr. Marlis Hochbruck
- Prof. Dr Tobias Jahnke
- Prof. Dr. Andreas Rieder
- Prof. Dr. Christian Wieners

**Organisation:**
KIT Department of Mathematics

**Part of:**
- **M-MATH-102888** - Numerical Methods for Differential Equations

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**Events**

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<td>Numerische Methoden für Differentialgleichungen</td>
<td>4 SWS</td>
<td>Lecture</td>
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<td>WT 21/22</td>
<td>0110800</td>
<td>Übungen zu 0110700</td>
<td>2 SWS</td>
<td>Practice</td>
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3.211 Course: Numerical Methods for Hyperbolic Equations [T-MATH-105900]

Responsible: Prof. Dr. Willy Dörfler
Organisation: KIT Department of Mathematics
Part of: M-MATH-102915 - Numerical Methods for Hyperbolic Equations

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<td>Grade to a third</td>
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Prerequisites
none
3.212 Course: Numerical Methods for Integral Equations [T-MATH-105901]

**Responsible:** PD Dr. Tilo Arens  
PD Dr. Frank Hettlich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102930 - Numerical Methods for Integral Equations

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**Events**

| ST 2021 | 0160500 | Numerische Methoden für Integralgleichungen | 4 SWS | Lecture / 🖥 | Arens |

**Exams**

| ST 2021 | 7700092 | Numerical Methods for Integral Equations | Arens |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗓 On-Site, ⌚ Cancelled
Course: Numerical Methods for Maxwell's Equations [T-MATH-105920]

Responsible: Prof. Dr. Marlis Hochbruck
Prof. Dr Tobias Jahnke

Organisation: KIT Department of Mathematics

Part of: M-MATH-102931 - Numerical Methods for Maxwell's Equations

Type: Oral examination
Credits: 6
Grading scale: Grade to a third
Version: 1

Mathematics Master 2016 (Master of Science (M.Sc.))
Module Handbook as of 21/09/2021

Responsible: Prof. Dr. Marlis Hochbruck
Prof. Dr. Tobias Jahnke

Organisation: KIT Department of Mathematics

Part of: M-MATH-102928 - Numerical Methods for Time-Dependent Partial Differential Equations

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<td>Numerical Methods for Time-Dependent Partial Differential Equations on October 1, 2021</td>
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<td>Hochbruck</td>
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Legend: 🖥 Online, Blended (On-Site/Online), 👨 On-Site, ❌ Cancelled
3.215 Course: Numerical Methods in Computational Electrodynamics [T-MATH-105860]

**Responsible:**
- Prof. Dr. Willy Dörfler
- Prof. Dr. Marlis Hochbruck
- Prof. Dr. Tobias Jahnke
- Prof. Dr. Andreas Rieder
- Prof. Dr. Christian Wieners

**Organisation:**
- KIT Department of Mathematics

**Part of:**
- M-MATH-102894 - Numerical Methods in Computational Electrodynamics

**Type**
- Oral examination

**Credits**
- 6

**Grading scale**
- Grade to a third

**Version**
- 1

**Prerequisites**
- none
### 3.216 Course: Numerical Methods in Fluid Mechanics [T-MATH-105902]

**Responsible:** Prof. Dr. Willy Dörfler  
PD Dr. Gudrun Thäter  

**Organisation:** KIT Department of Mathematics  

**Part of:** M-MATH-102932 - Numerical Methods in Fluid Mechanics  

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#### Events

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<tbody>
<tr>
<td>0164200</td>
<td>Numerische Methoden in der Strömungsmechanik</td>
<td>2</td>
<td>Lecture</td>
<td>Thäter</td>
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<tr>
<td>0164210</td>
<td>Übungen zu 0164210 (Numerische Methoden in der Strömungsmechanik)</td>
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#### Exams

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<td>7700053</td>
<td>Numerical Methods in Fluid Mechanics</td>
<td>Thäter</td>
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Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
### 3.217 Course: Numerical Methods in Mathematical Finance [T-MATH-105865]

<table>
<thead>
<tr>
<th>Responsible</th>
<th>Prof. Dr Tobias Jahnke</th>
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<tbody>
<tr>
<td>Organisation</td>
<td>KIT Department of Mathematics</td>
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<tr>
<td>Part of</td>
<td>M-MATH-102901 - Numerical Methods in Mathematical Finance</td>
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<td>Version</td>
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#### Exams

| ST 2021 | 7700055 | Numerical Methods in Mathematical Finance | Jahnke |

**Prerequisites**

none
### 3.218 Course: Numerical Methods in Mathematical Finance II [T-MATH-105880]

**Responsible:** Prof. Dr Tobias Jahnke  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102914 - Numerical Methods in Mathematical Finance II

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**Competition Certificate**  
Mündliche Prüfung im Umfang von ca. 30 Minuten

**Prerequisites**  
none
3.219 Course: Numerical Optimisation Methods [T-MATH-105858]

**Responsible:** Prof. Dr. Willy Dörfler
Prof. Dr. Marlis Hochbruck
Prof. Dr Tobias Jahnke
Prof. Dr. Andreas Rieder
Prof. Dr. Christian Wieners

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102892 - Numerical Optimisation Methods

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<td>Grade to a third</td>
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</table>
### 3.220 Course: Numerical Simulation in Molecular Dynamics [T-MATH-110807]

| Responsible: | PD Dr. Volker Grimm |
| Organisation: | KIT Department of Mathematics |
| Part of: | M-MATH-105327 - Numerical Simulation in Molecular Dynamics |

<table>
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<td>Grade to a third</td>
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**Prerequisites**

none
3.221 Course: Operations Research in Supply Chain Management [T-WIWI-102715]

**Responsible:** Prof. Dr. Stefan Nickel

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101473 - Mathematical Programming
- M-WIWI-102832 - Operations Research in Supply Chain Management

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**Exams**

| ST 2021 | 7900283  | Operations Research in Supply Chain Management | Nickel |

**Competence Certificate**

The assessment is a 60 minutes written examination (according to §4(2), 1 of the examination regulation).

The examination is held in the term of the lecture and the following lecture.

**Prerequisites**

None

**Recommendation**

Basic knowledge as conveyed in the module Introduction to Operations Research and in the lectures Facility Location and Strategic SCM, Tactical and operational SCMs assumed.

**Annotation**

The course is offered irregularly. Planned lectures for the next three years can be found in the internet at http://dol.ior.kit.edu/english/Courses.php.
3.222 Course: Optical Waveguides and Fibers [T-ETIT-101945]

**Responsible:** Prof. Dr.-Ing. Christian Koos

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** M-ETIT-100506 - Optical Waveguides and Fibers

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<td>Optical Waveguides</td>
<td>2 SWS</td>
<td>Koos</td>
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<td></td>
<td></td>
<td>and Fibers</td>
<td>Lecture</td>
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<tr>
<td>WT 21/22</td>
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<td>Tutorial for 2309464</td>
<td>1 SWS</td>
<td>Koos</td>
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<td></td>
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<td>Optical Waveguides and Fibers</td>
<td>Practice</td>
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<td>Koos</td>
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<td>and Fibers</td>
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<td>WT 21/22</td>
<td>7309464</td>
<td>Optical Waveguides</td>
<td>Koos</td>
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<tr>
<td></td>
<td></td>
<td>and Fibers</td>
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**Prerequisites**

none
3.223 Course: Optimal Control and Estimation [T-ETIT-104594]

**Responsible:** Prof. Dr.-Ing. Sören Hohmann

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** M-ETIT-102310 - Optimal Control and Estimation

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<td>Grade to a third</td>
<td>Each summer term</td>
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**Events**

| ST 2021 | 2303162 | **Optimale Regelung und Schätzung** 2 SWS | Lecture / 🖥 | Kluwe |

**Exams**

| ST 2021 | 7303162 | **Optimal Control and Estimation** | Kluwe |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔔 On-Site, ✗ Cancelled

**Prerequisites**

none
3.224 Course: Optimisation and Optimal Control for Differential Equations [T-MATH-105864]

Organisation: KIT Department of Mathematics
Part of: M-MATH-102899 - Optimisation and Optimal Control for Differential Equations

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<td>Grade to a third</td>
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Prerequisites
none
3.225 Course: Optimization in Banach Spaces [T-MATH-105893]

**Responsible:** Prof. Dr. Roland Griesmaier
PD Dr. Frank Hettlich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102924 - Optimization in Banach Spaces

**Type:** Oral examination

**Credits:** 8

**Grading scale:** Grade to a third

**Version:** 1

**Prerequisites**
none
3.226 Course: Optimization Models and Applications [T-WIWI-110162]

**Responsible:** Dr. Nathan Sudermann-Merx  
**Organisation:** KIT Department of Economics and Management  
**Part of:**  
- M-WIWI-101473 - Mathematical Programming  
- M-WIWI-102832 - Operations Research in Supply Chain Management

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<td>see Annotations</td>
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**Competence Certificate**
The examination will take place for the last time in the winter semester 2020/2021.  
The assessment consists of a written exam (60 min.) according to § 4 paragraph 2 Nr. 1 of the examination regulation.  
The prerequisite for participation in the exam is the achievement of a minimum number of points in delivery sheets. Details will be announced at the beginning of the course.

**Prerequisites**  
None.

**Annotation**  
The course will take place for the last time in the winter semester 20/21.
### Course: Optimization of Dynamic Systems [T-ETIT-100685]

**Responsible:** Prof. Dr.-Ing. Sören Hohmann  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-100531 - Optimization of Dynamic Systems

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<td>Optimization of Dynamic Systems</td>
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<td>Lecture</td>
<td>Hohmann</td>
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<td>WT 21/22</td>
<td>2303185</td>
<td>Optimization of Dynamic Systems (Tutorial to 2303183)</td>
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<td>Practice</td>
<td>Bohn</td>
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<td>WT 21/22</td>
<td>2303851</td>
<td>Accompanying group tutorial for 2303183 Optimization of Dynamic Systems</td>
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#### Exams

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<td>Optimization of Dynamic Systems</td>
<td>Hohmann</td>
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</table>

#### Competence Certificate

The assessment consists of a written exam (120 min) taking place in the recess period.

#### Prerequisites

none
### 3.228 Course: Optimization Under Uncertainty [T-WIWI-106545]

**Responsible:** Prof. Dr. Steffen Rebennack  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101413 - Applications of Operations Research

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<td>Optimization under Uncertainty</td>
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**Competence Certificate**

The assessment consists of a written exam (60 minutes) according to Section 4(2), 1 of the examination regulation. The exam takes place in every the semester.

**Prerequisites**

None.
### 3.229 Course: Parallel Computing [T-MATH-102271]

**Responsible:** Dr. rer. nat. Mathias Krause  
Prof. Dr. Christian Wieners

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-101338 - Parallel Computing

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</table>
3.230 Course: Parametric Optimization [T-WIWI-102855]

**Responsible:** Prof. Dr. Oliver Stein  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101473 - Mathematical Programming

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<td>Grade to a third</td>
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**Exams**
- ST 2021 7900274_SS2021_NK Parametric Optimization Stein

**Competence Certificate**
The assessment of the lecture is a written examination (60 minutes) according to §4(2), 1 of the examination regulation. The successful completion of the exercises is required for admission to the written exam. The examination is held in the semester of the lecture and in the following semester.

**Prerequisites**
None

**Recommendation**
It is strongly recommended to visit at least one lecture from the Bachelor program of this chair before attending this course.

**Annotation**
The lecture is offered irregularly. The curriculum of the next three years is available online (www.ior.kit.edu).
3.231 Course: Percolation [T-MATH-105869]

**Responsible:** Prof. Dr. Günter Last

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102905 - Percolation

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**Prerequisites**
none
### Course: Photorealistic Rendering [T-INFO-101268]

**Responsible:** Prof. Dr.-Ing. Carsten Dachsbacher  
**Organisation:** KIT Department of Informatics  
**Part of:** M-INFO-100731 - Photorealistic Rendering

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<td>Each summer term</td>
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**Events**

| ST 2021 | 24682 | **Fotorealistische Bildsynthese** | 2 SWS | Lecture / 🖥 | Schudeiske |

**Exams**

| ST 2021 | 7500124 | **Photorealistic Rendering** | | Dachsbacher |

Legend: 🖥 Online, ⚰️ Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
3.233 Course: Physiology and Anatomy for Engineers I [T-ETIT-101932]

**Responsible:** Prof. Dr. Werner Nahm

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** M-ETIT-100390 - Physiology and Anatomy for Engineers I

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<td>Each winter term</td>
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**Events**

| WT 21/22 | 2305281 | Physiology and Anatomy for Engineers I | 2 SWS | Lecture | Nahm |

**Exams**

| ST 2021 | 7305281 | Physiology and Anatomy for Engineers I | Breustedt |

**Competence Certificate**

Success control is carried out in the form of a written test of 60 minutes.

**Prerequisites**

none
### 3.234 Course: Poisson Processes [T-MATH-105922]

**Responsible:** Prof. Dr. Vicky Fasen-Hartmann  
Prof. Dr. Daniel Hug  
Prof. Dr. Günter Last

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102922 - Poisson Processes

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**Prerequisites**
none
### 3.235 Course: Potential Theory [T-MATH-105850]

**Responsible:**
- PD Dr. Tilo Arens
- PD Dr. Frank Hettlich
- Prof. Dr. Andreas Kirsch
- Prof. Dr. Wolfgang Reichel

**Organisation:**
- KIT Department of Mathematics

**Part of:**
- M-MATH-102879 - Potential Theory

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Mathematics Master 2016 (Master of Science (M.Sc.))
Module Handbook as of 21/09/2021
### Course: Predictive Driver Assistance Systems [T-ETIT-100692]

**Responsible:** Dr. Rüdiger Walter Henn

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** M-ETIT-100360 - Predictive Driver Assistance Systems

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<td>Grade to a third</td>
<td>Each winter term</td>
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**Events**

| WT 21/22 | 2308097 | Predictive Driver Assistance Systems | 2 SWS | Lecture | Henn, Weber |

**Exams**

| ST 2021 | 7308097 | Predictive Driver Assistance Systems | Henn |

**Prerequisites**

none

**Responsible:** Prof. Dr. Daniel Hug  
Prof. Dr. Günter Last  

**Organisation:** KIT Department of Mathematics  

**Part of:** [M-MATH-102947 - Probability Theory and Combinatorial Optimization](#)  

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**Prerequisites**  
none
### 3.238 Course: Process Mining [T-WIWI-109799]

**Responsible:** Prof. Dr. Andreas Oberweis  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101472 - Informatics

<table>
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<td>Process Mining</td>
<td>2</td>
<td>Lecture / 🖥️</td>
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<td>ST 2021</td>
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<td>Lecture (V)</td>
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Legend: 🖥️ Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled

#### Competence Certificate

The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation in the first week after lecture period.

#### Prerequisites

None

#### Annotation

Former name (up to winter semester 2018/1019) "Workflow Management".

Below you will find excerpts from events related to this course:

#### Process Mining

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<thead>
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Lecture (V)  
Online
Content
The area of process mining covers approaches which aim at deducting new knowledge on the basis of logfiles generated by information systems. Such information systems are e.g., workflow-management-systems which are used for an efficient control of processes and organizations. The lecture introduces the foundations of processes and respective modeling and analysis techniques. In the following, the foundations of process mining and the three classical types of approaches - discovery, conformance and enhancement - will be taught. In addition to the theoretical basics, tools, application scenarios in practice and open research questions are covered as well.

Learning objectives:
Students
- understand the concepts and approaches of process mining and know how they are applied,
- create and evaluate business process models,
- analyze static and dynamic properties of workflows,
- apply approaches and tools of process mining.

Recommendations:
Knowledge of course Applied Informatics - Modelling is expected.

Workload:
- Lecture 30h
- Exercise 15h
- Preparation of lecture 24h
- Preparation of exercises 25h
- Exam preparation 40h
- Exam 1h

Literature

Weitere Literatur wird in der Vorlesung bekannt gegeben.
### 3.239 Course: Project Centered Software-Lab [T-MATH-105907]

**Responsible:** PD Dr. Gudrun Thäter  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102938 - Project Centered Software-Lab

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#### Exams

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

### Prerequisites

none
**3.240 Course: Project Lab Cognitive Automobiles and Robots [T-WIWI-109985]**

**Responsible:** Prof. Dr.-Ing. Johann Marius Zöllner

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101472 - Informatics

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**Exams**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

The alternative exam assessment consists of:

- a practical work
- a presentation and
- a written seminar thesis

Details of the grade formation will be announced at the beginning of the course.

**Prerequisites**

None

**Below you will find excerpts from events related to this course:**

**Cognitive Automobiles and Robots**

2513500, SS 2021, 2 SWS, Language: German/English, [Open in study portal]

**Content**

The seminar is intended as a theoretical supplement to lectures such as "Machine Learning". The theoretical basics will be deepened in the seminar. The aim of the seminar is that the participants work individually to analyze a subsystem from the field of robotics and cognitive systems using one or more procedures from the field of AI/ML.

The individual projects require the analysis of the task at hand, selection of suitable procedures, specification and theoretical evaluation of the approach taken. Finally, the chosen solution has to be documented and presented in a short presentation.

**Learning objectives:**

- Students can apply knowledge from the Machine Learning lecture in a selected field of current research in robotics or cognitive automobiles for theoretical analysis.
- Students can evaluate, document and present their concepts and results.

**Recommendations:**

Attendance of the lecture machine learning

**Workload:**

The workload of 3 credit points consists of the time spent on literature research and planning/specifying the proposed solution. In addition, a short report and a presentation of the work carried out will be prepared.

**Organizational issues**

Anmeldung und weitere Informationen sind im WiWi-Portal zu finden.

Registration and further information can be found in the WiWi-portal.
Content
The lab is intended as a practical supplement to lectures such as "Machine Learning". The theoretical basics are applied in the lab course. The aim of the lab course is that the participants work together to design, develop and evaluate a subsystem from the field of robotics and cognitive systems using one or more procedures from the field of AI/ML.

In addition to the scientific objectives involved in the investigation and application of the methods, aspects of project-specific teamwork in research (from specification to presentation of the results) are also developed in this practical course.

The individual projects require the analysis of the task at hand, selection of suitable procedures, specification and implementation and evaluation of the approach taken. Finally, the chosen solution has to be documented and presented in a short presentation.

Learning objectives:
- Students can practically apply knowledge from the Machine Learning lecture in a selected field of current research in robotics or cognitive automobiles.
- Students master the analysis and solution of corresponding problems in a team.
- Students can evaluate, document and present their concepts and results.

Recommendations:
Attendance of the lecture machine learning, C/C++ knowledge, Python knowledge

Workload:
The workload of 4.5 credit points consists of the time spent in the lab for practical implementation of the selected solution, as well as the time spent on literature research and planning/specifying the proposed solution. In addition, a short report and a presentation of the work carried out will be prepared.

Organizational issues
Anmeldung und weitere Informationen sind im WiWi-Portal zu finden.
Registration and further information can be found in the WiWi-portal.
3.241 Course: Project Lab Machine Learning [T-WIWI-109983]

**Responsible:** Prof. Dr.-Ing. Johann Marius Zöllner

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101472 - Informatics

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**Exams**

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Legend: 🏥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ☠ Cancelled

**Competence Certificate**

The alternative exam assessment consists of:

- a practical work
- a presentation and
- a written seminar thesis

Details of the grade formation will be announced at the beginning of the course.

**Prerequisites**

None

**Below you will find excerpts from events related to this course:**

### Project Lab Machine Learning

**2512500, SS 2021, 3 SWS, Language: German/English, Open in study portal**

**Practical course (P)**

**Blended (On-Site/Online)**

---

**Content**

The lab is intended as a practical supplement to lectures such as "Machine Learning". The theoretical basics are applied in the lab course. The aim of the lab course is that the participants work together to design, develop and evaluate a subsystem from the field of robotics and cognitive systems using one or more procedures from the field of AI/ML.

In addition to the scientific objectives involved in the investigation and application of the methods, aspects of project-specific teamwork in research (from specification to presentation of the results) are also developed in this practical course.

The individual projects require the analysis of the task at hand, selection of suitable procedures, specification and implementation and evaluation of the approach taken. Finally, the chosen solution has to be documented and presented in a short presentation.

**Learning objectives:**

- Students can practically apply knowledge from the Machine Learning lecture in a selected field of current research in robotics or cognitive automobiles.
- Students master the analysis and solution of corresponding problems in a team.
- Students can evaluate, document and present their concepts and results.

**Recommendations:**

Attendance of the lecture machine learning, C/C++ knowledge, Python knowledge

**Workload:**

The workload of 4.5 credit points consists of the time spent in the lab for practical implementation of the selected solution, as well as the time spent on literature research and planning/specifying the proposed solution. In addition, a short report and a presentation of the work carried out will be prepared.
Organizational issues
Anmeldung und weitere Informationen sind im WiWi-Portal zu finden.
Registration and further information can be found in the WiWi-portal.
3.242 Course: Random Graphs [T-MATH-105929]

- **Responsible:** Dr. Matthias Schulte
- **Organisation:** KIT Department of Mathematics
- **Part of:** M-MATH-102951 - Random Graphs

**Prerequisites**
none

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# 3.243 Course: Robotics I - Introduction to Robotics [T-INFO-108014]

**Responsible:** Prof. Dr.-Ing. Tamim Asfour  
**Organisation:** KIT Department of Informatics  
**Part of:** M-INFO-100893 - Robotics I - Introduction to Robotics

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Legend: 🖥 Online, 🧱 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled
3.244 Course: Ruin Theory [T-MATH-108400]

**Responsible:** Prof. Dr. Vicky Fasen-Hartmann

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-104055 - Ruin Theory

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Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗽 On-Site, ✗ Cancelled

**Prerequisites**

none
T 3.245 Course: Scattering Theory [T-MATH-105855]

Responsible: PD Dr. Tilo Arens
      Prof. Dr. Roland Griesmaier
      PD Dr. Frank Hettlich

Organisation: KIT Department of Mathematics

Part of: M-MATH-102884 - Scattering Theory

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Legend: 🛩 Online, 🧩 Blended (On-Site/Online), 🔵 On-Site, ☑ Cancelled
3.247 Course: Selected Issues in Critical Information Infrastructures [T-WIWI-109251]

**Responsible:** Prof. Dr. Ali Sunyaev

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101472 - Informatics

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**Exams**

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**Legend:** 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
Alternative exam assessment (§ 4(2), 3 SPO). Details will be announced in the respective course.

**Prerequisites**
None.

**Annotation**
T-WIWI-109251 "Selected Issues in Critical Information Infrastructures" serves to credit an extracurricular course in the module "Critical Digital Infrastructures".
3.248 Course: Selected Topics in Cryptography [T-INFO-101373]

**Responsible:** Prof. Dr. Jörn Müller-Quade

**Organisation:** KIT Department of Informatics

**Part of:** M-INFO-100836 - Selected Topics in Cryptography

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3.249 Course: Selected Topics in Harmonic Analysis [T-MATH-109065]

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<tr>
<th>Responsible</th>
<th>Prof. Dr. Dirk Hundertmark</th>
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Prerequisites
none
3.250 Course: Self-Booking-HOC-SPZ-ZAK-1-Graded [T-MATH-111515]

**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103053 - Key Competences

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**Self service assignment of supplementary studies**  
This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

**Annotation**  
Placeholder for self-booking of a graded interdisciplinary qualification, which was provided at the House of Competence, the “Sprachenzentrum” or the Center for Applied Cultural Studies and Studium Generale.
Course: Self-Booking-HOC-SPZ-ZAK-2-Graded [T-MATH-111517]

** Organisation:** KIT Department of Mathematics  
** Part of:** M-MATH-103053 - Key Competences

### Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

### Annotation

Placeholder for self-booking of a graded interdisciplinary qualification, which was provided at the House of Competence, the "Sprachenzentrum" or the Center for Applied Cultural Studies and Studium Generale.
3.252 Course: Self-Booking-HOC-SPZ-ZAK-4-Graded [T-MATH-111519]

Organisation: KIT Department of Mathematics
Part of: M-MATH-103053 - Key Competences

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Self service assignment of supplementary studies
This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

Annotation
Placeholder for self-booking of a graded interdisciplinary qualification, which was provided at the House of Competence, the "Sprachenzentrum" or the Center for Applied Cultural Studies and Studium Generale.
Course: Self-Booking-HOC-SPZ-ZAK-5-Ungraded [T-MATH-111516]

Organisation: KIT Department of Mathematics
Part of: M-MATH-103053 - Key Competences

Self service assignment of supplementary studies
This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

Annotation
Placeholder for self-booking of a graded interdisciplinary qualification, which was provided at the House of Competence, the “Sprachzentrum” or the Center for Applied Cultural Studies and Studium Generale.
3.254 Course: Self-Booking-HOC-SPZ-ZAK-6-Ungraded [T-MATH-111520]

**Organisation:** KIT Department of Mathematics  
**Part of:** [M-MATH-103053 - Key Competences](#)

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**Self service assignment of supplementary studies**
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence  
- Sprachenzentrum  
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

**Annotation**
Placeholder for self-booking of a graded interdisciplinary qualification, which was provided at the House of Competence, the "Sprachzentrum" or the Center for Applied Cultural Studies and Studium Generale.
3.255 Course: Self-Booking-HOC-SPZ-ZAK-7-Ungraded [T-MATH-111521]

**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103053 - Key Competences

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**Self service assignment of supplementary studies**
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

**Annotation**
Placeholder for self-booking of a graded interdisciplinary qualification, which was provided at the House of Competence, the “Sprachzentrum” or the Center for Applied Cultural Studies and Studium Generale.
3.256 Course: Self-Booking-HOC-SPZ-ZAK-8-Ungraded [T-MATH-111522]

**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103053 - Key Competences

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**Self service assignment of supplementary studies**  
This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

**Annotation**  
Placeholder for self-booking of a graded interdisciplinary qualification, which was provided at the House of Competence, the “Sprachenzentrum” or the Center for Applied Cultural Studies and Studium Generale.
3.257 Course: Self-Booking-HOC-SPZ-ZAK-Graded [T-MATH-111518]

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-103053 - Key Competences

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**Self service assignment of supplementary studies**

This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

**Annotation**

Placeholder for self-booking of a graded interdisciplinary qualification, which was provided at the House of Competence, the “Sprachenzentrum” or the Center for Applied Cultural Studies and Studium Generale.
3.258 Course: Semantic Web Technologies [T-WIWI-110848]

Responsible: Tobias Christof Käfer
Organisation: KIT Department of Economics and Management
Part of: M-WIWI-101472 - Informatics

Type  | Credits | Grading scale | Recurrence  | Version
--- | --- | --- | --- | ---
Written examination | 4,5 | Grade to a third | Each summer term | 1

Events

| ST 2021 | 2511310 | Semantic Web Technologies | 2 SWS | Lecture / 🖥 | Färber, Käfer, Heling
| ST 2021 | 2511311 | Exercises to Semantic Web Technologies | 1 SWS | Practice / 🖥 | Färber, Käfer, Heling

Exams

| ST 2021 | 7900028 | Semantic Web Technologies (Registration until 12 July 2021) | Färber

Legend: Online, 🖥 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Competence Certificate
The assessment consists of an 1h written exam following §4, Abs. 1 of the examination regulation or of an oral exam (20 min) following §4, Abs. 2, of the examination regulation.

The exam takes place every semester and can be repeated at every regular examination date.

Prerequisites
None

Recommendation
Lectures on Informatics of the Bachelor on Information Systems (Semester 1–4) or equivalent are required.

Below you will find excerpts from events related to this course:

Semantic Web Technologies
2511310, SS 2021, 2 SWS, Language: English, Open in study portal

Lecture (V)
Online
Content
The aim of the Semantic Web is to make the meaning (semantics) of data on the web usable in intelligent systems, e.g. in e-commerce and internet portals.

Central concepts are the representation of knowledge in form of RDF and ontologies, the access via Linked Data, as well as querying the data by using SPARQL. This lecture provides the foundations of knowledge representation and processing for the corresponding technologies and presents example applications.

The following topics are covered:

- Resource Description Framework (RDF) and RDF Schema (RDFS)
- Web Architecture and Linked Data
- Web Ontology Language (OWL)
- Query language SPARQL
- Rule languages
- Applications

Learning objectives:
The student

- understands the motivation and foundational ideas behind Semantic Web and Linked Data technologies, and is able to analyse and realise systems
- demonstrates basic competency in the areas of data and system integration on the web
- masters advanced knowledge representation scenarios involving ontologies

Recommendations:
Lectures on Informatics of the Bachelor on Information Systems (Semester 1-4) or equivalent are required. Knowledge of modeling with UML is required.

Workload:

- The total workload for this course is approximately 135 hours
- Time of presentness: 45 hours
- Time of preparation and postprocessing: 60 hours
- Exam and exam preparation: 30 hours

Literature


Weitere Literatur


Exercises to Semantic Web Technologies
2511311, SS 2021, 1 SWS, Language: English, Open in study portal
Content
The exercises are related to the lecture Semantic Web Technologies. Multiple exercises are held that capture the topics, held in the lecture Semantic Web Technologies, and discuss them in detail. Thereby, practical examples are given to the students in order to transfer theoretical aspects into practical implementation.

The following topics are covered:

- Resource Description Framework (RDF) and RDF Schema (RDFS)
- Web Architecture and Linked Data
- Web Ontology Language (OWL)
- Query language SPARQL
- Rule languages
- Applications

Learning objectives:
The student

- understands the motivation and foundational ideas behind Semantic Web and Linked Data technologies, and is able to analyse and realise systems
- demonstrates basic competency in the areas of data and system integration on the web
- masters advanced knowledge representation scenarios involving ontologies

Recommendations:
Lectures on Informatics of the Bachelor on Information Systems (Semester 1-4) or equivalent are required. Knowledge of modeling with UML is required.

Literature


Weitere Literatur

3.259 Course: Seminar Advanced Topics in Parallel Programming [T-INFO-103584]

**Responsibe:** Prof. Dr. Achim Streit
**Organisation:** KIT Department of Informatics
**Part of:** M-INFO-101887 - Seminar Advanced Topics in Parallel Programming

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Mathematics Master 2016 (Master of Science (M.Sc.))
Module Handbook as of 21/09/2021
### 3.260 Course: Seminar Mathematics [T-MATH-106541]

**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103276 - Seminar

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### 3.261 Course: Seminar Mathematics [T-MATH-105686]

**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102730 - Seminar

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3.262 Course: Seminar Mathematics 2 [T-MATH-108020]

**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103925 - Seminar 2

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**Exams**

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3.263 Course: Signals and Codes [T-INFO-101360]

**Responsible:** Prof. Dr. Jörn Müller-Quade  
**Organisation:** KIT Department of Informatics  
**Part of:** M-INFO-100823 - Signals and Codes

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Below you will find excerpts from events related to this course:**

**Signals and Codes**

24137, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)  
Lecture (V)  
Blended (On-Site/Online)

---

**Content**

In this lecture, bounds for codes (Hamming, Gilbert-Varshamov, Singleton) are presented. Coding and decoding for classical algebraic codes (linear, cyclic, Reed Solomon-, Goppa- und Reed Muller-codes) will be presented as well as concatenated codes.

**Literature**

Todd Moon, 'Error Correction Coding', Wiley, 2005  
Weitere Literatur wird in der Vorlesung bekannt gegeben.

**Weiterführende Literatur**

Wird in der Vorlesung bekannt gegeben.
# 3.264 Course: Smart Energy Infrastructure [T-WIWI-107464]

**Responsible:** Dr. Armin Ardone  
Dr. Dr. Andrej Marko Pustisek  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101452 - Energy Economics and Technology

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## Events

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## Competence Certificate

The assessment consists of a written exam (60 minutes). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

## Prerequisites

None.

Below you will find excerpts from events related to this course:

## Content

- Basic terms and concepts
- Meaning of infrastructure
- Excursus: regulation of infrastructure
- Natural gas transportation
- Natural gas storage
- Electricity transmission
- (Overview) Crude oil and oil product transportation
### 3.265 Course: Sobolev Spaces [T-MATH-105896]

**Responsible:** Prof. Dr. Andreas Kirsch  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102926 - Sobolev Spaces

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔔 On-Site, ✗ Cancelled
3.266 Course: Social Choice Theory [T-WIWI-102859]

**Responsible:** Prof. Dr. Clemens Puppe  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101500 - Microeconomic Theory

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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

The assessment consists of an alternative exam assessment (open book exam). The exam takes place in every summer semester.

**Prerequisites**

None

Below you will find excerpts from events related to this course:

**Social Choice Theory**  
2520537, SS 2021, 2 SWS, Language: English, Open in study portal

**Content**

How should (political) candidates be elected? What are good ways of merging individual judgments into collective judgments? Social Choice Theory is the systematic study and comparison of how groups and societies can come to collective decisions.

The course offers a rigorous and comprehensive treatment of judgment and preference aggregation as well as voting theory. It is divided into two parts. The first part deals with (general binary) aggregation theory and builds towards a general impossibility result that has the famous Arrow theorem as a corollary. The second part treats voting theory. Among other things, it includes proving the Gibbard-Satterthwaite theorem.

**Literature**

Main texts:


Secondary texts:

### 3.267 Course: Sociotechnical Information Systems Development [T-WIWI-109249]

**Responsible:** Prof. Dr. Ali Sunyaev  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101472 - Informatics

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**Exams**

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**Legend:** Online, Blend (On-Site/Online), On-Site, Cancelled

### Competence Certificate

The alternative exam assessment consists of an implementation and a final thesis documenting the development and use of the application.

### Prerequisites

None.

**Below you will find excerpts from events related to this course:**

#### Advanced Lab Development of Sociotechnical Information Systems (Bachelor)

*2512400, SS 2021, 3 SWS, Language: German/English, [Open in study portal](#)*

**Content**

The aim of the lab is to get to know the development of socio-technical information systems in different application areas. In the event framework, you should develop a suitable solution strategy for your problem alone or in group work, collect requirements, and implement a software artifact based on it (for example, web platform, mobile apps, desktop application). Another focus of the lab is on the subsequent quality assurance and documentation of the implemented software artifact.

Registration information will be announced on the course page.

#### Development of Sociotechnical Information Systems (Master)

*2512401, SS 2021, 3 SWS, Language: German/English, [Open in study portal](#)*

**Content**

The aim of the lab is to get to know the development of socio-technical information systems in different application areas. In the event framework, you should develop a suitable solution strategy for your problem alone or in group work, collect requirements, and implement a software artifact based on it (for example, web platform, mobile apps, desktop application). Another focus of the lab is on the subsequent quality assurance and documentation of the implemented software artifact.

Registration information will be announced on the course page.
3.268 Course: Software Quality Management [T-WIWI-102895]

Responsible: Prof. Dr. Andreas Oberweis
Organisation: KIT Department of Economics and Management
Part of: M-WIWI-101472 - Informatics

<table>
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<td>Each summer term</td>
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Events

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<th>CWS</th>
<th>Type</th>
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<td>ST 2021</td>
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<td>Software Quality Management</td>
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<td>Lecture / 🖥️</td>
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Exams

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<tr>
<td>ST 2021</td>
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<td>Software Quality Management (Registration until 12 July 2021)</td>
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<td>WT 21/22</td>
<td>7900027</td>
<td>Software Quality Management</td>
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<td>Practice / 🖥️</td>
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</table>

Legend: 🖥️ Online, Blended (On-Site/Online), On-Site, X Cancelled

Competence Certificate
The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation in the first week after lecture period.

Prerequisites
None

Below you will find excerpts from events related to this course:

Software Quality Management
2511208, SS 2021, 2 SWS, Language: German, Open in study portal
Lecture (V) Online

Content
This lecture imparts fundamentals of active software quality management (quality planning, quality testing, quality control, quality assurance) and illustrates them with concrete examples, as currently applied in industrial software development. Keywords of the lecture content are: software and software quality, process models, software process quality, ISO 9000-3, CMM(I), BOOTSTRAP, SPICE, software tests.

Learning objectives:
Students

- explain the relevant quality models,
- apply methods to evaluate the software quality and evaluate the results,
- know the mail models of software certification, compare and evaluate these models,
- write scientific theses in the area of software quality management and find own solutions for given problems.

Recommendations:
Programming knowledge in Java and basic knowledge of computer science are expected.

Workload:

- Lecture 30h
- Exercise 15h
- Preparation of lecture 24h
- Preparation of exercises 25h
- Exam preparation 40h
- Exam 1h
Literature

- Peter Liggesmeyer: Software-Qualität, Testen, Analysieren und Verifizieren von Software. Spektrum Akademischer Verlag 2002
- Mauro Pezzè, Michal Young: Software testen und analysieren. Oldenbourg Verlag 2009

Weitere Literatur wird in der Vorlesung bekanntgegeben.
Course: Spatial Economics [T-WIWI-103107]

** Responsible:** Prof. Dr. Ingrid Ott

** Organisation:** KIT Department of Economics and Management

** Part of:** M-WIWI-101496 - Growth and Agglomeration

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<td>Grade to a third</td>
<td>Each winter term</td>
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</table>

** Competence Certificate **
Depending on further pandemic developments, the examination will be offered either as an open-book examination, or as a 60-minute written examination.

** Prerequisites **
None

** Recommendation **
Basic knowledge of micro- and macroeconomics is assumed, as taught in the courses "Economics I" [2600012], and "Economics II" [2600014]. In addition, an interest in quantitative-mathematical modeling is required. The attendance of the course "Introduction to economic policy" [2560280] is recommended.

** Annotation **
Due to the research semester of Prof. Dr. Ingrid Ott, the course will not be offered in the winter semester 2021/22. The exam will take place. Preparation materials can be found in ILIAS.

Below you will find excerpts from events related to this course:
Content
The course covers the following topics:

• Geography, trade and development
• Geography and economic theory
• Core models of economic geography and empirical evidence
• Agglomeration, home market effect, and spatial wages
• Applications and extensions

Learning objectives:
The student

• analyses how spatial distribution of economic activity is determined.
• uses quantitative methods within the context of economic models.
• has basic knowledge of formal-analytic methods.
• understands the link between economic theory and its empirical applications.
• understands to what extent concentration processes result from agglomeration and dispersion forces.
• is able to determine theory based policy recommendations.

Recommendations:
Basic knowledge of micro- and macroeconomics is assumed, as taught in the courses Economics I [2600012], and Economics II [2600014]. An interest in mathematical modeling is advantageous.

Workload:
The total workload for this course is approximately 135 hours.

• Classes: ca. 30 h
• Self-study: ca. 45 h
• Exam and exam preparation: ca. 60 h

Assessment:
The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation).

Organizational issues
Die Vorlesung wird im WiSe 2021 aufgrund eines Forschungssemesters nicht gelesen. Die Prüfung findet statt. Vorbereitungsmaterialien finden Sie im ILIAS.

Literature

Weitere Literatur wird in der Vorlesung bekanntgegeben.
(Further literature will be announced in the lecture.)
3.270 Course: Spatial Stochastics [T-MATH-105867]

Responsible: Prof. Dr. Daniel Hug  
Prof. Dr. Günter Last

Organisation: KIT Department of Mathematics  
Part of: M-MATH-102903 - Spatial Stochastics

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Events

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<td>0105610</td>
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Prerequisites

none
### 3.271 Course: Special Functions and Applications in Potential Theory [T-MATH-102274]

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<th>Prof. Dr. Andreas Kirsch</th>
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<td>KIT Department of Mathematics</td>
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<tr>
<td>Part of</td>
<td>M-MATH-101335 - Special Functions and Applications in Potential Theory</td>
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**Type**
- Oral examination

**Credits**
- 5

**Grading scale**
- Grade to a third

**Version**
- 1

**Prerequisites**
- None
Course: Special Topics of Numerical Linear Algebra [T-MATH-105891]

**Responsible:** Prof. Dr. Marlis Hochbruck

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102920 - Special Topics of Numerical Linear Algebra

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**Events**

| ST 2021 | 0160400 | Topics in Numerical Linear Algebra | 4 SWS | Lecture / 📱 | Neher |

**Exams**

| ST 2021 | 7700095 | Special Topics of Numerical Linear Algebra | Neher |
| WT 21/22 | 7700012 | Special Topics of Numerical Linear Algebra | Neher |

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🔌 On-Site, ✗ Cancelled

**Prerequisites**

none
3.273 Course: Spectral Theory - Exam [T-MATH-103414]

**Responsible:**
- Prof. Dr. Dorothee Frey
- PD Dr. Gerd Herzog
- apl. Prof. Dr. Peer Kunstmann
- Dr. Christoph Schmoeger
- Prof. Dr. Roland Schnaubelt

**Organisation:**
KIT Department of Mathematics

**Part of:**
- M-MATH-101768 - Spectral Theory

**Type**
Oral examination

**Credits**
8

**Grading scale**
Grade to a third

**Version**
1

**Events**

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**Exams**

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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), ☝ On-Site, ✗ Cancelled

Below you will find excerpts from events related to this course:

**Spectral Theory**
0163700, SS 2021, 4 SWS, Language: English, [Open in study portal](#)

**Organizational issues**
Die Vorlesung wird online abgehalten. Nähere Informationen dazu finden Sie im Ilias.

**Literature**

- J.B. Conway: A Course in Functional Analysis.
- D. Werner: Funktionalanalysis.

Responsible: Prof. Dr. Michael Plum
Organisation: KIT Department of Mathematics
Part of: M-MATH-102880 - Spectral Theory of Differential Operators

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3.275 Course: Spin Manifolds, Alpha Invariant and Positive Scalar Curvature [T-MATH-105932]

**Responsible:** Stephan Klaus  
Prof. Dr. Wilderich Tuschmann

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102958 - Spin Manifolds, Alpha Invariant and Positive Scalar Curvature

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3.276 Course: Splitting Methods [T-MATH-105903]

**Responsible:**
- Prof. Dr. Marlis Hochbruck
- Prof. Dr. Tobias Jahnke
- Prof. Dr. Katharina Schratz

**Organisation:**
KIT Department of Mathematics

**Part of:**
M-MATH-102933 - Splitting Methods

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3.277 Course: Splitting Methods for Evolution Equations [T-MATH-110805]

**Responsible:** Prof. Dr Tobias Jahnke

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105325 - Splitting Methods for Evolution Equations

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**Exams**

| ST 2021 | 7700073 | Splitting Methods for Evolution Equations | Jahnke |

**Prerequisites**

none
3.278 Course: Statistical Learning [T-MATH-111726]

**Responsible:** Prof. Dr. Daniel Hug  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-105840 - Statistical Learning

### Competence Certificate
The module will be completed with an oral exam (approx. 30 min).

### Prerequisites
none

### Recommendation
The module "Introduction to Stochastics" is recommended. The module "Probability theory" is preferable.
3.279 Course: Stein's Method [T-MATH-105914]

**Responsible:** Dr. Matthias Schulte

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102946 - Stein's Method

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**Prerequisites**
none
### Course: Steins Method with Applications in Statistics [T-MATH-111187]

**Responsible:** Dr. rer. nat. Bruno Ebner  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-105579 - Steins Method with Applications in Statistics

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**Prerequisites**  
none
3.281 Course: Stochastic Control [T-MATH-105871]

**Responsible:** Prof. Dr. Nicole Bäuerle

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102908 - Stochastic Control

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**Prerequisites**

none
3.282 Course: Stochastic Differential Equations [T-MATH-105852]

**Responsible:** Prof. Dr. Dorothee Frey  
Prof. Dr. Roland Schnaubelt

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102881 - Stochastic Differential Equations

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<td>Grade to a third</td>
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3.283 Course: Stochastic Evolution Equations [T-MATH-105910]

**Responsible:** Prof. Dr. Lutz Weis

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102942 - Stochastic Evolution Equations

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**Prerequisites**
none
3.284 Course: Stochastic Geometry [T-MATH-105840]

**Responsible:** Prof. Dr. Daniel Hug  
Prof. Dr. Günter Last

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102865 - Stochastic Geometry

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**Events**

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<td>4 SWS</td>
<td>Lecture / 🖥</td>
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<td>ST 2021 0152610</td>
<td>Übungen zu 0152600 (Stochastische Geometrie)</td>
<td>2 SWS</td>
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**Exams**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 👤 On-Site, ✗ Cancelled
3.285 Course: Stochastic Information Processing [T-INFO-101366]

**Responsible:** Prof. Dr.-Ing. Uwe Hanebeck  
**Organisation:** KIT Department of Informatics  
**Part of:** M-INFO-100829 - Stochastic Information Processing

**Type** | **Credits** | **Grading scale** | **Recurrence** | **Version**
---|---|---|---|---
Oral examination | 6 | Grade to a third | Each winter term | 1

**Events**

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<td>3 SWS</td>
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<td>Lecture</td>
<td>Hanebeck, Frisch</td>
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**Exams**

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<td>ST 2021 7500313</td>
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Below you will find excerpts from events related to this course:

**Stochastic Information Processing**  
24113, WS 21/22, 3 SWS, Language: German, [Open in study portal]

**Content**

In order to handle complex dynamic systems (e.g., in robotics), an in-step estimation of the system's internal state (e.g., position and orientation of the actuator) is required. Such an estimation is ideally based on the system model (e.g., a discretized differential equation describing the system dynamics) and the measurement model (e.g., a nonlinear function that maps the state space to a measurement subspace). Both system and measurement model are uncertain (e.g., include additive or multiplicative noise).

For continuous state spaces, an exact calculation of the probability densities is only possible in a few special cases. In practice, general nonlinear systems are often traced back to these special cases by simplifying assumptions. One extreme is linearization with subsequent application of linear estimation theory. However, this often leads to unsatisfactory results and requires additional heuristic measures. At the other extreme are numerical approximation methods, which only evaluate the desired distribution densities at discrete points in the state space. Although the working principle of these procedures is usually quite simple, a practical implementation often turns out to be difficult and especially for higher-dimensional systems it is computationally complex.

As a middle ground, analytical nonlinear estimation methods would therefore often be desirable. In this lecture the main difficulties in the development of such estimation methods are presented and corresponding solution modules are presented. Based on these building blocks, some analytical estimation methods are discussed in detail as examples, which are very suitable for practical implementation and offer a good compromise between computing effort and performance. Useful applications of these estimation methods are also discussed. Both known methods and the results of current research are presented.

**Organizational issues**

Der Prüfungstermin ist per E-Mail (gambichler@kit.edu) zu vereinbaren.

**Literature**

Weiterführende Literatur  
Skript zur Vorlesung
3.286 Course: Strategic Finance and Technology Change [T-WIWI-110511]

Responsibility: Prof. Dr. Martin Ruckes
Organisation: KIT Department of Economics and Management
Part of: M-WIWI-101480 - Finance 3
M-WIWI-101483 - Finance 2

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<td>Each summer term</td>
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Exams
- ST 2021 7900268 Strategic Finance and Technology Change Ruckes
- WT 21/22 7900219 Strategic Finance and Technology Change Ruckes

Competence Certificate
The assessment consists of a written exam (60 min.) according to § 4 paragraph 2 Nr. 1 of the examination regulation. The exam is offered each semester. If there are only a small number of participants registered for the exam, we reserve the right to hold an oral examination instead of a written one.

Prerequisites
None

Recommendation
Attending the lecture "Financial Management" is strongly recommended.
3.287 Course: Structural Graph Theory [T-MATH-111004]

**Responsible:** Prof. Dr. Maria Aksenovich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105463 - Structural Graph Theory

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<td>4</td>
<td>Grade to a third</td>
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**Prerequisites**

none
3.288 Course: Supplement Enterprise Information Systems [T-WIWI-110346]

**Responsible:** Prof. Dr. Andreas Oberweis

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101472 - Informatics

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**Competence Certificate**
The assessment of this course is a written or (if necessary) oral examination. Depending on the particular course associated with this placeholder a bonus on the examination grade is possible.

**Prerequisites**
None

**Annotation**
This course can be used in particular for the acceptance of external courses whose content is in the broader area of applied informatics, but is not equivalent to another course of this topic.
3.289 Course: Supplement Software- and Systemsengineering [T-WIWI-110372]

**Responsible:** Prof. Dr. Andreas Oberweis
**Organisation:** KIT Department of Economics and Management
**Part of:** M-WIWI-101472 - Informatics

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<td>Each term</td>
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**Competence Certificate**
The assessment of this course is a written or (if necessary) oral examination. Depending on the particular course associated with this placeholder a bonus on the examination grade is possible.

**Prerequisites**
None

**Annotation**
This course can be used in particular for the acceptance of external courses whose content is in the broader area of software and systems engineering, but cannot assigned to another course of this topic.
### Course: Symmetric Encryption [T-INFO-101390]

**Responsible:** Prof. Dr. Jörn Müller-Quade  
**Organisation:** KIT Department of Informatics  
**Part of:** M-INFO-100853 - Symmetric Encryption

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<td>Each summer term</td>
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**Exams**

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<td>Geiselmann, Müller-Quade</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Es wird empfohlen, das Modul Sicherheit zu belegen.

Below you will find excerpts from events related to this course:

**Symmetric encryption**

24629, SS 2021, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

Online
### 3.291 Course: Tactical and Operational Supply Chain Management [T-WIWI-102714]

**Responsible:** Prof. Dr. Stefan Nickel  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-WIWI-101413 - Applications of Operations Research

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**Exams**

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**Competence Certificate**

Depending on further pandemic developments, the exam will be offered either as an open-book exam, or as a written exam (60 min). The exam takes place in every semester. Prerequisite for admission to examination is the successful completion of the online assessments.

**Prerequisites**

Prerequisite for admission to examination is the successful completion of the online assessments.

**Recommendation**

None

**Annotation**

The lecture is held in every summer term. The planned lectures and courses for the next three years are announced online.

**Below you will find excerpts from events related to this course:**

#### Taktisches und operatives SCM

**2550486, SS 2021, 2 SWS, Language: German, Open in study portal**

**Lecture (V) Online**

**Content**

The planning of material transport is an essential element of Supply Chain Management. By linking transport connections across different facilities, the material source (production plant) is connected with the material sink (customer). The general supply task can be formulated as follows (cf. Gudehus): For given material flows or shipments, choose the optimal (in terms of minimal costs) distribution and transportation chain from the set of possible logistics chains, which asserts the compliance of delivery times and further constraints. The main goal of the inventory management is the optimal determination of order quantities in terms of minimization of fixed and variable costs subject to resource constraints, supply availability and service level requirements. Similarly, the problem of lot sizing in production considers the determination of the optimal amount of products to be produced in a time slot. The course includes an introduction to basic terms and definitions of Supply Chain Management and a presentation of fundamental quantitative planning models for distribution, vehicle routing, inventory management and lot sizing. Furthermore, case studies from practice will be discussed in detail.
Literature

Weiterführende Literatur

- Domschke: Logistik: Transporte, 5. Auflage, Oldenbourg, 2005
- Ghiani, Laporte, Musmanno: Introduction to Logistics Systems Planning and Control, Wiley, 2004
- Gudehus: Logistik, 3. Auflage, Springer, 2005
### 3.292 Course: Technical Optics [T-ETIT-100804]

**Responsible:** Prof. Dr. Cornelius Neumann  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-100538 - Technical Optics

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<td>2 SWS</td>
<td>Technical Optics</td>
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#### Exams

| ST 2021  | 2313720 | Technical Optics            | Neumann |

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**

none
3.293 Course: The Riemann Zeta Function [T-MATH-105934]

**Responsible:** Dr. Fabian Januszewski

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102960 - The Riemann Zeta Function

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3.294 Course: Theoretical Particle Physics I, Fundamentals and Advanced Topics, with Exercises [T-PHYS-102544]

**Responsible:**
- Prof. Dr. Kirill Melnikov
- Prof. Dr. Milada Margarete Mühlleitner
- Prof. Dr. Ulrich Nierste
- Prof. Dr. Matthias Steinhauser
- Prof. Dr. Dieter Zeppenfeld

**Organisation:** KIT Department of Physics

**Part of:** M-PHYS-102033 - Theoretical Particle Physics I, Fundamentals and Advanced Topics, with Exercises

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<td>2 SWS</td>
<td>Practice / 🖥</td>
<td>Zeppenfeld, Löschner</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**
none
3.295 Course: Theoretical Particle Physics I, Fundamentals and Advanced Topics, without Exercises [T-PHYS-102546]

Responsible: Prof. Dr. Kirill Melnikov
Prof. Dr. Milada Margarete Mühlleitner
Prof. Dr. Ulrich Nierste
Prof. Dr. Matthias Steinhauser
Prof. Dr. Dieter Zeppenfeld

Organisation: KIT Department of Physics

Part of: M-PHYS-102035 - Theoretical Particle Physics I, Fundamentals and Advanced Topics, without Exercises

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Legend: 🖥 Online, ⚫ Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Prerequisites

none
3.296 Course: Theoretical Particle Physics II, with Exercises [T-PHYS-102552]

**Responsible:** Prof. Dr. Gudrun Heinrich  
Prof. Dr. Milada Margarete Mühlleitner  
Prof. Dr. Dieter Zeppenfeld

**Organisation:** KIT Department of Physics

**Part of:** M-PHYS-102046 - Theoretical Particle Physics II, with Exercises

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<td>2 SWS</td>
<td>Practice</td>
<td>Heinrich, Agarwal</td>
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**Prerequisites**

none
### 3.297 Course: Theoretical Particle Physics II, without Exercises [T-PHYS-102554]

**Responsible:** Prof. Dr. Gudrun Heinrich  
Prof. Dr. Milada Margarete Mühlleitner  
Prof. Dr. Dieter Zeppenfeld

**Organisation:** KIT Department of Physics

**Part of:** M-PHYS-102048 - Theoretical Particle Physics II, without Exercises

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**Prerequisites**

none
### 3.298 Course: Time Series Analysis [T-MATH-105874]

**Responsible:** Prof. Dr. Norbert Henze  
PD Dr. Bernhard Klar  

**Organisation:** KIT Department of Mathematics  

**Part of:** M-MATH-102911 - Time Series Analysis

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**Exams**

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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled
3.299 Course: Topological Data Analysis [T-MATH-111031]

**Responsible:** Prof. Dr. Tobias Hartnick
Prof. Dr. Roman Sauer

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105487 - Topological Data Analysis

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**Prerequisites**
none
3.300 Course: Topological Groups [T-MATH-110802]

**Responsible:** Dr. rer. nat. Rafael Dahmen
Prof. Dr. Wilderich Tuschmann

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105323 - Topological Groups

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**Prerequisites**
none
3.301 Course: Traveling Waves [T-MATH-105897]

**Responsible:** Prof. Dr. Jens Rottmann-Matthes

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102927 - Traveling Waves

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Mathematics Master 2016 (Master of Science (M.Sc.))
Module Handbook as of 21/09/2021
### 3.302 Course: Uncertainty Quantification [T-MATH-108399]

**Responsible:** Prof. Dr. Martin Frank  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-104054 - Uncertainty Quantification

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**Legend:** 📲 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**

none

Below you will find excerpts from events related to this course:

**Uncertainty Quantification**  
0164400, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**Literature**

3.303 Course: Valuation [T-WIWI-102621]

**Responsible:** Prof. Dr. Martin Ruckes

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101480 - Finance 3
- M-WIWI-101482 - Finance 1
- M-WIWI-101483 - Finance 2

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**Exams**

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**Competence Certificate**

See German version.

**Prerequisites**

None

**Recommendation**

None

Below you will find excerpts from events related to this course:

**Valuation**

2530212, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

**Literature**

Weiterführende Literatur

3.04 Course: Variational Methods [T-MATH-110302]

**Responsible:** Prof. Dr. Wolfgang Reichel

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-105093 - Variational Methods

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<tbody>
<tr>
<td>Oral examination</td>
<td>8</td>
<td>Grade to a third</td>
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3.305 Course: Wave Propagation in Periodic Waveguides [T-MATH-111002]

Responsible: Prof. Dr. Roland Griesmaier
Organisation: KIT Department of Mathematics
Part of: M-MATH-105462 - Wave Propagation in Periodic Waveguides

<table>
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<tr>
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Prerequisites
none
### 3.306 Course: Wavelets [T-MATH-105838]

**Responsible:** Prof. Dr. Andreas Rieder  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102895 - Wavelets

<table>
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<td>Grade to a third</td>
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<tr>
<td>ST 2021</td>
<td>7700106</td>
<td>Wavelets</td>
<td></td>
<td>Rieder</td>
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**Competence Certificate**
Mündliche Prüfung im Umfang von ca. 30 Minuten.

**Prerequisites**
none

**Responsible:** Jun.-Prof. Dr. Julian Thimme

**Organisation:** KIT Department of Economics and Management

**Part of:**
- M-WIWI-101480 - Finance 3
- M-WIWI-101483 - Finance 2

<table>
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<tr>
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<td>Once</td>
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**Competence Certificate**

Non exam assessment according to § 4 paragraph 3 of the examination regulation. (Anmerkung: gilt nur für SPO 2015). The grade is made up as follows: 50% result of the project (R-code), 50% presentation of the project.

**Prerequisites**

None

**Recommendation**

The content of the bachelor course Investments is assumed to be known and necessary to follow the course.
3.308 Course: Web Science [T-WIWI-103112]

**Responsible:** Michael Färber

**Organisation:** KIT Department of Economics and Management

**Part of:** M-WIWI-101472 - Informatics

<table>
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<tr>
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**Exams**

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<tr>
<td>ST 2021</td>
<td>7900032</td>
<td>Web Science (Registration until 12 July 2021)</td>
<td>Färber</td>
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<tr>
<td>WT 21/22</td>
<td>7900031</td>
<td>Web Science</td>
<td>Sure-Vetter</td>
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**Competence Certificate**

The exam will be offered for the last time for first-time takers in the summer semester 2021. The last opportunity to take the exam (for repeaters only) is in the winter semester 2021/22.

The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation or an oral exam (20 min) following §4, Abs. 2, 2 of the examination regulation.

The exam takes place every semester and can be repeated at every regular examination date.

**Prerequisites**

None

**Annotation**

The lecture is no longer offered.
3.309 Course: Wildcard 1 [T-MATH-106331]

 Organisation: University
 Part of: M-MATH-103198 - Wildcard

<table>
<thead>
<tr>
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