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
Responsible: Chair of Chemical Technology of Material Synthesis
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)):

04-Apr-2016 (2016-51)
05-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.
The subject is divided into

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Alternatively, within these 20 ECTS credits, modules from the “Subfield Focus Topic A and/or B” can also be included, whereby the modules already taken in the selected “Subfield Focus Topic” and brought in there cannot be used again in the “Subfield General Compulsory Electives”.

If none of the following modules are taken, the 20 ECTS credits are to be selected from modules in the subfield of one and/or both focus topics that have not yet been used within the 30 credits of the "Subfield Focus Topic".

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### Module Group Material Sciences

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<tr>
<td>chairperson of examination committee Funktionswerkstoffe</td>
<td>Chair of Chemical Technology of Material Synthesis</td>
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<tbody>
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<td>1 semester</td>
<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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### Module title
Analytical Methods - Examples from Practical Failure Analysis

### Abbreviation
08-FU-ANA-161-m01

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<th>Module coordinator</th>
<th>Module offered by</th>
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<tr>
<td>Dean of Studies Funktionswerkstoffe (Functional Materials)</td>
<td>Chair of Chemical Technology of Material Synthesis</td>
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### ECTS
5

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

### Duration
1 semester

### Module level
graduate

### Other prerequisites
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### 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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<tr>
<td>Selected Topics in Theoretical Chemistry</td>
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**Module coordinator**
- lecturer of lecture "Theoretische Chemie"

**Module offered by**
- Institute of Physical and Theoretical Chemistry

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**Duration**
- 1 semester

**Module level**
- graduate

**Other prerequisites**
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**Contents**
The module introduces students to theoretical chemistry.

**Intended learning outcomes**
Students are able to describe the mathematical and physical principles underlying the quantum chemical and quantum dynamical approaches 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**
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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>Coating Technologies based on Vapour Deposition</td>
<td>11-BVG-152-m01</td>
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</table>

**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).

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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<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)

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**

--

**Additional information**

--

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

--
## Image and Signal Processing in Physics

**Abbreviation**  
11-BSV-161-m01

### Module title

Image and Signal Processing in Physics

### 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

### 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

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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 coordinator**

holder of the Chair of Functional Materials in Medicine and Dentistry

**Module offered by**

Faculty of Medicine

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**Duration**

1 semester

**Module level**

graduate

**Other prerequisites**

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**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**

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**Additional information**

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

--
Module title: Bioorganic Chemistry
Abbreviation: 08-SCM3-152-m01

Module coordinator
lecturer of lecture "Bioorganische Chemie" (Bioorganic Chemistry)

Module offered by
Institute of Organic Chemistry

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 discusses topics at the interface of organic chemistry, biology and medicine. It focuses on molecular interactions and recognition, molecular diversity, active agent development, new aspects of DNA, RNA, proteins and carbohydrates.

Intended learning outcomes
Students are able to describe molecular interactions and detection mechanisms of bioorganic chemistry. They can explain the molecular diversity of biological systems. They can characterise the fabrication of agents. They can describe modern aspects of DNA, RNA, proteins and carbohydrates.

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)
--
### Module title
- **Biophysical Measurement Technology in Medical Science**

### Abbreviation
- **11-BMT-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
- --

### 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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<td>Chemical Nanotechnology: Analytics and Applications</td>
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<td>degree programme coordinator Funktionswerkstoffe (Functional Materials)</td>
<td>Chair of Chemical Technology of Material Synthesis</td>
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**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 I** (examination regulations for teaching-degree programmes)

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**Contents**

Technological significance of small inorganic particles, their properties und 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) 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, 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)**

--
## Computational Materials Science (DFT)

**Module title**

*Computational Materials Science (DFT)*

**Abbreviation**

11-CMS-161-m01

**Module coordinator**

Managing Director of the Institute of Theoretical Physics and Astrophysics

**Module offered by**

Faculty of Physics and Astronomy

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**Duration**

1 semester

**Module level**

graduate

**Other prerequisites**

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### 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)

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**

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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>Structure and Properties of Modern Materials: Experiments vs. Simulations</td>
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</table>

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

--
Module title | Abbreviation
---|---
Principles of Energy Technologies | 11-ENT-152-m01

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

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

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

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).

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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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§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)
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<td>Electrochemical Energy Storage and Conversion</td>
<td>08-FU-EEW-152-m01</td>
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<tr>
<td>holder of the Chair of Chemical Technology of Material Synthesis</td>
<td>Chair of Chemical Technology of Material Synthesis</td>
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<tr>
<td>1 semester</td>
<td>undergraduate</td>
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### 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
(V (2) + P (1) + E (1))

### Method of assessment
(a) assessment and (b) Vortestate/Nachtestate (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
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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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<td>Solid State Physics 2</td>
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<td>Managing Director of the Institute of Applied Physics</td>
<td>Faculty of Physics and Astronomy</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)

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: 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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<td>Fundamentals of Physiology and Application of Surgical Implants by Loss of Function</td>
<td>03-FU-IMP-161-m01</td>
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<td>holder of the Chair of Functional Materials in Medicine and Dentistry</td>
<td>Faculty of Medicine</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 | Abbreviation
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Supramolecular Chemistry (Basics) | 08-SCM1-161-m01

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<th>Module offered by</th>
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<td>lecturer of lecture &quot;Organischen Chemie&quot;</td>
<td>Faculty of Chemistry and Pharmacy</td>
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</table>

Contents

This module introduces students to the fundamental principles of supramolecular chemistry. It focuses on interactions between molecules, molecular recognition by receptors, complexes, supramolecular polymers, coordination polymers and networks, liquid crystals, self-assembly in aqueous media, synthetic ion channels and modern applications of supramolecular chemistry.

Intended learning outcomes

Students are able to explain interactions between molecules demonstrating a high degree of expertise in the field as well as to describe the formation, structure and polymers of coordination compounds. They are able to describe the self-assembly of polymers in aqueous media as well as to identify the characteristics of synthetic ion channels. They can name modern applications of supramolecular chemistry.

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)

--
Principles of Two- and Three-Dimensional Röntgen Imaging

Managing Director of the Institute of Applied Physics
Faculty of Physics and Astronomy

Only after succ. compl. of module(s)

Graduate

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, ...).

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.

V (3) + R (1)

Module taught in: German or English

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

分配

Additional information

考参到 LPO I (考试规定，适用于学位课程)
### 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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**Contents**

The module introduces students to computational chemistry.

**Intended learning outcomes**

Students are able to explain the theoretical principles of computational chemistry and to apply methods in computational 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)
- 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)

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**  
Semiconductor Lasers and Photonics

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<th>Abbreviation</th>
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**Module coordinator**  
Managing Director of the Institute of Applied Physics

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

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**Duration**  
1 semester

**Module level**  
graduate

**Other prerequisites**  
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### 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

<table>
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<th>(type, number of weekly contact hours, language — if other than German)</th>
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<tr>
<td>V (3) + R (1)</td>
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Module taught in: German or English

### Method of assessment

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<td>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).</td>
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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)

--
### 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
6

### Method of grading
Numerical grade

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

### Duration
1 semester

### Module level
Graduate

### Other prerequisites

### Contents
1. Symmetry properties
2. Crystal formation and electronic band structure
3. Optical excitations and their coupling effects
4. Electron-phonon coupling
5. Temperature-dependent transport properties
6. Magnetic semiconductors

### 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
(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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<tr>
<td>Dean of the Faculty of Electrical Engineering at the University of Applied Sciences Würzburg-Schweinfurt</td>
<td>University of Applied Sciences Würzburg-Schweinfurt (FHWS)</td>
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</table>

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

V (2) + Ü (1) + 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) 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 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)

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Lab User: MTL 112 PM-01

Module title: Laboratory and Measurement Technology

Abbreviation: 11-LMT-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: undergraduate

Other prerequisites: --

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).

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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):
--
Laboratory and Measurement Technology in Biophysics

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: 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
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Additional information
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<td>Laser Spectroscopy</td>
<td>08-PCM1a-161-m01</td>
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<tr>
<td>lecturer of seminar &quot;Laserspektroskopie&quot; (Laser Spectroscopy)</td>
<td>Institute of Physical and Theoretical Chemistry</td>
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</table>

**Contents**

This module introduces students to the fundamental principles of laser spectroscopy. It discusses absorption and emission spectroscopy.

**Intended learning outcomes**

Students are able to explain the components and operating principles of lasers as well as the optical principles of laser technology. They are able to describe the principles of absorption and emission spectroscopy.

**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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<tr>
<td>Master Thesis Functional Materials</td>
<td>08-FU-MT-161-m01</td>
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<tr>
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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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<tr>
<td></td>
<td>graduate</td>
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**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**

--

**Additional information**

--

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

--
### Module title

**Mechanical and Thermal Material Properties**

### Abbreviation

11-FU-MTE-161-m01

### Module coordinator

Managing Director of the Institute of Applied Physics

### Module offered by

Faculty of Physics and Astronomy

### ECTS

5

### Method of grading

numerical grade

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

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### Duration

1 semester

### Module level

graduate

### Other prerequisites

--

### 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).

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.

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
Methods of Non-Destructive Material Testing

### Abbreviation
11-ZMB-152-m01

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### 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
(type, number of weekly contact hours, language — if other than German)
V (2) + 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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<td>Dean of the Faculty of Mechanical Engineering at the University of Applied Sciences Würzburg-Schweinfurt</td>
<td>University of Applied Sciences Würzburg-Schweinfurt (FHWS)</td>
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</table>

**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 semester, 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)

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<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</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)

<table>
<thead>
<tr>
<th>V (4) + Ü (2)</th>
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</table>

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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<table>
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<td>Modern Synthetic Methods</td>
<td>08-OCM-SYNT-161-m01</td>
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<td>lecturer of the seminar</td>
<td>Institute of Organic Chemistry</td>
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<td>1 semester</td>
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**Contents**

This module discusses modern stereoselective synthesis methods. It focuses on selected total syntheses, organometallic chemistry and catalysis.

**Intended learning outcomes**

Students are able to stereoselectively plan complex chemical syntheses and to stereochromically analyse them. They can explain total syntheses. They can describe aspects of organometallic chemistry and catalysis in synthesis chemistry.

**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**

--

**Additional information**

--

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

--
**Module title**
Molecular Biology for Advanced Students

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

**Module coordinator**
holder of the Chair of Biochemistry

**Module offered by**
Chair of Biochemistry

**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 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)

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**
(examination regulations for teaching-degree programmes)
--
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
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:
V (2) + S (2)

Method of assessment:
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 Mathematik (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.

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### Subdivided Module Catalogue for the Subject Functional Materials

**Module title** | **Abbreviation**
--- | ---
Nanoanalytics | 11-NAN-152-m01

**Module coordinator** | **Module offered by**
--- | ---
Managing Director of the Institute of Applied Physics | Faculty of Physics and Astronomy

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

### Contents

- Principles of analytic procedures in the field of nanostructure physics, imaging techniques from a microscopic level up to an atomic level, examination of chemical composition, spectroscopy of electronic properties, usage of X-ray methods.
- Physics and material systems on the nanoscale.
- Secondary ions - mass spectrometry - X-ray methods: Synchrotron spectroscopy. Photoemission. X-ray absorption

### 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

(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

--

### 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

This module discusses advanced topics in nanoscale materials. It focuses on the structure, properties, fabrica-
tion, modern characterisation methods and application areas of nanoscale materials.

### Intended learning outcomes

Students are able to characterise nanoscale materials. They are able to name analytical methods and applica-
tion areas of nanoscale materials.

### 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 seme-
ter, 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

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

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<td>lecturer of lecture &quot;Programmieren in Theoretischer Chemie&quot;</td>
<td>Institute of Physical and Theoretical Chemistry</td>
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<td>1 semester</td>
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</table>

**Contents**

This module provides an introduction to the fundamentals of programming in theoretical chemistry and discusses its application areas.

**Intended learning outcomes**

Students are able to explain and use one of the programming languages typically used in theoretical chemistry as well as to name its application areas.

**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>Optical Properties of Semiconductor Nanostructures</td>
<td>11-HNS-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

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**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
--

**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** (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: 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**
--

**Referred to in LPO I** (examination regulations for teaching-degree programmes)
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Module title | Abbreviation
---|---
Opto-Electronic Material Properties | 11-FU-MOE-161-m01

Module coordinator | Module offered by
Managing Director of the Institute of Applied Physics | 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 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)
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.

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**
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**
numerical grade

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

**Duration**
1 semester

**Module level**
undergraduate

**Other prerequisites**
--

**Contents**
This module discusses biologically important bonding classes, their reactions and syntheses, working with special hazardous substances, complicated working and synthesis techniques, purification methods and product analysis.

**Intended learning outcomes**
Students are able to name important heteroaromatics and to formulate their reactions and syntheses. They are able to characterise and categorise dyes. Students are able to describe the structure and selective synthesis of proteins. In addition, they are able to describe the structure of the DNA, carbohydrates, fats, terpenes and steroids.

**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**
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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)
§ 62 I Nr. 2
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<td>Organic Functional Materials</td>
<td>08-OCM-FM-161-m01</td>
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<td>lecturer of the seminar &quot;Organische Funktionsmaterialien&quot;</td>
<td>Institute of Organic Chemistry</td>
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**Contents**

This module discusses advanced topics in organic functional materials. It focuses on basic physical effects, organic solids, the application of organic functional materials as well as organic and metal-organic polymer chemistry.

**Intended learning outcomes**

Students are able to explain the basic physical properties of organic functional materials. They are able to name and characterise organic solids and their applications in modern chemistry. Students are able to outline the fundamental principles of organic and metal-organic polymer chemistry and to name polymers of technological importance.

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

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**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>

**Contents**

Fundamentals of organic semiconductors, molecular and polymer electronics and sensor technology, applications.

**Intended learning outcomes**

The students have advanced knowledge of organic semiconductors.

**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: 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
Physical Chemistry of Supramolecular Assemblies

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<th>Abbreviation</th>
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## Module coordinator
lecturer of the seminar "Physikalische Chemie Supramole- kularer Strukturen"

## 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
This module examines the basic interactions between molecules. It discusses the formation and physical-chemical properties of aggregates as well as key applications of supramolecular chemistry.

### Intended learning outcomes
Students are able to explain the basic interactions between molecules demonstrating a high degree of expertise in the field. They can describe the formation and physical-chemical properties of aggregates. They can name modern applications of supramolecular chemistry.

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

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<td>Ü</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)

- 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
--

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

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Module title: Physics of Semiconductor Devices

Abbreviation: 11-SPD-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: undergraduate

Other prerequisites: --

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, Barit- 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, Barit- 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:

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:

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

--
## Module title

**Physics of Advanced Materials**

### Abbreviation

11-PMM-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

Numerical grade

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


### Duration

1 semester

### Module level

Graduate

### Other prerequisites


### 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

*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: 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


### Referred to in LPO I

(examination regulations for teaching-degree programmes)
Module title: Polymers II
Abbreviation: 03-FU-PM2-161-m01

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

ECTS: 5
Method of grading: numerical grade
Only after succ. compl. of module(s): --
Duration: 1 semester
Module level: graduate
Other prerequisites: --

Contents:
Deeepend 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 (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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<td>Polymer Materials 1: Technology of Polymer Modification</td>
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<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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<td>Polymer Materials 2: Technology of Filler Modification for Polymer Materials</td>
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<td>degree programme coordinator Funktionswerkstoffe (Functional Materials)</td>
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**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: Applied Spectroscopy 3
Abbreviation: 08-PS3-152-m01

Module coordinator: Lecturer of lecture “Praktische Spektroskopie 3”
Module offered by: Institute of Physical and Theoretical Chemistry

ECTS: 5
Method of grading: Only after successful completion of module(s)
Numerical grade: --

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

Contents:
This module gives students the opportunity to apply their theoretical knowledge of spectroscopic methods in practice and to interpret readings or graphs. We will record and analyse UV-VIS, fluorescence and vibration spectra and discuss modern mass spectrometry methods.

Intended learning outcomes:
Students are able to work with different spectrometers and to interpret the resulting spectra. They are able to conduct error discussions.

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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## 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

### 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
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### Additional information
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### Referred to in LPO I (examination regulations for teaching-degree programmes)
- § 49 I Nr. 1c
- § 69 I Nr. 1d
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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**

--

**Additional information**

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

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### Research Project 2

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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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<td>lecturer of lecture &quot;Quantendynamik&quot;</td>
<td>Institute of Physical and Theoretical Chemistry</td>
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<th>Other prerequisites</th>
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</thead>
<tbody>
<tr>
<td>1 semester</td>
<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

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### Additional information

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

--
# Module title
Quantum Transport

# Abbreviation
11-QTH-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
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
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: 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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<table>
<thead>
<tr>
<th>Module title</th>
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<tbody>
<tr>
<td>Sensor and Actor Materials - Functional Ceramics and Magnetic Particles</td>
<td>08-FU-SAM-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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<tbody>
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</table>

### 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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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

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<table>
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<tbody>
<tr>
<td>Statistical Mechanics and Reaction Dynamics</td>
<td>08-PCM2-161-m01</td>
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<tr>
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<tbody>
<tr>
<td>lecturer of seminar &quot;Chemische Dynamik&quot; (Chemical Dynamics)</td>
<td>Institute of Physical and Theoretical Chemistry</td>
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**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**

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

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<tr>
<td>Technologies to Support Regenerative Medicine</td>
<td>03-FU-TRM-161-m01</td>
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<tbody>
<tr>
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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>
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<tr>
<td>Tissue Engineering - Alternatives to Animal Testing</td>
<td>03-FU-TE-AT-161-m01</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**

--

**Additional information**

--

**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

### Module coordinator
unknown

### Module offered by
Faculty of Medicine

### ECTS
5

### 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
Students gain fundamental knowledge occuring in the tranplatation 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 therapeutical 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
(examination regulations for teaching-degree programmes)
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### Module title
**Carrier Materials and Devices for Therapeutic Compounds**

### Abbreviation
**03-FU-TMW-161-m01**

### Module coordinator
holder of the Chair of Regenerative Medicine

### Module offered by
Faculty of Medicine

### ECTS
5

### Method of grading
numerical grade

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

### Duration
1 semester

### Module level
graduate

### Other prerequisites
--

### 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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