Subdivided Module Catalogue
for the Subject

Functional Materials

as a Master’s with 1 major
with the degree "Master of Science"
(120 ECTS credits)

Examination regulations version: 2016
Responsible: Faculty of Chemistry and Pharmacy
Course of Studies - Contents and Objectives

The Functional Materials programme leading to the degree of Master of Science (MSc) is offered by the Faculty of Chemistry and Pharmacy in cooperation with the Faculty of Physics and Astronomy and the Faculty of Medicine of JMU and the University of Applied Sciences Würzburg-Schweinfurt as a research-based course in the framework of a consecutive Bachelor’s/Master’s model.

Students who graduated from this programme
• have an advanced understanding of the fundamental principles of functional materials,
• know how to conduct research according to the principles of good scientific practice and have become familiar with industry practices,
• are able to conduct scientific work in research, development and practice in the interdisciplinary field of functional materials and materials science,
• are able to familiarise themselves with complex interdisciplinary issues, to independently apply the knowledge they have developed at university as well as to transfer what they have learned to new problems.
Abbreviations used

Course types: E = field trip, K = colloquium, O = conversatorium, P = placement/lab course, R = project, S = seminar, T = tutorial, Ü = exercise, V = lecture

Term: SS = summer semester, WS = winter semester

Methods of grading: NUM = numerical grade, B/NB = (not) successfully completed

Regulations: (L)ASPO = general academic and examination regulations (for teaching-degree programmes), FSB = subject-specific provisions, SFB = list of modules

Other: A = thesis, LV = course(s), PL = assessment(s), TN = participants, VL = prerequisite(s)

Conventions

Unless otherwise stated, courses and assessments will be held in German, assessments will be offered every semester and modules are not creditable for bonus.

Notes

Should there be the option to choose between several methods of assessment, the lecturer will agree with the module coordinator on the method of assessment to be used in the current semester by two weeks after the start of the course at the latest and will communicate this in the customary manner.

Should the module comprise more than one graded assessment, all assessments will be equally weighted, unless otherwise stated below.

Should the assessment comprise several individual assessments, successful completion of the module will require successful completion of all individual assessments.

In accordance with

the general regulations governing the degree subject described in this module catalogue:

ASPO2015

associated official publications (FSB (subject-specific provisions)/SFB (list of modules)):

4-Apr-2016 (2016-51)
5-Jul-2017 (2017-44)
26-Jul-2018 (2018-52)
30-Jul-2020 (2020-60)

This module handbook seeks to render, as accurately as possible, the data that is of statutory relevance according to the examination regulations of the degree subject. However, only the FSB (subject-specific provisions) and SFB (list of modules) in their officially published versions shall be legally binding. In the case of doubt, the provisions on, in particular, module assessments specified in the FSB/SFB shall prevail.
### Subdivided Module Catalogue for the Subject Functional Materials

Master’s with 1 major, 120 ECTS credits

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### Subdivided Module Catalogue for the Subject Functional Materials

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**08-FU-PART-161-m01** Chemical Technology of Inorganic Nano and Micro Particles

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**Master's with 1 major Functional Materials (2016)**  
**JMU Würzburg • generated 03-Apr-2021 • exam. reg. data record Master (120 ECTS) Funktionswerkstoffe - 2016**
### Subdivided Module Catalogue for the Subject
### Functional Materials
### Master's with 1 major, 120 ECTS credits

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### Module title
Practical Course in Programming

### Abbreviation
10-I-PP-152-m01

### Module coordinator
Dean of Studies Informatik (Computer Science)

### Module offered by
Institute of Computer Science

### ECTS
10

### Method of grading
Only after succ. compl. of module(s)

### Duration
undergraduate

### Module level

### Other prerequisites
--

### Contents
The programming language Java. Independent creation of small to middle-sized, high-quality Java programs.

### Intended learning outcomes
The students are able to independently develop small to middle-sized, high-quality Java programs.

### Courses (type, number of weekly contact hours, language — if other than German)
P (6)

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
written examination (approx. 60 to 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

### Allocation of places
--

### Additional information
--

### Referred to in LPO I (examination regulations for teaching-degree programmes)
§ 49 I Nr. 1c
§ 69 I Nr. 1d
**Module title**
Organic Chemistry 4

**Abbreviation**
08-OC4-152-m01

**Module coordinator**
holder of the Chair of Organic Chemistry II

**Module offered by**
Institute of Organic Chemistry

**ECTS**
5

**Method of grading**
umerical grade

**Only after succ. compl. of module(s)**
--

**Duration**
1 semester

**Module level**
dergraduate

**Other prerequisites**
--

### Contents

German contents available but not translated yet.

Das Modul behandelt biologisch wichtige Verbindungsklassen, deren Reaktionen und Synthesen, den Umgang mit besonderen Gefahrstoffen, anspruchsvollere Arbeits- und Synthesentechniken, Reinigungsmethoden und Produktanalytik.

### Intended learning outcomes

German intended learning outcomes available but not translated yet.


### Courses
(type, number of weekly contact hours, language — if other than German)
V (2) + Ü (2)

**Method of assessment**
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes)

Language of assessment: German and/or English

### Allocation of places
--

### Additional information
--

### Referred to in LPO I
(enumeration regulations for teaching-degree programmes)

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 62 I Nr. 2
Module title | Biofabrication
---|---
Abbreviation | 03-BIOFAB-152-m01

Module coordinator | holder of the Chair of Functional Materials in Medicine and Dentistry
Module offered by | Faculty of Medicine

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<tr>
<td>5</td>
<td>numerical grade</td>
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Duration | Module level | Other prerequisites |
1 semester | graduate | -- |

Contents
Definitions within biomaterials, tissue engineering and biofabrication, overview of medical device regulations and practices, description of extracellular matrix, bioprinting, continuous liquid interface polymerisation, two-photon polymerisation, fused deposition modelling, inorganic powder printing, stereolithography, selective laser sintering, melt electrospinning writing, self-healing hydrogels, polymers in 3D printing, introduction to rheology, scientific method and reproducibility, digital signal generation and quality control.

Intended learning outcomes
Students gain a thorough appreciation of the different additive manufacturing (3D printing) technologies available in the context of biofabrication. This includes how the polymers are processed and how each class of 3D printer works, with its strengths and weaknesses. A holistic view of biofabrication is taught, with an understanding of scientific methodology for each stage and the different regulations governing medical devices. Students will acquire the necessary skills to critique and develop opinions on the 3D printing industry and the resulting biomedical applications.

Courses (type, number of weekly contact hours, language — if other than German)
V (2) + Ü (1)
Module taught in: V, Ü: English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (20 minutes) or c) talk (30 minutes)
Language of assessment: English

Allocation of places
--

Additional information
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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<td>lecturer of lecture &quot;Praktische Spektroskopie 3&quot;</td>
<td>Institute of Physical and Theoretical Chemistry</td>
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<tbody>
<tr>
<td>1 semester</td>
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**Contents**

German contents available but not translated yet.

Das Modul bietet die Möglichkeit, das theoretische Wissen über spektroskopische Methoden praktisch umzusetzen und die erhaltenen Messwerte bzw. Graphen zu interpretieren. Im Detail werden UV/VIS-, Fluoreszenz- und Schwingungsspektren aufgenommen sowie analysiert. Im Modul werden zudem moderne Methoden der Massenspektrometrie behandelt.

**Intended learning outcomes**

German intended learning outcomes available but not translated yet.

Die Studierenden sind in der Lage, verschiedene Spektrometer zu bedienen und das erhaltene Spektrum zu interpretieren. Er/Sie kann eine Fehlerdiskussion durchführen.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (3)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes)

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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<table>
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<td>Modelling and Computational Science</td>
<td>10-M-MWR-152-m01</td>
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### Contents


### Intended learning outcomes

The student masters the fundamental mathematical methods and techniques to simulate processes from natural and engineering sciences on a computer.

### Courses (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

Module taught in: German and/or English

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)

Language of assessment: German and/or English

creditable for bonus

### Allocation of places

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### Additional information

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### Referred to in LPO I (examination regulations for teaching-degree programmes)

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<td>Laboratory and Measurement Technology</td>
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<td>Faculty of Physics and Astronomy</td>
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</table>

**Contents**

Introduction to electronic and optical measuring methods of physical metrology, vacuum technology and cryogenics, cryogenics, light sources, spectroscopic methods and measured value acquisition.

**Intended learning outcomes**

The students have competencies in the field of electronic and optical measuring methods of physical metrology, vacuum technology and cryogenics, cryogenics, light sources, spectroscopic methods and measured value acquisition.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (3) + R (1)

Module taught in: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes).

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Assessment offered: Once a year, winter semester

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Contents**

German contents available but not translated yet.


**Intended learning outcomes**

German intended learning outcomes available but not translated yet.


**Courses (type, number of weekly contact hours, language — if other than German)**

S (3)

**Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)**

a) written examination (approx. 45 to 90 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (15 to 30 minutes per candidate)

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I (examination regulations for teaching-degree programmes)**

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<td>Physics of Semiconductor Devices</td>
<td>11-SPD-152-m01</td>
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<td>undergraduate</td>
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**Contents**

Based on the fundamentals of Semiconductor Physics, the lecture provides an insight into semiconductor key technologies and discusses the main components in the fields of electronics and photonics on the basis of examples. The basic part introduces the crystal structures and band and phonon dispersions of technologically relevant semiconductors. The following part discusses the principles of charge transport involving non-equilibrium effects based on the charge carrier density of the thermal equilibrium. The part on technology gives an insight into the methods of production of semiconductor materials and presents the most important methods of planar technology. It discusses the way of functioning of the following components, sorted according to volume components, interface components and application fields: Rectifier diodes, Zener diodes, varistor, varactor, tunnel diodes, IMPATT, Baritt- and Gunn diodes, photodiode, solar cell, LED, semiconductor injection laser, transistor, JFET, Thyristor, Diac, Triac, Schottky diode, MOSFET, MESFET, HFET. It highlights the importance of low-dimensional charge carrier systems for technology and basic research and shows recent developments in the components sector.

**Intended learning outcomes**

The students know the characteristics of semiconductors, they have gained an overview of the electronic and phonon band structures of important semiconductors and the resulting electronic, optical and thermal properties. They know the principles of charge transport as well as the Poisson, Boltzmann and continuity equation for the solution of questions. They have gained insights into the methods of semiconductor production and are familiar with the theories of planar technology and recent developments in this field, they have a basic understanding of component production. They understand the structure and way of functioning of the main components of electronics (diode, transistor, field-effect transistor, thyristor, diac, triac), of microwave applications (tunnel, IMPATT, Baritt or Gunn diode) and of optoelectronics (photo diode, solar cell, light-emitting diode, semiconductor injection laser), they know the realisation possibilities of low-dimensional charge carrier systems on the basis of semiconductors and their technological relevance, they are familiar with current developments in the field of components.

**Courses** (type, number of weekly contact hours, language — if other than German)

- V (3) + R (1)
  - Module taught in: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

- written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes).

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Assessment offered: Once a year, summer semester

Language of assessment: German and/or English

**Allocation of places**

- --

**Additional information**

- --
Subdivided Module Catalogue for the Subject
Functional Materials
Master's with 1 major, 120 ECTS credits

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</table>
### Module title
Semiconductor Lasers and Photonics

### Abbreviation
11-HLF-152-m01

### Module coordinator
Managing Director of the Institute of Applied Physics

### Module offered by
Faculty of Physics and Astronomy

### ECTS
6

### Method of grading
Only after succ. compl. of module(s)

### Duration
1 semester

### Module level
Graduate

### Other prerequisites

### Contents
This lecture discusses the principles of laser physics, based on the example of semiconductor lasers, and current developments regarding components. The principles of lasers are described on the basis of a general laser model, which will then be extended to special aspects of semiconductor lasers. Basic concepts such as threshold condition, characteristic curve and laser efficiency are derived from coupled rate equations for charge carriers and photons. Other topics of the lecture are optical processes in semiconductors, layer and ridge waveguides, laser resonators, mode selection, dynamic properties as well as technology for the generation of semiconductor lasers. The lecture closes with current topics of laser research such as quantum dot lasers, quantum cascade lasers, terahertz lasers or high-performance lasers.

### Intended learning outcomes
The students have advanced knowledge of the principles of semiconductor-laser physics. They can apply their knowledge to modern questions and know the applications in the current development of components.

### Courses
(V (3) + R (1))
Module taught in: German or English

### Method of assessment
written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes).
If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.
Assessment offered: Once a year, summer semester
Language of assessment: German and/or English

### Allocation of places

### Additional information

### Referred to in LPO I
(examination regulations for teaching-degree programmes)
## Module title
Nanoanalytics

## Abbreviation
11-NAN-152-m01

## Module coordinator
Managing Director of the Institute of Applied Physics

## Module offered by
Faculty of Physics and Astronomy

## ECTS
6

## Method of grading
numerical grade

## Only after succ. compl. of module(s)
--

## Duration
1 semester

## Module level
graduate

## Other prerequisites
--

## Contents

## Intended learning outcomes
The students have basic knowledge of modern research methods for different nanostructures up to an atomic level. They know microscoping procedures that are used in practice in labs and the industry as well as spectroscopic methods for the determination of electronic properties. They are able to evaluate the efficiency of different research methods.

## Courses
**V (3) + R (1)**
Module taught in: German or English

## Method of assessment
**written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes)**
or **oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes).**

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Assessment offered: Once a year, winter semester
Language of assessment: German and/or English

## Allocation of places
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## Additional information
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## Referred to in LPO I
(examination regulations for teaching-degree programmes)
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### Principles of Energy Technologies

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</table>

#### Contents


#### Intended learning outcomes

The students know the principles of different methods of energy technology, especially energy conversion, transport and storage. They understand the structures of corresponding installations and are able to compare them.

#### Courses (type, number of weekly contact hours, language — if other than German)

V (3) + R (1)

Module taught in: German or English

#### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

- a) written examination (approx. 90 to 120 minutes) or
- b) oral examination of one candidate each (approx. 30 minutes) or
- c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or
- d) project report (approx. 8 to 10 pages) or
- e) presentation/talk (approx. 30 minutes).

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Assessment offered: Once a year, winter semester

Language of assessment: German and/or English

#### Allocation of places

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#### Additional information

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#### Referred to in LPO I (examination regulations for teaching-degree programmes)

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)
**Module title** | **Abbreviation**  
---|---  
Coating Technologies based on Vapour Deposition | 11-BVG-152-m01  

**Module coordinator**  
Managing Director of the Institute of Applied Physics  

**Module offered by**  
Faculty of Physics and Astronomy  

**ECTS** | **Method of grading** | **Only after succ. compl. of module(s)**  
---|---|---  
5 | numerical grade | --  

**Duration** | **Module level** | **Other prerequisites**  
---|---|---  
1 semester | graduate | --  

**Contents**  
Physical technical principles of PVD and CVD installations and processes. Coating deposit and layer characterisation. Application of layer materials on an industrial level.  

**Intended learning outcomes**  
The students have advanced knowledge of coating deposit processes in the gaseous phase and gain insights into their industrial relevance and variety.  

**Courses** (type, number of weekly contact hours, language — if other than German)  
V (3) + R (1)  
Module taught in: German or English  

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)  
written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes).  
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Assessment offered: Once a year, summer semester  
Language of assessment: German and/or English  

**Allocation of places**  
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**Additional information**  
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**Referred to in LPO I** (examination regulations for teaching-degree programmes)  
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</table>

**Contents**

Introduction to theory and application of characterisation methods in nano-chemistry. Thermoanalysis, rheological methods, dynamic light scattering, application of nano materials in industry and technology.

**Intended learning outcomes**

The students possess advanced knowledge of characterisation and application of nano materials.

**Courses** (type, number of weekly contact hours, language — if other than German)

| V (4) |

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes)

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO 1** (examination regulations for teaching-degree programmes)

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## Module title

Methods of non-destructive Material Testing

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## Module coordinator

Managing Director of the Institute of Applied Physics

## Module offered by

Faculty of Physics and Astronomy

## ECTS

4

## Method of grading

numerical grade

## Only after succ. compl. of module(s)

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## Duration

1 semester

## Module level

undergraduate

## Other prerequisites

--

## Contents


## Intended learning outcomes

The students have basic knowledge of the generation and interaction processes of different types of radiation (heat, X-ray, terahertz), particles (neutrons) or ultrasound waves with materials. They know the applied methods for the detection of radiation types, particles and ultrasound waves and are able to apply them to basic problems of material testing and characterisation.

## Courses

<table>
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<th>(type, number of weekly contact hours, language — if other than German)</th>
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<td>V (2) + R (1)</td>
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Module taught in: German or English

## Method of assessment

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes).

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Assessment offered: Once a year, winter semester

Language of assessment: German and/or English

## Allocation of places

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## Additional information

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## Referred to in LPO I

( examination regulations for teaching-degree programmes)

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Module title: Aspects of molecular Biotechnology
Abbreviation: 07-4S1MOLB-152-m01

Module coordinator: holder of the Chair of Biotechnology and Biophysics
Module offered by: Faculty of Biology

ECTS: 5
Method of grading: numerical grade
Only after succ. compl. of module(s)

Duration: 1 semester
Module level: undergraduate
Other prerequisites: --

Contents:
Fundamental principles of "white" biotechnology, bioreactors, biocatalysis, immobilisation of cells and enzymes, production of biomolecules, molecular biology, recombinant DNA technology, protein engineering, biosensor design, drug design, drug targeting, molecular diagnostics, recombinant antibodies, hybridoma technology, electromanipulation of cells.

Intended learning outcomes:
Students will gain an overview of traditional and modern methods in biotechnology and their respective advantages and disadvantages. They will learn to decide what method is most suitable for addressing a particular issue. Students will acquire a knowledge of fundamental methods in biotechnology that will enable them to independently review relevant literature. In addition, they will become acquainted with - or, where necessary, will be able to independently acquaint themselves with - relevant mechanisms.

Courses (type, number of weekly contact hours, language — if other than German):
V (2) + S (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus):
written examination (approx. 30 to 60 minutes)
creditable for bonus

Allocation of places:
25 places. Should the number of applications exceed the number of available places, places will be allocated as follows:
Students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits will be given preferential consideration. Should the module be used in other subjects, there will be two quotas: 95% of places will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits and 5% of places (a minimum of one place in total) will be allocated to students of the Bachelor's degree subject Biologie (Biology) with 60 ECTS credits and to students of the Bachelor's degree subjects Computational Mathematics and Mathematics, each with 180 ECTS credits, as part of the application-oriented subject Biology (as well as potentially to students of other 'importing' subjects). Should the number of places available in one quota exceed the number of applications, the remaining places will be allocated to applicants from the other quota. Should there be, within one module component, several courses with a restricted number of places, there will be a uniform regulation for the courses of one module component. In this case, places on all courses of a module component that are concerned will be allocated in the same procedure. In this procedure, applicants who already have successfully completed at least one other module component of the respective module will be given preferential consideration.
A waiting list will be maintained and places re-allocated as they become available.
Selection process group 1 (95%): Places will primarily be allocated according to the applicants' previous academic achievements. For this purpose, applicants will be ranked according to the number of ECTS credits they have achieved and their average grade of all assessments taken during their studies or of all module components in the subject of Biologie (Biology) (excluding Chemie (Chemistry), Physik (Physics), Mathematik (Mathematics)) at the time of application. This will be done as follows: First, applicants will be ranked, firstly, according to their average grade weighted according to the number of ECTS credits (qualitative ranking) and, secondly, according to their total number of ECTS credits achieved (quantitative ranking). The applicants' position in a third ranking will be calculated as the sum of these two rankings, and places will be allocated according to this third ranking. Among applicants with the same ranking, places will be allocated according to the qualitative ranking or otherwise by lot.
Selection process group 2 (5%): Places will be allocated according to the following quotas: Quota 1 (50% of places): total number of ECTS credits already achieved in modules/module components of the Faculty of Biology; among applicants with the same number of ECTS credits achieved, places will be allocated by lot. Quota 2 (25% of places): number of subject semesters of the respective applicant; among applicants with the same number of subject semesters, places will be allocated by lot. Quota 3 (25% of places): lottery.

Should the module be used only in the Bachelor’s degree subject Biologie (Biology) with 180 ECTS credits, places will be allocated according to the selection process of group 1.

Additional information

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Referred to in LPO I (examination regulations for teaching-degree programmes)

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### Module title
Laboratory and Measurement Technology in Biophysics

### Abbreviation
11-LMB-152-m01

### Module coordinator
Managing Director of the Institute of Applied Physics

### Module offered by
Faculty of Physics and Astronomy

### ECTS
6

### Method of grading
Only after succ. compl. of module(s)

### Numerical grade
--

### Duration
1 semester

### Module level
graduate

### Other prerequisites
--

### Contents
The lecture covers relevant principles of molecular and cellular biology as well as the physical principles of biophysical procedures for the examination and manipulation of biological systems. The main topics are optical measuring techniques and sensors, methods of single-particle detection, special microscoping techniques and methods of structure elucidation of biomolecules.

### Intended learning outcomes
The students know the principles of molecular and cellular biology as well as the physical principles of biophysical procedures for the examination and manipulation of biological systems. They have knowledge of optical measuring techniques and their applications and are able to apply techniques of structure elucidation to simple biomolecules.

### Courses
(V (3) + R (1))

Module taught in: German or English

### Method of assessment
Written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes).

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Assessment offered: Once a year, summer semester

Language of assessment: German and/or English

### Allocation of places
--

### Additional information
--

### Referred to in LPO I
(examination regulations for teaching-degree programmes)

--
# Module title

**Principles of two- and three-dimensional Röntgen imaging**

| Abbreviation | 11-ZDR-152-m01 |

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## Module coordinator

Managing Director of the Institute of Applied Physics

## Module offered by

Faculty of Physics and Astronomy

## ECTS

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<thead>
<tr>
<th>Method of grading</th>
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## Duration

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<th>Module level</th>
<th>Other prerequisites</th>
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<tr>
<td>1 semester</td>
<td>graduate</td>
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</table>

## Contents

Physics of X-ray generation (X-ray tubes, synchrotron). Physics of the interaction between X-rays and matter (photon absorption, scattering), physics of X-ray detection. Mathematics of reconstruction algorithms (filtered rear projection, Fourier reconstruction, iterative methods). Image processing (image data pre-processing, feature extraction, visualisation,...). Applications of X-ray imaging in the industrial sector (component testing, material characterisation, metrology, biology,...). Radiation protection and biological radiation effect (dose,...).

## Intended learning outcomes

The students know the principles of generating X-rays and of their interactions with matter. They know imaging techniques using X-rays and methods of image processing as well as application areas of these methods.

## Courses (type, number of weekly contact hours, language — if other than German)

V (3) + R (1)

Module taught in: German or English

## Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

Written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes).

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Assessment offered: Once a year, summer semester

Language of assessment: German and/or English

## Allocation of places

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## Additional information

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## Referred to in LPO I (examination regulations for teaching-degree programmes)

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<table>
<thead>
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<th>Abbreviation</th>
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<td>Imaging Methods at the Synchroton</td>
<td>11-BMS-152-m01</td>
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<td>Faculty of Physics and Astronomy</td>
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<tbody>
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<td>1 semester</td>
<td>undergraduate</td>
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</table>

### Contents


### Intended learning outcomes

The students know the principles of digital image and signal processing. They know the ways of functioning and applications of different image processing methods and are able to apply them in practice.

### Courses (type, number of weekly contact hours, language — if other than German)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Module taught in: German or English</td>
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</table>

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes).

If a written examination was chosen as method of assessment, this may be changed and assessment may instead take the form of an oral examination of one candidate each or an oral examination in groups. If the method of assessment is changed, the lecturer must inform students about this by four weeks prior to the original examination date at the latest.

Assessment offered: Once a year, summer semester

Language of assessment: German and/or English

### Allocation of places

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### Additional information

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### Referred to in LPO I (examination regulations for teaching-degree programmes)

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Module title: Electrochemical Energy Storage and Conversion
Abbreviation: 08-FU-EEW-152-m01

Module coordinator: holder of the Chair of Chemical Technology of Material Synthesis
Module offered by: Chair of Chemical Technology of Material Synthesis

ECTS: 5
Method of grading: numerical grade
Only after succ. compl. of module(s): --

Duration: 1 semester
Module level: undergraduate
Other prerequisites: --

Contents:
Chemistry and application of battery systems (aqueous and non-aqueous systems like lead, nickel cadmium and nickel metal hydride, sodium sulfur, sodium nickel chloride, lithium ion accumulators), electrochemical double layer capacitors, redox-flow battery, fuel cell systems (AFC, PEMFC, DMFC, PAFC, SOFC), Solar cells (Si, CIS, CIGS, GaAs, organic and dye solar cell), thermoelectric devices.

Intended learning outcomes:
The students gain comprehensive knowledge in the field of electrochemical energy storage and transformation and are able to apply this to scientific problems.

Courses:
(type, number of weekly contact hours, language — if other than German)
V (2) + P (1) + E (1)

Method of assessment:
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
a) assessment and b) Vortestate/Nachttestate (pre and post-experiment examination talks approx. 15 minutes each, log approx. 5 to 10 pages each) and assessment of practical assignments (2 to 4 random examinations), weighted 7:3
Assessment offered: Once a year, summer semester
Language of assessment: German and/or English

Allocation of places:
--

Additional information:
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Referred to in LPO I (examination regulations for teaching-degree programmes)
--
### Laser Spectroscopy

**Module title**: Laser Spectroscopy  
**Abbreviation**: 08-PCM1a-161-m01

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</table>

**Module coordinator**: lecturer of seminar "Laserspektroskopie" (Laser Spectroscopy)  
**Module offered by**: Institute of Physical and Theoretical Chemistry

**ECTS**: 5  
**Duration**: 1 semester  
**Module level**: graduate  
**Other prerequisites**: --

**Contents**

German contents available but not translated yet.

Das Modul führt in die Grundlagen der Laserspektroskopie ein. Als experimentelle Methoden werden die Absorptions- und Emissionsspektroskopie behandelt.

**Intended learning outcomes**

German intended learning outcomes available but not translated yet.

Die Studierenden sind in der Lage, Aufbau und Funktionsweise eines Lasers sowie die optischen Grundlagen zu erklären. Er/Sie kann das Prinzip der Absorptions- und Emissionsspektroskopie darstellen.

**Courses** (type, number of weekly contact hours, language — if other than German)

S (2) + Ü (1)  
Module taught in: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes)  
Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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### Module title
Statistical Mechanics and Reaction Dynamics

### Abbreviation
08-PCM2-161-m01

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<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
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<tr>
<td>lecturer of seminar &quot;Chemische Dynamik&quot; (Chemical Dynamics)</td>
<td>Institute of Physical and Theoretical Chemistry</td>
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<tr>
<td>1 semester</td>
<td>graduate</td>
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</table>

### Contents
The module deals with selected contents of statistical mechanics and reaction dynamics. It introduces the basic principles of statistical thermodynamics and conveys the transition state theory. Other topics are uni- and bimolecular reactions as well as charge and energy transfer.

### Intended learning outcomes
The students are familiar with selected contents of statistical mechanics and reaction dynamics. They know the basic principles of statistical thermodynamics and can apply them.

### Courses
(type, number of weekly contact hours, language — if other than German)
S (2) + Ü (1)
Module taught in: German or English

### Method of assessment
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) talk (approx. 30 minutes)

Language of assessment: German and/or English

### Allocation of places
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### Additional information
--

### Referred to in LPO I
(examination regulations for teaching-degree programmes)
--
### Module title
Nanoscale Materials

### Abbreviation
08-PCM3-161-m01

### Module coordinator
lecturer of the seminar "Nanoskalige Materialien"

### Module offered by
Institute of Physical and Theoretical Chemistry

### ECTS
5

### Method of grading
numerical grade

### Only after succ. compl. of module(s)
--

### Duration
1 semester

### Module level
graduate

### Other prerequisites
--

### Contents
German contents available but not translated yet.


### Intended learning outcomes
German intended learning outcomes available but not translated yet.

Die Studierenden sind in der Lage, nanoskalige Materialien zu charakterisieren. Er/Sie kann Analysenmethoden sowie Anwendungsgebiete nanoskaliger Materialien anführen.

### Courses
(type, number of weekly contact hours, language — if other than German)

S (2) + Ü (1)

Module taught in: German or English

### Method of assessment
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) talk (approx. 30 minutes)

Language of assessment: German and/or English

creditable for bonus

### Allocation of places
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### Additional information
--

### Referred to in LPO I
(examination regulations for teaching-degree programmes)

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### Physical chemistry of supramolecular assemblies

**Module title**
Physical chemistry of supramolecular assemblies

**Abbreviation**
08-PCM5-161-m01

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**Contents**
German contents available but not translated yet.

Das Modul betrachtet im Detail die grundlegenden Wechselwirkungen zwischen Molekülen. Es werden Bildung und physikalische-chemische Eigenschaften von Aggregaten besprochen. Wichtige Anwendungen supramolekularer Chemie werden thematisiert.

**Intended learning outcomes**
German intended learning outcomes available but not translated yet.


**Courses** (type, number of weekly contact hours, language — if other than German)
S (2) + Ü (1)
Module taught in: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) talk (approx. 30 minutes)
Language of assessment: German and/or English

**Allocation of places**
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**Additional information**
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**Referred to in LPO I** (examination regulations for teaching-degree programmes)
--
### Basics and applications of quantum chemistry

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<td>Basics and applications of quantum chemistry</td>
<td>08-TCM2-161-m01</td>
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<td>lecturer of lecture &quot;Computational Chemistry&quot;</td>
<td>Institute of Physical and Theoretical Chemistry</td>
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<td>graduate</td>
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</tbody>
</table>

### Contents

The module introduces students to computational chemistry.

### Intended learning outcomes

German intended learning outcomes available but not translated yet.

Die Studierenden sind in der Lage, die theoretischen Grundlagen der Computational Chemistry zu erklären sowie Methoden der Computational Chemistry anzuwenden.

### Courses

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<tr>
<td>S (2) + Ü (2)</td>
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### Method of assessment

<table>
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<td>a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes)</td>
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</tbody>
</table>

Language of assessment: German and/or English

### Allocation of places

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### Additional information

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### Referred to in LPO I (examination regulations for teaching-degree programmes)

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Module title | Abbreviation
---|---
Numerical Methods and Programming | 08-TCM3-161-m01

Module coordinator | Module offered by
lecturer of lecture "Programmieren in Theoretischer Chemie" | Institute of Physical and Theoretical Chemistry

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<td>1 semester</td>
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</table>

Contents

German contents available but not translated yet.

Das Modul führt in Grundlagen der Programmierung in der Theoretischen Chemie ein und zeigt Anwendungsgebiete auf.

Intended learning outcomes

German intended learning outcomes available but not translated yet.

Die Studierenden können eine in der Theoretischen Chemie verwendete Programmiersprache theoretisch erklären und praktisch anwenden sowie Anwendungsmöglichkeiten anführen.

Courses (type, number of weekly contact hours, language — if other than German)

S (2) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes)

Language of assessment: German and/or English

Allocation of places

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Additional information

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Referred to in LPO I (examination regulations for teaching-degree programmes)

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<table>
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<td>lecturer of lecture &quot;Quantendynamik&quot;</td>
<td>Institute of Physical and Theoretical Chemistry</td>
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<td>graduate</td>
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</table>

**Contents**

Time-dependent Schrödinger equation, propagators, time-dependent perturbation theory, adiabatic theorem, diabatic and adiabatic states, non-adiabatic dynamics, mixed quantum-classical dynamics.

**Intended learning outcomes**

The students possess knowledge about the time-dependent description of the nuclear and electronic dynamics in molecules. Their insight into the methods and the numerical realizations allow them to carry out applications in the field of theoretical chemistry.

**Courses** (type, number of weekly contact hours, language — if other than German)

S (2) + Ü (2)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes)

Language of assessment: German and/or English

**Allocation of places**

--

**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--
### Module title
Selected topics in theoretical chemistry

### Abbreviation
08-TCM1-161-m01

### Module coordinator
lecturer of lecture "Theoretische Chemie"

### Module offered by
Institute of Physical and Theoretical Chemistry

### ECTS
5

### Method of grading
numerical grade

### Only after succ. compl. of module(s)
--

### Duration
1 semester

### Module level
graduate

### Other prerequisites
--

## Contents
The module introduces students to theoretical chemistry.

## Intended learning outcomes
German intended learning outcomes available but not translated yet.

Die Studierenden können mathematische und physikalische Grundlagen quantenchemischer und quantendynamischer Ansätze der Theoretischen Chemie darstellen.

## Courses (type, number of weekly contact hours, language — if other than German)
S (2) + Ü (2)

## Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes)

Language of assessment: German and/or English

## Allocation of places
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## Additional information
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<td>Faculty of Physics and Astronomy</td>
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</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
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</table>

**Contents**

- Periodic and aperiodic signals; principles of discreet and exact Fourier transformation; principles of digital signal and image processing; discretisation of signals/sampling theorem (Shannon); homogeneous and linear filters, convolution product; tapering functions and interpolation of images; the Parsival theorem, correlation and energetic observation; statistical signals, image noise, moments, stationary signals; tomography: Hankel and Radon transformation.

**Intended learning outcomes**

The students have advanced knowledge of digital image and signal processing. They know the physical principles of image processing and are familiar with different methods of signal processing. They are able to explain different methods and to implement them, especially in the field of tomography.

**Courses**

- **V (2) + Ü (2)**
  - Module taught in: German or English

**Method of assessment**

- written examination (approx. 90 to 120 minutes) or oral examination of one candidate each (approx. 30 minutes) or oral examination in groups (groups of 2, approx. 30 minutes per candidate) or project report (approx. 8 to 10 pages) or presentation/talk (approx. 30 minutes).
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  - Assessment offered: In the semester in which the course is offered and in the subsequent semester
  - Language of assessment: German and/or English

**Allocation of places**

- --

**Additional information**

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**Referred to in LPO I**

- (examination regulations for teaching-degree programmes)
<table>
<thead>
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<th>Module title</th>
<th>Abbreviation</th>
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<tr>
<td>Physics of Advanced Materials</td>
<td>11-PMM-161-m01</td>
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<td>Managing Director of the Institute of Applied Physics</td>
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<td>1 semester</td>
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</table>

**Contents**

General properties of various material groups such as liquids, liquid crystals and polymers; magnetic materials and superconductors; thin films, heterostructures and superlattices. Methods of characterising these material groups; two-dimensional layer materials.

**Intended learning outcomes**

The students know the properties and characterization methods of some modern materials.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (3) + R (1)

Module taught in: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

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Assessment offered: In the semester in which the course is offered and in the subsequent semester

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--
### Subdivided Module Catalogue for the Subject Functional Materials

**Master's with 1 major, 120 ECTS credits**

<table>
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<td>Solid State Physics 2</td>
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</table>

**Contents**

Modern scattering methods; neutron scattering as a method to investigate the atomic and magnetic structure and excitations such as phonons and magnetic waves; resonant elastic X-ray scattering and absorption; investigation of magnetic, orbital and charge order; X-ray and neutron reflectometry; investigation of the structural, magnetic and electronic properties of thin films and superlattices; resonant inelastic X-ray scattering; investigation of excitations in solids and thin films; STEM ("scanning transmission electron microscopy"); further topics upon agreement.

**Intended learning outcomes**

The students know different modern scattering methods such as neutron scattering, resonant elastic X-ray scattering, modern scattering theory, X-ray and neutron reflectometry and resonant inelastic X-ray scattering. They are familiar with the theoretical principles and applications of these methods.

**Courses** (type, number of weekly contact hours, language — if other than German)

| V (4) + R (2) |

Module taught in: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

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Assessment offered: In the semester in which the course is offered and in the subsequent semester

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--
## Module title
Semiconductor Physics

### Abbreviation
11-HLPH-161-m01

### Module coordinator
Managing Director of the Institute of Applied Physics

### Module offered by
Faculty of Physics and Astronomy

#### ECTS

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#### Duration
1 semester

#### Module level
graduate

#### Other prerequisites

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<tr>
<td>1. Symmetry properties</td>
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<td>2. Crystal formation and electronic band structure</td>
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<tr>
<td>3. Optical excitations and their coupling effects</td>
</tr>
<tr>
<td>4. Electron-phonon coupling</td>
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<tr>
<td>5. Temperature-dependent transport properties</td>
</tr>
<tr>
<td>6. Magnetic semiconductors</td>
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#### Intended learning outcomes

The students are familiar with the principles of Semiconductor Physics. They understand the structure of semiconductors and know their physical properties and effects. They know important applications.

#### Courses

<table>
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Module taught in: German or English

#### Method of assessment

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Assessment offered: In the semester in which the course is offered and in the subsequent semester

Language of assessment: German and/or English

#### Allocation of places

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#### Additional information

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#### Referred to in LPO I
(examination regulations for teaching-degree programmes)

--
### Module title
Optical Properties of Semiconductor Nanostructures

### Abbreviation
11-HNS-161-m01

### Module coordinator
Managing Director of the Institute of Applied Physics

### Module offered by
Faculty of Physics and Astronomy

### ECTS
6

### Method of grading
Only after succ. compl. of module(s)

### Duration
1 semester

### Module level
graduate

### Other prerequisites
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### Contents
Semiconductor nanostructures are frequently referred to as "artificial materials". In contrast to atoms, molecules or macroscopic crystals, their electronic, optical and magnetic properties can be systematically tailored by changing their size. The lecture addresses technological challenges in the preparation of semiconductor nanostructures of varying dimensions (2D, 1D, 0D). It provides the basic theoretical concepts to describe their properties, with a focus on optical properties and light-matter coupling. Moreover, it discusses the challenges and concepts of novel optoelectronic and quantum photonic devices based on such nanostructures, including building blocks for quantum communication and quantum computing architectures.

### Intended learning outcomes
The students know the theoretical principles and characteristics of semiconductor nanostructures. They have knowledge of the technological methods to fabricate such structures, and of their applications to novel photonic devices. They are able to apply their knowledge to problems in this field of research.

### Courses
(type, number of weekly contact hours, language — if other than German)

- V (3) + R (1)

Module taught in: German or English

### Method of assessment
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### Allocation of places
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</table>

**Contents**

The lecture addresses the fundamental transport phenomena of electrons in nanostructures. This includes the topics of: ballistic and diffuse transport, electron interference effects, quantisation of conductivity, interaction phenomena between electrons, Coulomb blockade, thermoelectric properties, description of spin-dependent transport phenomena, topological insulators, solid-state quantum computers.

**Intended learning outcomes**

The students have mastered the basics of electronics of nanostructures in theory and practice. They know functions and applications of respective components.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (3) + R (1)

Module taught in: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

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Assessment offered: In the semester in which the course is offered and in the subsequent semester

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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Module title | Abbreviation
---|---
Computational Materials Science (DFT) | 11-CMS-161-m01

| Module coordinator | Module offered by |
---|---|
Managing Director of the Institute of Theoretical Physics and Astrophysics | Faculty of Physics and Astronomy |

| ECTS | Method of grading | Only after succ. compl. of module(s) |
---|---|---|
8 | numerical grade | -- |

| Duration | Module level | Other prerequisites |
---|---|---|
1 semester | graduate | -- |

Contents

1. Density functional theory (DFT)
2. Wannier functions and localized basis functions
3. Numerical evaluation of topological invariants
4. Hartree-Fock and static mean-field theory
5. Many-body methods for solid state physics
6. Anderson impurity model (AIM) and Kondo physics
7. Dynamical mean-field theory (DMFT)
8. DFT + DMFT methods for realistic modeling of solids
9. Strongly correlated electrons

Intended learning outcomes

Aside from the theoretical discussion of these topics, the students carry out hands-on exercises from the CIP pool. The participants are introduced to the use of DFT software packages such as VASP or Wien2k and to the construction of maximally localised Wannier functions through the projection of DFT results on atom orbitals with the software wannier90. Furthermore, the students learn how to construct many-particle solutions of AIM and observe border cases such as the Kondo regime. Impurity solvers such as exact diagonalisation or continuous-time quantum Monte Carlo are utilised to solve the self consistency equations of dynamic molecular field theory (DMFT). These steps are necessary to reach the peak of the lecture: a DFT-DMFT calculation of a strongly correlated transition metal oxide such as SrVO3.

Courses (type, number of weekly contact hours, language — if other than German)

V (4) + R (2)
Module taught in: German or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

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Assessment offered: In the semester in which the course is offered and in the subsequent semester
Language of assessment: German and/or English

Allocation of places

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<td>Modern Synthetic Methods</td>
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<tr>
<td>lecturer of the seminar</td>
<td>Institute of Organic Chemistry</td>
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</table>

**Contents**

German contents available but not translated yet.

Das Modul behandelt moderne stereoselektive Synthesemethoden. Schwerpunkt sind ausgewählte Totalsynthesen, Organometallchemie und Katalyse.

**Intended learning outcomes**

German intended learning outcomes available but not translated yet.

Die Studierenden sind in der Lage, anspruchsvolle chemische Synthesen stereoselektiv zu planen sowie stereoisomer verständlich zu analysieren. Er/Sie kann Totalsynthesen erklären. Er/Sie kann Aspekte der Organometallchemie und Katalyse in der Synthesemethode darstellen.

**Courses** (type, number of weekly contact hours, language — if other than German)

S (2) + Ü (1)

Module taught in: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes)

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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<td>Organic Functional Materials</td>
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<td>Institute of Organic Chemistry</td>
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**Contents**

German contents available but not translated yet.

Das Modul behandelt spezifische Themen der organischen Funktionsmaterialien. Schwerpunkte sind grundlegende physikalische Effekte, organische Festkörper, Anwendung organischer Funktionsmaterialien und organische und metallorganische Polymerchemie.

**Intended learning outcomes**

German intended learning outcomes available but not translated yet.


**Courses** (type, number of weekly contact hours, language — if other than German)

S (3)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

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Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module title**
Molecular Biology for advanced students

**Abbreviation**
08-BC-MOLMC-161-m01

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**Contents**
The module covers specific topics of molecular physiology and functional biochemistry in lectures and exercises.

**Intended learning outcomes**
After attending the module events, students have solid knowledge in molecular biology.

**Courses** (type, number of weekly contact hours, language — if other than German)
V (2) + Ü (1)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
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Language of assessment: German and/or English

**Allocation of places**
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**Additional information**
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<td>Polymers II</td>
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<td>holder of the Chair of Functional Materials in Medicine and Dentistry</td>
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### Contents

Deepend polymer synthesis methods, special polymers (block copolymers, co-polymerization techniques, complex polymer architectures), biodegradable polymers, polypeptoides, natural polymers. We will discuss the application of the respective polymers: e.g. as biomaterials, for electrospinning, for the production of hydrogels and their behavior on surfaces.

### Intended learning outcomes

The student acquire advanced knowledge in polymer manufacturing, analysis and applications. This involves different synthetic routes with which the different molecules can be prepared from different starting materials. Students can estimate if and how fast a polymer degrades under given circumstances. Furthermore, they gain insight into the field of technically used polymers from nature. Each section also points to possible consequences / disadvantages that synthesis of the various polymers may have, thus drawing students' understanding to ethical concerns.

### Courses

(type, number of weekly contact hours, language — if other than German)

S (2) + Ü (1)

### Method of assessment

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Language of assessment: German and/or English

### Allocation of places

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### Additional information

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

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**Subdivided Module Catalogue for the Subject Functional Materials**

**Master's with 1 major, 120 ECTS credits**

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<table>
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<th>Contents</th>
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<tbody>
<tr>
<td>Fundamentals of organic semiconductors, molecular and polymer electronics and sensor technology, applications.</td>
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<table>
<thead>
<tr>
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<tr>
<td>The students have advanced knowledge of organic semiconductors.</td>
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Assessment offered: In the semester in which the course is offered and in the subsequent semester

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</table>
## Biophysical Measurement Technology in Medical Science

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<td>Biophysical Measurement Technology in Medical Science</td>
<td>11-BMT-161-m01</td>
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### Module coordinator
Managing Director of the Institute of Applied Physics

### Module offered by
Faculty of Physics and Astronomy

### ECTS | Method of grading | Only after succ. compl. of module(s) |
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### Duration | Module level | Other prerequisites |
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### Contents
The lecture covers the physical principles of imaging techniques and their application in Biomedicine. The main topics are conventional X-ray technique, computer tomography, imaging techniques of nuclear medicine, ultrasound and MR-tomography. The lecture additionally addresses the systems theory of imaging systems and digital image processing.

### Intended learning outcomes
The students know the physical principles of imaging techniques and their application in Biomedicine. They understand the principles of image generation and are able to explain different techniques and interpret simple images.

### Courses (type, number of weekly contact hours, language — if other than German)
V (3) + R (1)
Module taught in: German or English

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes).

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Assessment offered: In the semester in which the course is offered and in the subsequent semester

Language of assessment: German and/or English

### Allocation of places
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### Additional information
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### Referred to in LPO I (examination regulations for teaching-degree programmes)
--
# Sensor and Actor Materials - Functional Ceramics and Magnetic Particles

**Module title**  
Sensor and Actor Materials - Functional Ceramics and Magnetic Particles

**Abbreviation**  
08-FU-SAM-161-m01

**Module coordinator**  
degree programme coordinator Funktionswerkstoffe (Functional Materials)

**Module offered by**  
Chair of Chemical Technology of Material Synthesis

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**Duration**  
1 semester

**Module level**  
graduate

**Other prerequisites**  
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**Contents**


**Intended learning outcomes**

The students acquire fundamental knowledge in sensoric and actoric materials.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (2) + P (2)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

- a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes)
- or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate)

Assessment offered: Once a year, summer semester

Language of assessment: German and/or English

P: creditable for bonus

**Allocation of places**  
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**Additional information**  
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<td>Structure and Properties of Modern Materials: Experiments vs. Simulations</td>
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**Contents**

Material properties of metals and ceramics: Structur-property relationships through experiments and simulation.

**Intended learning outcomes**

The students gain fundamental knowledge about the properties of modern materials: aviation aluminum alloys and high performance ceramics. Analytical methods and predictions through numerical simulations will be presented. The relationship of micro- and nanoscopic structure of materials and the resulting properties are emphasized.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (2) + S (1)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) talk (approx. 30 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups of 2 (approx. 30 minutes total)
Assessment offered: Once a year, winter semester
Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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<td>Mechanical and Thermal Material Properties</td>
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</table>

**Contents**

Physical laws of solids: Bonding and structure, lattice dynamics, thermal and mechanical properties.

**Intended learning outcomes**

The students have knowledge of mechanical/thermal material characteristics.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (3) + Ü (1)

Module taught in: Ü: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 to 120 minutes) or b) oral examination of one candidate each (approx. 30 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate) or d) project report (approx. 8 to 10 pages) or e) presentation/talk (approx. 30 minutes).

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Language of assessment: German and/or English

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**Additional information**

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**Contents**

Physical principles of optoelectronic material properties and applications..

**Intended learning outcomes**

The students know the principles of optoelectronic material characteristics.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (3) + Ü (1)

Module taught in: Ü: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

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Language of assessment: German and/or English

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**Contents**

Independent laboratory course in the area of functional materials.

**Intended learning outcomes**

The students gain advanced knowledge in independent research and scientific documentation.

**Courses** (type, number of weekly contact hours, language — if other than German)

R (10)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

report (approx. 25 pages)

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Contents**

Independent laboratory course in the area of functional materials.

**Intended learning outcomes**

The students gain advanced knowledge in independent research and scientific documentation.

**Courses** (type, number of weekly contact hours, language — if other than German)

R (10)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

Report (approx. 25 pages)

Language of assessment: German and/or English

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<td>Tissue Engineering - Alternatives to Animal Testing</td>
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**Contents**


**Intended learning outcomes**

Students gain basic knowledge to construct complex 3D tissue equivalents and the use thereof as alternative test system for animal experiments or as transplant in the clinic.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) report on practical course (approx. 10 pages) and b) presentation (approx. 30 minutes) or written examination (approx. 60 minutes)

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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<td>Fundamentals of Physiology and Application of Surgical Implants by Loss of Function</td>
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<td>holder of the Chair of Functional Materials in Medicine and Dentistry</td>
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**Contents**

Anatomy and physiology of the cardiovascular system, ear and eye, skeletal system, of the jaw including tooth structure and pathological processes that lead to functional impairment or loss of function. Materials and use of medical implants in the respective tissue.

**Intended learning outcomes**

The students receive advanced knowledge in human physiology. In addition, knowledge about pathological processes that can lead to the use of medical materials and implants will be taught.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (3) + P (1)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

- a) report on practical course (approx. 10 pages) and b) presentation (approx. 30 minutes) or written examination (approx. 90 minutes); weighted 1:1
- Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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# Module title
Tissue Engineering - Basics for Tissue Regeneration

# Abbreviation
03-TE-REG-161-m01

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## Contents

## Intended learning outcomes
Students gain fundamental knowledge occurring in the transplantation of non-autologuous cells, the selection of stem cells for the cartilage and bone regeneration and materials which can be used as diagnostics and for therapeutic approaches.

## Courses
(type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

## Method of assessment
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) report on practical course (approx. 10 pages) and b) presentation (approx. 30 minutes) or written examination (approx. 60 minutes)

Language of assessment: German and/or English

## Allocation of places
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## Additional information
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## Referred to in LPO I
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<td>Carrier Materials and Devices for Therapeutic Compounds</td>
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**Contents**

In-depth introduction to the field of medically applicable carrier materials, in particular nanoparticles; presentation of various loading mechanisms as well as the controlled release of drugs from the drug delivery system. Furthermore, different application forms and their clinical use are presented. Students gain a deeper insight into medical and biological requirements for the used particles and drug conjugates.

**Intended learning outcomes**

Students gain in-depth knowledge of the possibilities of using drug delivery systems. In addition, they will be taught what production options are available and what complications can be expected, so that they can deal with them critically.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (2) + P (1)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) report on practical course (approx. 10 pages) and b) written examination (approx. 90 minutes) or presentation (approx. 30 minutes)

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Technologies to Support Regenerative Medicine</td>
<td>03-FU-TRM-161-m01</td>
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<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
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<tbody>
<tr>
<td>holder of the Chair of Regenerative Medicine</td>
<td>Faculty of Medicine</td>
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<tr>
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<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</table>

### Contents


### Intended learning outcomes

Students gain fundamental knowledge in the area of tissue/material interfaces, with specific tissue material interactions and the appropriate tissue quality parameters.

### Courses (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) report on practical course (approx. 10 pages) and b) presentation (approx. 30 minutes) or written examination (approx. 60 minutes)

Language of assessment: German and/or English

### Allocation of places

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### Additional information

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### Referred to in LPO I (examination regulations for teaching-degree programmes)

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<table>
<thead>
<tr>
<th><strong>Module title</strong></th>
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<tbody>
<tr>
<td>Supramolecular Chemistry (Basics)</td>
<td>08-SCM1-161-m01</td>
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<tbody>
<tr>
<td>lecturer of lecture &quot;Organischen Chemie&quot;</td>
<td>Faculty of Chemistry and Pharmacy</td>
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**Contents**

German contents available but not translated yet.


**Intended learning outcomes**

German intended learning outcomes available but not translated yet.


**Courses** (type, number of weekly contact hours, language — if other than German)

S (3)

Module taught in: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes)

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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<table>
<thead>
<tr>
<th>Module title</th>
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<tbody>
<tr>
<td>Polymer Materials 1: Technology of Polymer Modification</td>
<td>08-FU-PW1-161-m01</td>
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<tbody>
<tr>
<td>degree programme coordinator Funktionswerkstoffe (Functional Materials)</td>
<td>Chair of Chemical Technology of Material Synthesis</td>
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### Contents

Methods of polymer synthesis; composition of polymers and polymer compounds; properties of polymers; technologies for the production of polymers compound and polymer components; means of characterisation of polymer compounds and polymer components.

### Intended learning outcomes

The students possess knowledge of the special properties of polymers and polymer compounds (e.g. time and temperature dependent viscoelastic behaviour). They know the characteristics of important production technologies (methods of polymer synthesis, compounding technologies, processing methods e.g. injection moulding) and understands the different ways of influencing properties of materials and manufactured products. They have knowledge of ways to calculate complex flow conditions in polymer processing machines and tools.

### Courses (type, number of weekly contact hours, language — if other than German)

V (2) + P (2)

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate)

Assessment offered: Once a year, winter semester
Language of assessment: German and/or English
P: creditable for bonus

### Allocation of places

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### Additional information

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### Referred to in LPO I (examination regulations for teaching-degree programmes)

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<table>
<thead>
<tr>
<th>Module title</th>
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<tbody>
<tr>
<td>Polymer Materials 2: Technology of Filler Modification for Polymer Materials</td>
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</table>

**Contents**

Principles and technologies for the functionalization of additives and their utilization for the modification of polymers and their properties, interaction between polymers and additives and determination of the particular properties of such functionalized polymers (e.g. electric, bactericidal, flame retardant properties). Also the influence on other properties such as mechanical and rheological properties, color, turbidity and surface finish will be discussed.

**Intended learning outcomes**

The students possess knowledge on the technologies to functionalize polymeric materials with additives. They know the possibilities and issues regarding of such modifications, the interaction between additives and polymers. Moreover, they are qualified to determine particular properties of functionalized polymers (e.g. flame retardancy) and understand the interactions with other properties of the polymers, such as rheology, mechanical properties, color, turbidity or surface finish.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (2) + P (2)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes per candidate)

Assessment offered: Once a year, summer semester

Language of assessment: German and/or English

P: creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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### Module title

Materials for High Voltage insulation and High Voltage Systems

### Abbreviation

99-HIS-161-m01

### Module coordinator

Dean of the Faculty of Electrical Engineering at the University of Applied Sciences Würzburg-Schweinfurt

### Module offered by

University of Applied Sciences Würzburg-Schweinfurt (FHWS)

### ECTS

5

### Method of grading

Numerical grade

### Only after succ. compl. of module(s)

--

### Duration

1 semester

### Module level

Graduate

### Other prerequisites

--

### Contents

Electrical stress, electrical strength, dielectric material properties, technology and application of insulating materials and systems, diagnostics, measurements, simulation and tests of insulating systems.

### Intended learning outcomes

The student gain basic knowledge about the electrical field and insulating systems with layering of different materials. They can design simple insulating systems by their own and approve the existing design. They have basic knowledge in the field of diagnosis and technology of insulating materials.

### Courses

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<tr>
<th>Type</th>
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<th>Language</th>
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<tbody>
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<tr>
<td>Ü</td>
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<td>P</td>
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### Method of assessment

- a) written examination (approx. 90 minutes)
- b) oral examination of one candidate each (approx. 20 minutes)
- c) oral examination in groups (groups of 2, approx. 30 minutes total)

Language of assessment: German and/or English

P: creditable for bonus

### Allocation of places

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### Additional information

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)
Module title
Modeling and Simulation for Technological Systems

Abbreviation
99-MST-161-m01

Module coordinator
Dean of the Faculty of Mechanical Engineering at the Uni-
versity of Applied Sciences Würzburg-Schweinfurt

Module offered by
University of Applied Sciences Würzburg-Schwein-
furt (FHWS)

ECTS
5

Method of grading
only after succ. compl. of module(s)

Duration
1 semester

Module level
graduate

Other prerequisites
--

Contents
Theoretical foundations and practical application of the theory of linear and non-linear dynamic systems in electrical engineering and beyond.

Intended learning outcomes
The student has basic knowledge of dynamic and nonlinear systems and can describe them with the help of modelling and analyse their behaviour by simulation.

Courses (type, number of weekly contact hours, language — if other than German)
V (2) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every seme-
ter, information on whether module can be chosen to earn a bonus)
written examination (approx. 90 minutes) and practical examination (modelling assignment, approx. 40 hours)
Assessment offered: Once a year, winter semester
Language of assessment: German and/or English
Ü: creditable for bonus

Allocation of places
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Additional information
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Referred to in LPO I (examination regulations for teaching-degree programmes)
--
### Analytical Methods - Examples from Practical Failure Analysis

**Module title**
Analytical Methods - Examples from Practical Failure Analysis

**Abbreviation**
08-FU-ANA-161-m01

**Module coordinator**
Dean of Studies Funktionswerkstoffe (Functional Materials)

**Module offered by**
Chair of Chemical Technology of Material Synthesis

**ECTS**
5

**Method of grading**
numerical grade

**Only after succ. compl. of module(s)**
--

**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
--

### Contents
This module treats special topics in the area damage analysis of materials (Ceramics, semiconductors, metals and polymers). The students become acquainted to different methods for the characterization of the different material classes. They deepen this knowledge in a practical part.

### Intended learning outcomes
The students gain fundamental knowledge in measuring methods in the physical / chemical laboratory.

### Courses
(type, number of weekly contact hours, language — if other than German)

V (2) + P (2)

### Method of assessment
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes)

Assessment offered: Once a year, summer semester
Language of assessment: German and/or English
P: creditable for bonus

### Allocation of places
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### Additional information
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### Referred to in LPO I
(examination regulations for teaching-degree programmes)

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### Module title
Chemical Technology of Inorganic Nano and Micro Particles

### Abbreviation
08-FU-PART-161-m01

### Module coordinator
Degree programme coordinator Funktionswerkstoffe (Functional Materials)

### Module offered by
Chair of Chemical Technology of Material Synthesis

### ECTS
5

### Method of grading
Numerical grade

### Only after succ. compl. of module(s)

### Duration
1 semester

### Module level
Graduate

### Other prerequisites

### Contents
Technological significance of small inorganic particles, their properties and fundamental methods of particle synthesis. Characterization of small particles and structure-property relationships. Introduction of important particle materials. Applications and laboratory course.

### Intended learning outcomes
Students gain advanced knowledge in nano- and microparticles.

### Courses (type, number of weekly contact hours, language — if other than German)
V (2) + P (2)

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

- a) written examination (approx. 90 to 180 minutes)
- b) oral examination of one candidate each (20 to 30 minutes)
- c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate)
- d) log (approx. 20 pages)
- e) presentation (approx. 30 minutes)

Assessment offered: Once a year, winter semester

Language of assessment: German and/or English

P: creditable for bonus

### Allocation of places

### Additional information

### Referred to in LPO I (examination regulations for teaching-degree programmes)

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**Module title**  
Master Thesis Functional Materials

**Abbreviation**  
08-FU-MT-161-m01

**Module coordinator**  
degree programme coordinator Funktionswerkstoffe (Functional Materials)

**Module offered by**  
Chair of Chemical Technology of Material Synthesis

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</table>

**Duration**  
graduate  

**Contents**

Working on a defined problem from the field of technology of functional materials using scientific methods.

**Intended learning outcomes**

The students are able to work on a defined problem using scientific methods and to document the results in written form.

**Courses** (type, number of weekly contact hours, language — if other than German)

No courses assigned to module

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)

Master's thesis (approx. 70 pages)  
Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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Module title | Abbreviation
--- | ---
Master Thesis Defense | 08-FU-Koll-161-m01

Module coordinator | Module offered by
chairperson of examination committee Funktionswerkstoffe | Chair of Chemical Technology of Material Synthesis

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<td>graduate</td>
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Contents
Präsentation and defense of the results of the Master-Thesis

Intended learning outcomes
The students learn how to present and defend a scientific piece of work.

Courses (type, number of weekly contact hours, language — if other than German)
K (0)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)
final colloquium (approx. 60 minutes): talk (approx. 30 minutes) with subsequent discussion (approx. 30 minutes)
Language of assessment: German and/or English

Allocation of places
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Additional information
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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