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: 2012
Responsible: Faculty of Chemistry and Pharmacy
Course of Studies - Contents and Objectives

The “Functional Materials” course programme (120 ECTS credits) with the Master of Science qualification prepares students for work of a scientific nature in the interdisciplinary area of materials science with a focus on functional materials. Students deepen their knowledge of specific topics and the methodical basics of the scientific work from their Bachelor studies. This course also prepares students for PhD-studies (Dr.rer.nat or Dr.-Ing.). The interdisciplinary character of this degree programme is reflected in co-operations with the Fachhochschule Würzburg-Schweinfurt, the Fraunhofer Institut für Silicatforschung, the Süddeutsches Kunststoffzentrum Würzburg, and the Bavarian Centre for Applied Energy Research (ZAE Bayern). These bring students into contact with the many topics of modern functional materials in the areas of chemistry, physics, materials science, and bio materials. The compulsory topics (45 ECTS credits) consist of lectures and practical training courses from the areas of Physics and Chemistry on mechanical/thermal and optical/electronic material properties, as well as Organic Chemistry and organic functional materials. These topics include a colloquium for the master thesis (5 ECTS credits) as well as two project assignments (each 10 ECTS credits) which can – as is the case for the master thesis - be undertaken at the universities and at the named research institutes participating in the course program or in industrial companies. The optional topics are divided into general topics (20 ECTS credits), where students may choose from Chemistry, Physics, Computer Science and Mathematics, and specific topics (30 ECTS credits). Here, students may choose between the Bio Materials and Technical Functional Materials subject areas. In their master thesis (25 ECTS credits) students show that they are able to deal predominantly independently with a thematically and temporally restricted experimental or theoretical topic from (engineering) sciences on the basis of their acquired methods and scientific skills. The results of the master thesis are presented and graded in a compulsory colloquium. The internationally comparable Master Degree qualifies students for scientifically oriented work in research and development in materials science with a focus on functional materials, as well as for attending a PhD study program.
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:

ASPO2009

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

12-Jul-2012 (2012-139)

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

Master’s with 1 major, 120 ECTS credits

The subject is divided into

#### Compulsory Courses (40 ECTS credits)

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<td>11-E5T-092-m01</td>
<td>Mechanical and Thermal Material Properties</td>
<td>5</td>
<td>NUM</td>
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<tr>
<td>11-MOE-092-m01</td>
<td>Opto-electronic Material Properties</td>
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<td>08-IOC4-122-m01</td>
<td>Organic Chemistry 4 for Engineers</td>
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<td>08-OCM-FM-102-m01</td>
<td>Organic Functional Materials</td>
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<tr>
<td>08-PR-092-m01</td>
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<td>Research project 2</td>
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#### Compulsory Electives (50 ECTS credits)

**General Compulsory Electives**

Of the following modules, students may take up to two modules. The remaining ECTS credits in the sub-area of mandatory electives must be achieved in the focuses A and/or B; modules already completed as part of the sub-area of focuses may not be used again in the sub-area of mandatory electives. If none of the following modules are chosen, the remaining ECTS credits must be achieved in the two focuses.

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<thead>
<tr>
<th>Abbreviation</th>
<th>Module title</th>
<th>ECTS credits</th>
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<tr>
<td>08-FS5-101-m01</td>
<td>Chemical Nanotechnology: Analytics and Applications</td>
<td>5</td>
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<td>Chemically and bio-inspired Nanotechnology for Material Synthesis</td>
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<td>Electrochemical Energy Storage and Conversion</td>
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<td>Coating Technologies based on Vapour Deposition</td>
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<td>11-SPD-102-m01</td>
<td>Semiconductor Physics and Devices</td>
<td>6</td>
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<td>11-HLF-092-m01</td>
<td>Semiconductor Lasers - Principles and Current Research</td>
<td>6</td>
<td>NUM</td>
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<td>11-QTH-102-m01</td>
<td>Quantum Transport in Semiconductor Nanostructures</td>
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<td>11-ZMB-112-m01</td>
<td>Methods for non-destructive Characterization of Materials and Components</td>
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<td>11-A3-072-m01</td>
<td>Laboratory and Measurement Technology</td>
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<td>Principles of two- and threedimensional Röntgen imaging</td>
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<td>Materials for high voltage insulation and high voltage systems</td>
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<td>Modelling and simulation for technology systems</td>
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<td>07-4S1MZ5-102-m01</td>
<td>Aspects of molecular Biotechnology</td>
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<td>10-M-FAN-072-m01</td>
<td>Introduction to Functional Analysis</td>
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<td>10-M-ODE-082-m01</td>
<td>Ordinary Differential Equations</td>
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<td>10-M-PRG-082-m01</td>
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<td>3</td>
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<td>Information Retrieval</td>
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<td>11-OHL-092-m01</td>
<td>Organic Semiconductor</td>
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### Master's with 1 major, 120 ECTS credits

Subdivided Module Catalogue for the Subject Functional Materials

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<td>03-SP1A2-101-m01</td>
<td>Fundamentals of Tissue Engineering and Quality Management</td>
<td>5</td>
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<tr>
<td>03-SP2A1-101-m01</td>
<td>Materials used for surgical implants</td>
<td>5</td>
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<td>03-SP2A2-101-m01</td>
<td>Materials for biosensors, tissue engineering and tissue regeneration</td>
<td>5</td>
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<td>03-SP3A1-101-m01</td>
<td>Carrier materials and devices for therapeutic compounds</td>
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<td>NUM 58</td>
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<td>03-SP3A2-101-m01</td>
<td>Microsystems for biological and medicinal Applications</td>
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<td>08-SCM1-102-m01</td>
<td>Supramolecular Chemistry (Basics)</td>
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<td>08-PCM3-102-m01</td>
<td>Nanoscale Materials</td>
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<td>Physical chemistry of supramolecular assemblies</td>
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<td>11-HNS-092-m01</td>
<td>Semiconductor Nanostructures</td>
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<td>11-NAN-092-m01</td>
<td>Nanoanalytics</td>
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<td>08-MW-122-m01</td>
<td>Structure and Properties of Modern Materials: Experiments and Simulations</td>
<td>5</td>
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<tr>
<td>08-SAM-122-m01</td>
<td>Technology of Sensor and Actor Materials including Smart Fluids</td>
<td>5</td>
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<tr>
<td>03-PM2-122-m01</td>
<td>Polymers II</td>
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<td>08-PW1-122-m01</td>
<td>Polymer Materials 1: Technology of Polymer Modification</td>
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<tr>
<td>08-PW2-122-m01</td>
<td>Polymer Materials 2: Technology of Filler Modification for Polymer Materials</td>
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**Focus**

Students must select a focus (A or B) and, within this focus, must take modules worth no less than 30 ECTS credits.

**Focus Subject A: Biocompatible materials (30 ECTS credits)**

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<th>Module Code</th>
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**Focus Subject B: Technical functional materials**

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<td>Structure and Properties of Modern Materials: Experiments and Simulations</td>
<td>5</td>
<td>NUM 14</td>
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<td>11-OHL-092-m01</td>
<td>Organic Semiconductor</td>
<td>5</td>
<td>NUM 47</td>
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<tr>
<td>08-SAM-122-m01</td>
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<td>11-ENT-092-m01</td>
<td>Principles of Energy Technologies</td>
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<td>Nanoanalytics</td>
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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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<th>Module level</th>
<th>Other prerequisites</th>
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<tr>
<td>1 semester</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 student is able to work on a defined problem using scientific methods and to present the results in written form.

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

This module has 2 components; information on courses listed separately for each component.

- 08-MT-TF-2-122: K (no information on language and number of weekly contact hours available)
- 08-MT-TF-1-122: A (no information on language and number of weekly contact hours available)

**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)

This module has the following 2 assessment components. Unless stated otherwise, students must pass all of these assessment components to pass the module as a whole.

**Assessment component to module component 08-MT-TF-2-122:** Kolloquium zur Master-Arbeit

- 5 ECTS credits, method of grading: numerical grade
- Abschlusskolloquium (approx. 60 minutes) bestehend aus talk (approx. 30 minutes) and anschließender Diskussion (approx. 30 minutes)
- Language of assessment: German, English
- Only after succ. compl. of module component(s): Successful completion of module component 08-MT-TF-1 is a prerequisite for participation in module component 08-MT-TF-2.

**Assessment component to module component 08-MT-TF-1-122:** Master-Arbeit

- 25 ECTS credits, method of grading: numerical grade
- Master thesis (approx. 50-70 pages)

**Allocation of places**

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**Additional information**

Additional information listed separately for each module component.

- 08-MT-TF-1-122: Additional information on module duration: 6 months.
- 08-MT-TF-2-122: --

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

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<th>Module title</th>
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<tr>
<td>Coating Technologies based on Vapour Deposition</td>
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<tr>
<td>Managing Director of the Institute of Applied Physics</td>
<td>Faculty of Physics and Astronomy</td>
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<th>Module level</th>
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<td>1 semester</td>
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<td>Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.</td>
<td>1 semester</td>
<td>graduate</td>
<td>Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.</td>
</tr>
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## 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 + R (no information on SWS (weekly contact hours) and course language available)

## 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 or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

## 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-092-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
Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

### 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 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
R + V (no information on SWS (weekly contact hours) and course language available)

### Method of assessment
(a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

### Allocation of places
--

### Additional information
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### Referred to in LPO I
(examination regulations for teaching-degree programmes)
--
Module title | Abbreviation
--- | ---
Chemical Nanotechnology: Analytics and Applications | 08-FS5-101-m01

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

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

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

Contents

The module provides an application-oriented introduction to the characterisation methods of nanochemistry and includes practical exercises. It also discusses thermoanalysis, rheological processes and dynamic light scattering. The lecture also offers insights into the applications of nanomaterials in the industrial and technological sectors.

Intended learning outcomes

Students have developed an advanced knowledge of sol-gel chemistry and biomineralisation.

Courses

This module comprises 2 module components. Information on courses will be listed separately for each module component.

- 08-FS5-1-101: V (no information on SWS (weekly contact hours) and course language available)
- 08-FS5-2-101: V (no information on SWS (weekly contact hours) and course language available)

Method of assessment

Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

Assessment in module component 08-FS5-1-101: Sol-Gel Chemistry 2

- 2 ECTS, Method of grading: numerical grade
- a) oral examination (approx. 15 minutes) or b) written examination (approx. 45 minutes)

Assessment in module component 08-FS5-2-101: Application oriented Characterization of colloidal and polymeric systems

- 3 ECTS, Method of grading: numerical grade
- a) oral examination (approx. 20 minutes) or b) written examination (approx. 45 minutes)

Allocation of places

Number of places: 20. Should the number of applications exceed the number of available places, places will be allocated in a standardised procedure among all applicants irrespective of their subjects according to the following quotas: Quota 1 (50% of places): total number of ECTS credits already achieved in the respective degree subject; 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): allocation by lot. In this procedure, applicants who already have successfully completed at least one 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.

Additional information

The course is offered as a block course at the end of the semester.

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

--
Module title: Chemically and bio-inspired Nanotechnology for Material Synthesis

Abbreviation: 08-NT-122-m01

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

Module offered by: Chair of Chemical Technology of Material Synthesis

ECTS: 5

Method of grading: numerical grade

Duration: 1 semester

Module level: graduate

Other prerequisites: --

Contents

This module provides an introduction to the synthesis methods of sol-gel chemistry and discusses the methods of analysis used to characterise the generated materials. It also discusses the fundamental principles of biomineralisation and uses examples to introduce students to bio-inspired material synthesis.

Intended learning outcomes

Students have developed an advanced knowledge of sol-gel chemistry and biomineralisation.

Courses

This module comprises 2 module components. Information on courses will be listed separately for each module component.

- 08-NT-1-122: V (no information on SWS (weekly contact hours) and course language available)
- 08-NT-2-122: V (no information on SWS (weekly contact hours) and course language available)

Method of assessment

Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

Assessment in module component 08-NT-1-122: Sol-Gel Chemistry 1: Fundamentals

- 2 ECTS, Method of grading: numerical grade
- a) written examination (approx. 45 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes)

Assessment in module component 08-NT-2-122: From Biomineralisation to biologically inspired Materials Synthesis

- 3 ECTS, Method of grading: numerical grade
- a) written examination (approx. 45 minutes) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes)

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: Computer-oriented Mathematics

Abbreviation: 10-M-COM-082-m01

Module coordinator: Dean of Studies Mathematik (Mathematics)

Module offered by: Institute of Mathematics

ECTS: 3

Method of grading: Only after successfully completed module(s)

Duration: 1 semester

Module level: undergraduate

Other prerequisites: Admission prerequisite to assessment: regular attendance of exercises (attendance monitored, a maximum of one incident of unexcused absence).

Contents:
Introduction to modern mathematical software for symbolic computation (e.g. Mathematica or Maple) and numerical computation (e.g. Matlab) to supplement the basic modules in analysis and linear algebra (10-M-ANA or 10-M-ANL) and 10-M-LNA). Computer-based solution of problems in linear algebra, geometry, analysis, in particular differential and integral calculus; visualisation of functions.

Intended learning outcomes:
The student learns the use of advanced modern mathematical software packages, and is able to assess their fields of application to solve mathematical problems.

Courses (type, number of weekly contact hours, language — if other than German):
V + Ü (no information on SWS (weekly contact hours) and course language available)

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):
project in the form of programming exercises (as specified at the beginning of the course)
Assessment offered: once a year, summer semester
Language of assessment: German, English if agreed upon with the examiner

Allocation of places:
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Additional information:
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Referred to in LPO I (examination regulations for teaching-degree programmes):
§ 73 (1) 5. Mathematik Angewandte Mathematik
### Module title
Databases II

### Abbreviation
10-I=DB2-102-m01

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

### Module offered by
Institute of Computer Science

### ECTS
5

### Method of grading
numerical grade

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

### Duration
1 semester

### Module level
graduate

### Other prerequisites
Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e.g. completion of exercises).

### Contents
Data warehouses and data mining; XML databases; web databases; introduction to Datalog.

### Intended learning outcomes
The students have advanced knowledge about relational databases, XML and data mining.

### Courses
V + Ü (no information on SWS (weekly contact hours) and course language available)

### Method of assessment
written examination (approx. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)

Language of assessment: German, English if agreed upon with the examiner

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

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<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Structure and Properties of Modern Materials: Experiments and Simulations</td>
<td>08-MW-122-m01</td>
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<th>Module offered by</th>
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<td>holder of the Chair of Chemical Technology of Material Synthesis</td>
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<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
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<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
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</table>

### Contents

Material properties of metals and ceramics: correlation of structure/property relations through experiments and simulations.

### Intended learning outcomes

Students gain an insight into the properties of modern materials: aerospace aluminium alloys and high-performance ceramics. They are introduced to measuring methods and calculation methods using numerical simulation. A special focus is on the relation between the micro/nanoscpopic structure of materials and the resulting properties.

### Courses

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

V + S (no information on SWS (weekly contact hours) and course language available)

### 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 (groups of 2, approx. 30 minutes)

### 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
**Principles of Energy Technologies**

### Abbreviation
11-ENT-092-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
Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

### 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
(R + V (no information on SWS (weekly contact hours) and course language available)

### Method of assessment
(a) written examination (approx. 90 minutes) or (b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or (c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or (d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

### Allocation of places

### Additional information

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

<table>
<thead>
<tr>
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<tr>
<td>Introduction to Functional Analysis</td>
<td>10-M-FAN-072-m01</td>
<td>5</td>
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**Module coordinator**

Dean of Studies Mathematik (Mathematics)

**Module offered by**

Institute of Mathematics

<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Contents</th>
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</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
<td>Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis.</td>
</tr>
</tbody>
</table>

**Intended learning outcomes**

The student knows the fundamental concepts and methods of functional analysis as well as the pertinent proof methods, is able to apply methods from linear algebra and analysis to functional analysis, and realises the broad applicability of the theory to other branches of mathematics.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

**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); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)

Language of assessment: German, English if agreed upon with the examiner

**Allocation of places**

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**Additional information**

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

§ 73 (1) 1. Mathematik Analysis
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<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tr>
<td>E-Learning</td>
<td>10-I=EL-102-m01</td>
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<tbody>
<tr>
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<td>Institute of Computer Science</td>
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<th>Duration</th>
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<th>Other prerequisites</th>
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<tr>
<td>1 semester</td>
<td>graduate</td>
<td>Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e.g. completion of exercises).</td>
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</tbody>
</table>

**Contents**

Learning paradigms, learning system types, author systems, learning platforms, standards for learning systems, intelligent tutoring systems, student models, didactics, problem-oriented learning and case-based training systems, adaptive tutoring systems, computer-supported cooperative learning, evaluation of learning systems.

**Intended learning outcomes**

The students possess a theoretical and practical knowledge about eLearning and are able to assess possible applications.

**Courses**

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

\( V + Ü \) (no information on SWS (weekly contact hours) and course language available)

**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. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)

Language of assessment: German, English if agreed upon with the examiner

**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>Electrochemical Energy Storage and Conversion</td>
<td>08-EEW-122-m01</td>
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<th>Other prerequisites</th>
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<tr>
<td>1 semester</td>
<td>graduate</td>
<td>Admission prerequisite to assessment: regular attendance of lab course (a maximum of one incident of unexcused absence).</td>
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</tbody>
</table>

**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 possess comprehensive knowledge in the field of electrochemical energy storage and transformation and are able to apply this to scientific problems.

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

V + P + E (no information on SWS (weekly contact hours) and course language available)

**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)

placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (approx. 5 pages) and 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). Should a module component comprise more than one graded assessment, all assessments will be equally weighted, unless otherwise specified; should the lecturer want to make changes to the way in which assessments are weighted, he or she must do so by two weeks after the start of the course at the latest and must communicate this to students in an appropriate manner.

**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>Ordinary Differential Equations</td>
<td>10-M-ODE-082-m01</td>
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<tr>
<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
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<th>Other prerequisites</th>
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<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
<td>Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.</td>
</tr>
</tbody>
</table>

**Contents**

Existence and uniqueness theorem, continuous dependence of solutions on initial values, systems of linear differential equations, matrix exponential series, linear differential equations of higher order.

**Intended learning outcomes**

The student is acquainted with the fundamental concepts and methods of the theory of ordinary differential equations. He/she is able to apply these methods to practical problems.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

**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); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)

Language of assessment: German, English if agreed upon with the examiner

**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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<th>Module title</th>
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<tr>
<td>Supramolecular Chemistry (Basics)</td>
<td>08-SCM1-102-m01</td>
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<th>Module offered by</th>
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<tbody>
<tr>
<td>lecturer of lecture &quot;Organischen Chemie&quot;</td>
<td>Faculty of Chemistry and Pharmacy</td>
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<tr>
<td>1 semester</td>
<td>graduate</td>
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**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 (no information on SWS (weekly contact hours) and course language available)

**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) or oral examination of one candidate each (approx. 20 minutes)

Language of assessment: German 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>Basic principles of cell biology and tissue regeneration</td>
<td>03-SP1A1-101-m01</td>
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<tbody>
<tr>
<td>holder of the Chair of Orthopaedics and holder of the Chair of Regenerative Medicine</td>
<td>Faculty of Medicine</td>
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<tbody>
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<td>1 semester</td>
<td>graduate</td>
<td></td>
</tr>
</tbody>
</table>

**Contents**

Cell biology, metabolism, differentiation, cell behaviour, cell/cell interactions, cell adhesion, 2D/3D and surface geometry, mechanobiology (bioreactors with mechanics).

**Intended learning outcomes**

Students have developed a knowledge of cell biology, metabolism, differentiation, adhesion to surfaces, mechanobiology.

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

V + Ü + P (no information on SWS (weekly contact hours) and course language available)

**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)

placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (approx. 10 pages) and a) written examination (approx. 90 minutes) or b) presentation (approx. 30 minutes)

**Allocation of places**

--

**Additional information**

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

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<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Principles of two- and threedimensional Röntgen imaging</td>
<td>11-ZDR-111-m01</td>
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<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
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<tbody>
<tr>
<td>Managing Director of the Institute of Applied Physics</td>
<td>Faculty of Physics and Astronomy</td>
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<th>Other prerequisites</th>
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<tbody>
<tr>
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<td>Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.</td>
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</tbody>
</table>

**Contents**

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

**Intended learning outcomes**

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

**Courses**

<table>
<thead>
<tr>
<th>type, number of weekly contact hours, language — if other than German</th>
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<tr>
<td>V + R (no information on SWS (weekly contact hours) and course language available)</td>
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**Method of assessment**

<table>
<thead>
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<th>type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus</th>
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<tbody>
<tr>
<td>a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)</td>
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Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

**Allocation of places**

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**Additional information**

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**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

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<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Fundamentals of Tissue Engineering and Quality Management</td>
<td>03-SP1A2-101-m01</td>
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<table>
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<tbody>
<tr>
<td>holder of the Chair of Regenerative Medicine and holder of the Chair of Functional Materials in Medicine and Dentistry</td>
<td>Faculty of Medicine</td>
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</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
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</tbody>
</table>

**Contents**


**Intended learning outcomes**

Students are familiar with the fundamental principles of tissue engineering and quality management.

**Courses**

V + Ü + P (no information on SWS (weekly contact hours) and course language available)

**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)

placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (approx. 10 pages) and a) written examination (approx. 90 minutes) or b) presentation (approx. 30 minutes)

**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>Semiconductor Lasers - Principles and Current Research</td>
<td>11-HLF-092-m01</td>
</tr>
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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** (type, number of weekly contact hours, language — if other than German)

R + V (no information on SWS (weekly contact hours) and course language available)

**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 or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, 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 Nanostructures
---|---
Abbreviation | 11-HNS-092-m01

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

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Duration | Module level | Other prerequisites
---|---|---
1 semester | graduate | Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

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)
R + V (no information on SWS (weekly contact hours) and course language available)

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 or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, 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
---|---
Semiconductor Physics | 11-HLP-092-m01

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

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</tbody>
</table>

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

Contents

Intended learning outcomes
The students have specific and advanced knowledge in the field of Semiconductor Physics. They know the physical principles of semiconductors and have gained an overview of the important characteristics of semiconductor materials.

Courses
R + V (no information on SWS (weekly contact hours) and course language available)

Method of assessment
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, 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)
--
### Contents

Principles of Semiconductor Physics. Introduction to key theories on semiconductors. Components from the areas of electronics and photonics.

### Intended learning outcomes

The students are familiar with the properties of semiconductors, they have gained an overview of the electronic and phononic band structures of important semiconductors and the resulting electronic, optical and thermal properties. They know the principles of charge transport and are able to apply Poisson, Boltzmann and continuity equations to the solution of questions. They have gained insights into the methods of semiconductor production and are familiar with the methods of planar technology and current developments in this sector, they have a basic understanding of component production. They understand the structure and function of the main components of electronics (diodes, transistor, FET, thyristor, diac, triac), microwave applications (tunnel, impatt, baritt and Gunn diode) and 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 importance. They are familiar with current developments in the field of components.
Referred to in LPO I (examination regulations for teaching-degree programmes)
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<td>Materials for high voltage insulation and high</td>
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<td>voltage systems</td>
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<tbody>
<tr>
<td>Dean of the Faculty of Electrical Engineering at</td>
<td>University of Applied Sciences Würzburg-</td>
</tr>
<tr>
<td>the University of Applied Sciences Würzburg-Schweinfurt</td>
<td>Schweinfurt (FHWS)</td>
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<td>No information on intended learning outcomes available.</td>
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<td>V + Ü + P</td>
<td>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)</td>
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<table>
<thead>
<tr>
<th>Additional information</th>
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<td>-- (examination regulations for teaching-degree programmes)</td>
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<tr>
<td>Module title</td>
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<tr>
<td>Information Retrieval</td>
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<td>Dean of Studies Informatik (Computer Science)</td>
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<td>Where applicable, prerequisites as specified by the lecturer at the beginning of the course (e.g. completion of exercises).</td>
</tr>
</tbody>
</table>

**Contents**

IR models (e.g. Boolean and vector space model, evaluation), processing of text (tokenising, text properties), data structures (e.g. inverted index), query elements (e.g. query operations, relevance feedback, query languages and paradigms, structured queries), search engine (e.g. architecture, crawling, interfaces, link analysis), methods to support IR (e.g. recommendation systems, text clustering and classification, information extraction).

**Intended learning outcomes**

The students possess theoretical and practical knowledge in the area of information retrieval and have acquired the technical know-how to create a search engine.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

**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. 50 to 60 minutes); if announced by the lecturer by four weeks prior to the examination date, the written examination can be replaced by an oral examination of one candidate each or an oral examination in groups (one candidate each: 15 minutes, groups of 2: 20 minutes, groups of 3: 25 minutes)

Language of assessment: German, English if agreed upon with the examiner

**Allocation of places**

--

**Additional information**

--

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

--
Introduction to Electron Microscopy

**Abbreviation**
11-IEM-111-m01

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

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

**ECTS**
4

**Method of grading**
umerical grade --

**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

**Contents**
1. Microscopy with light and electrons.
2. Electrons and their interaction with a specimen.
3. Electron diffraction (selected-area ED, convergent beam ED, basics of electron crystallography, comparison with the X-ray diffraction technique).
4. Transmission electron microscopy (the instrument, contrast mechanisms, principles of image formation, imaging of microstructure).
5. Can we see atoms? High-resolution electron microscopy (principle of image formation, image simulation).
6. Scanning electron microscopy (the instrument, contrast mechanisms).
7. Chemical analysis with the electron microscope (energy-dispersive X-ray microanalysis, electron energy loss spectroscopy).

**Intended learning outcomes**
The students have basic knowledge of modern research methods of electron microscopy up to an atomic level. They know microscoping procedures that are used in practice in labs and the industry as well as electron-microscopic methods for chemical analysis. They are able to evaluate the efficiency of different research methods.

**Courses**
(type, number of weekly contact hours, language — if other than German)
V + R (no information on SWS (weekly contact hours) and course language available)

**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 or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, 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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<table>
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<td>Laboratory and Measurement Technology</td>
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<td>Admission prerequisite to assessment: successful completion of approx. 50% of exercises. Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.</td>
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**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 acquired the following transferable skills: Electronic and optical measuring methods in physical metrology, cryogenics and vacuum technology, cryogenics, light sources, spectroscopic methods and measured value acquisition.

**Courses**

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

**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. 120 minutes)

**Allocation of places**

Only as part of pool of general key skills (ASQ): 15 places. Places will be allocated by lot.

**Additional information**

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

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<td>11-LMB-092-m01</td>
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<td>Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.</td>
</tr>
</tbody>
</table>

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

R + V (no information on SWS (weekly contact hours) and course language available)

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 or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

Allocation of places

--

Additional information

--

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

--
**Module title**  
Mechanical and Thermal Material Properties

<table>
<thead>
<tr>
<th>Module Coordinator</th>
<th>Module Offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managing Director of the Institute of Applied Physics</td>
<td>Faculty of Physics and Astronomy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of Grading</th>
<th>Only after succ. compl. of module(s)</th>
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<tr>
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<thead>
<tr>
<th>Duration</th>
<th>Module Level</th>
<th>Other Prerequisites</th>
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</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>Admission prerequisite to assessment: successful completion of approx. 50% of exercises. Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.</td>
</tr>
</tbody>
</table>

**Contents**

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

**Intended learning outcomes**

The students have knowledge of mechanical/thermal material characteristics.

**Courses**

V + Ü (no information on SWS (weekly contact hours) and course language available)

<table>
<thead>
<tr>
<th>Method of assessment</th>
<th>Type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus</th>
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<tbody>
<tr>
<td>a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)</td>
<td></td>
</tr>
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</table>

**Allocation of places**

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**Additional information**

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

--
### Module title
Methods for non-destructive Characterization of Materials and Components

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>11-ZMB-112-m01</th>
</tr>
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</table>

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

### Module offered by
Faculty of Physics and Astronomy

### ECTS
4

### Method of grading
numerical grade

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

### Duration
1 semester

### Module level
undergraduate

### Other prerequisites
Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

### Contents
Methods of non-destructive material and component characterisation.

### Intended learning outcomes
The students know methods of non-destructive characterisation of materials and components.

### Courses
V + R (no information on SWS (weekly contact hours) and course language available)

### Method of assessment
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate) or c) project report (approx. 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

### Allocation of places
--

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

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<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Microsystems for biological and medicinal Applications</td>
<td>03-SP3A2-101-m01</td>
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</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>holder of the Chair of Functional Materials in Medicine and Dentistry and holder of the Chair of Regenerative Medicine</td>
<td>Faculty of Medicine</td>
</tr>
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<table>
<thead>
<tr>
<th>ECTS</th>
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<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
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</tr>
</tbody>
</table>

### Contents

Implantable drug delivery systems, lab-on-a-chip systems for bioanalysis, bioreactor technology, lab course: nanoparticles for regenerative medicine and protein biochemistry.

### Intended learning outcomes

Students have developed a knowledge of implantable drug delivery systems and lab-on-a-chip systems for bioanalysis, bioreactor technology, nanoparticles for regenerative medicine and protein biochemistry.

### Courses

V + Ü + P (no information on SWS (weekly contact hours) and course language available)

### Method of assessment

Placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (approx. 10 pages) and a) written examination (approx. 90 minutes) or b) presentation (approx. 30 minutes)

### Allocation of places

--

### Additional information

--

### Referred to in LPO I

(examination regulations for teaching-degree programmes)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Modelling and simulation for technology systems</td>
<td>99-MSTS-092-m01</td>
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<th>Module offered by</th>
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<tbody>
<tr>
<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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<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>unknown</td>
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</table>

**Contents**

No information on contents available.

**Intended learning outcomes**

No information on intended learning outcomes available.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

**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) or modelling assignment in the form of a project (expenditure of time for modelling assignment to be specified at the beginning of the course)

**Allocation of places**

--

**Additional information**

--

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

--
Module title | Abbreviation
---|---
Aspects of molecular Biotechnology | 07-4S1MZ5-102-m01

Module coordinator
holder of the Chair of Biotechnology

Module offered by
Faculty of Biology

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

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

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

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

Courses (type, number of weekly contact hours, language — if other than German)
This module comprises 2 module components. Information on courses will be listed separately for each module component.
- 07-4S1MZ5-1-102: V (no information on SWS (weekly contact hours) and course language available)
- 07-4S1MZ5-2-102: S (no information on SWS (weekly contact hours) and course language available)

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)
Assessment in this module comprises the assessments in the individual module components as specified below. Unless stated otherwise, successful completion of the module will require successful completion of all individual assessments.

Assessment in module component 07-4S1MZ5-1-102: Aspects of molecular Biotechnology
- 3 ECTS, Method of grading: numerical grade
- written examination (approx. 30 minutes)

Assessment in module component 07-4S1MZ5-2-102: Molecular Biotechnology - Seminar
- 2 ECTS, Method of grading: (not) successfully completed
- presentation (approx. 15 to 20 minutes)

Allocation of places
Number of places: XX1. Should the number of applications exceed the number of available places, places will be allocated as follows: Places will primarily be allocated to students of the Bachelor's degree subject Biologie (Biology) with 180 ECTS credits. 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 participant 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 a standardised 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 ap-
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): allocation by lot. 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. XX2: XX3 places. Places will be allocated by lot.

Additional information

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

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

#### Master’s with 1 major, 120 ECTS credits

<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nanoanalytics</td>
<td>11-NAN-092-m01</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managing Director of the Institute of Applied Physics</td>
<td>Faculty of Physics and Astronomy</td>
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<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.</td>
</tr>
</tbody>
</table>

### Contents


### Intended learning outcomes

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

### Courses

<table>
<thead>
<tr>
<th>(type, number of weekly contact hours, language — if other than German)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R + V (no information on SWS (weekly contact hours) and course language available)</td>
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### Method of assessment

<table>
<thead>
<tr>
<th>(type, scope, language — if other than German, examination offered — if not every semester, information on whether module can be chosen to earn a bonus)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)</td>
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</tbody>
</table>

Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.

Language of assessment: German, English

### Allocation of places

--

### Additional information

--

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

--
### Module title
Nanoscale Materials

### Abbreviation
08-PCM3-102-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, fabrication, 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 application areas of nanoscale materials.

### Courses
(type, number of weekly contact hours, language — if other than German)
S + Ü (no information on SWS (weekly contact hours) and course language available)

### 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 (90 minutes) or oral examination of one candidate each (20 minutes) or talk (30 minutes)

Language of assessment: German or English

### Allocation of places
--

### Additional information
--

### Referred to in LPO I
(examination regulations for teaching-degree programmes)
--
Module title | Abbreviation
---|---
Numerical Mathematics 1 | 10-M-NM1-082-m01

Module coordinator | Module offered by
---|---
Dean of Studies Mathematik (Mathematics) | Institute of Mathematics

<table>
<thead>
<tr>
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<tr>
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</tbody>
</table>

Duration | Module level | Other prerequisites
---|---|---
1 semester | undergraduate | Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

Contents
Solution of systems of linear equations and curve fitting problems, nonlinear equations and systems of equations, interpolation with polynomials, splines and trigonometric functions, numerical integration.

Intended learning outcomes
The student is acquainted with the fundamental concepts and methods in numerical mathematics, applies them to practical problems and knows about their typical fields of application.

Courses (type, number of weekly contact hours, language — if other than German)
V + Ü (no information on SWS (weekly contact hours) and course language available)

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); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English if agreed upon with the examiner

Allocation of places
--

Additional information
--

Referred to in LPO I (examination regulations for teaching-degree programmes)
§ 73 (i) 5. Mathematik Angewandte Mathematik
### Module title
Numerical Mathematics 2

### Abbreviation
10-M-NM2-082-m01

### Module coordinator
Dean of Studies Mathematik (Mathematics)

### Module offered by
Institute of Mathematics

### ECTS
5

### Method of grading
numerical grade

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

### Duration
1 semester

### Module level
undergraduate

### Other prerequisites
Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

### Contents
Solution methods and applications for eigenvalue problems, linear programming, initial value problems for ordinary differential equations, boundary value problems.

### Intended learning outcomes
The student is able to draw a distinction between the different concepts of numerical mathematics and knows about their advantages and limitations concerning the possibilities of application in different fields of natural and engineering sciences and economics.

### Courses (type, number of weekly contact hours, language — if other than German)
V + Ü (no information on SWS (weekly contact hours) and course language available)

### 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); if announced by the lecturer, the written examination can be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups (groups of 2, approx. 30 minutes)
Language of assessment: German, English if agreed upon with the examiner

### Allocation of places
--

### Additional information
--

### Referred to in LPO I (examination regulations for teaching-degree programmes)
§ 73 (1) 5. Mathematik Angewandte Mathematik
### Opto-electronic Material Properties

**Abbreviation**: 11-MOE-092-m01

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

<table>
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<th>ECTS</th>
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<tbody>
<tr>
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</tbody>
</table>

**Duration**: 1 semester  
**Module level**: graduate  
**Other prerequisites**: Admission prerequisite to assessment: successful completion of approx. 50% of exercises. Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

### Contents

Physical principles of optoelectronic material properties and applications.

### Intended learning outcomes

The students know the principles of optoelectronic material characteristics.

### Courses

**V + Ü** (no information on SWS (weekly contact hours) and course language available)

### 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 or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

### Allocation of places

--

### Additional information

--

### Referred to in LPO I

(examination regulations for teaching-degree programmes)
## Module title

Organic Chemistry 4 for Engineers

## Abbreviation

08-IOC4-122-m01

## Module coordinator

Lecturer of lecture “Organische Chemie 4”

## Module offered by

Institute of Organic Chemistry

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### ECTS

<table>
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<tbody>
<tr>
<td>5</td>
<td>numerical grade</td>
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</tbody>
</table>

## Duration

1 semester

## Module level

Undergraduate

## Other prerequisites

Admission prerequisite to assessment: successful completion of exercises in the respective classes as specified at the beginning of the course (usually 70% of exercises to be successfully completed) as well as regular attendance of exercises (usually a maximum of 2 incidents of unexcused absence).

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## Contents

This module discusses biologically important bonding classes, their reactions and syntheses.

---

### Intended learning outcomes

Students have become familiar with biologically important bonding classes, their reactions and syntheses.

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

V + Ü (no information on SWS (weekly contact hours) and course language available)

### 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) 1 to 3 written examinations (1 written examination: approx. 90 minutes; 2 written examinations: approx. 60 or 90 minutes each; 3 written examinations: approx. 60 minutes each) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes)

Language of assessment: German or English

### Allocation of places

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### Additional information

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

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<table>
<thead>
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<tbody>
<tr>
<td>Organic Functional Materials</td>
<td>08-OCM-FM-102-m01</td>
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</table>

**Module coordinator**
lecturer of the seminar "Organische Funktionsmaterialien"

**Module offered by**
Institute of Organic Chemistry

<table>
<thead>
<tr>
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<tr>
<td>5</td>
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</table>

**Duration**
1 semester

**ECTS**

**Module level**
graduate

**Other prerequisites**
--

**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)
S (no information on SWS (weekly contact hours) and course language available)

**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) 1 to 3 written examinations (60 or 90 minutes) or b) oral examination of one candidate each (20 minutes) or c) oral examination in groups (groups of 2, 30 minutes). Should there be the option to choose between several methods of assessment, the module coordinator will choose the method to be used for the module component in the current semester at the beginning of the course.
Language of assessment: German or English

**Allocation of places**
--

**Additional information**
--

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

## Abbreviation
11-OHL-092-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)
--

## Duration
1 semester

## Module level
graduate

## Other prerequisites
Admission prerequisite to assessment: successful completion of approx. 50% of exercises. Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

## Contents
Physical principles of organic semiconductors, molecular and polymer electronics and sensor technology, applications.

## Intended learning outcomes
The students have advanced knowledge of organic semiconductors.

## Courses
V + Ü (no information on SWS (weekly contact hours) and course language available)

## Method of assessment
a) written examination (approx. 90 minutes) or b) oral examination of one candidate each or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)

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

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<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Physical chemistry of supramolecular assemblies</td>
<td>08-PCM5-102-m01</td>
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<tbody>
<tr>
<td>lecturer of the seminar &quot;Physikalische Chemie Supramolekularer Strukturen&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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</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Type, number of weekly contact hours, language — if other than German</th>
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<tbody>
<tr>
<td>S + Ü (no information on SWS (weekly contact hours) and course language available)</td>
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### Method of assessment

<table>
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<tbody>
<tr>
<td>written examination (90 minutes) and/or oral examination of one candidate each (20 minutes) and/or talk (30 minutes)</td>
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Language of assessment: German 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>Polymers II</td>
<td>03-PM2-122-m01</td>
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<tbody>
<tr>
<td>holder of the Chair of Functional Materials in Medicine and Dentistry</td>
<td>Faculty of Medicine</td>
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<tr>
<td>1 semester</td>
<td>graduate</td>
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</tbody>
</table>

**Contents**

In-depth knowledge and practical application of: - free radical polymerisation, polyaddition - ionic polymerisations - controlled radical polymerisation - polymer characterisation (e.g. gel permeation chromatography, end-group analysis, mass spectrometry) - current aspects of polymer research (e.g. block-copolymers, polymer topographies, polymer functionalisation).

**Intended learning outcomes**

Students acquire an advanced knowledge of polymer synthesis, modification and characterisation.

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

S + Ü (no information on SWS (weekly contact hours) and course language available)

**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: German or English

**Allocation of places**

--

**Additional information**

--

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

--
**Module title**
Polymer Materials 1: Technology of Polymer Modification

**Abbreviation**
08-PW1-122-m01

**Module coordinator**
holder of the Chair of Chemical Technology of Material Synthesis

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

**ECTS**
5

**Method of grading**
umerical grade

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

**Duration**
1 semester

**Module level**
graduate

**Other prerequisites**
--

**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 + P (no information on SWS (weekly contact hours) and course language available)

**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)
Assessment offered: once a year, winter semester

**Allocation of places**
--

**Additional information**
--

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

Polymer Materials 2: Technology of Filler Modification for Polymer Materials

### Abbreviation

08-PW2-122-m01

### Module coordinator

holder of the Chair of Chemical Technology of Material Synthesis

### Module offered by

Chair of Chemical Technology of Material Synthesis

### ECTS

5

### Method of grading

numerical grade

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

--

### Duration

1 semester

### Module level

graduate

### Other prerequisites

--

### Contents

Principles of and technologies for the functionalisation of filler materials in order to modify polymers, interactions between filler materials and polymers, determination of the special properties of functionalised polymers (e.g. electrical behaviour, bactericidal behaviour) and influence of functionalisation on other properties (e.g. rheology, mechanical behaviour, colour, surface).

### Intended learning outcomes

Students have become familiar with technologies for the functionalisation of filler materials. They have developed an awareness of the possibilities and problems associated with the modification of polymers as well as the interactions between filler materials and polymers. They know how to determine the special properties of functionalised polymers (e.g. electrical behaviour, bactericidal behaviour) and understand how other properties are influenced by functionalisation (e.g. rheology, mechanical behaviour, colour, surface).

### Courses

(V + P (no information on SWS (weekly contact hours) and course language available)

### 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)

Assessment offered: once a year, summer semester

### Allocation of places

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### Additional information

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

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<table>
<thead>
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<td>08-PS3-092-m01</td>
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<tr>
<td>lecturer of lecture &quot;Praktische Spektroskopie 3&quot;</td>
<td>Institute of Physical and Theoretical Chemistry</td>
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<td>Other prerequisites</td>
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</table>

**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 (no information on SWS (weekly contact hours) and course language available)

**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)

1 written examination (approx. 90 minutes) or 2 written examinations (approx. 60 or 90 minutes each) or 3 written examinations (approx. 60 minutes each) or oral examination of one candidate each (approx. 20 minutes) or oral examination in groups (groups of 2, approx. 30 minutes)

**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>Programming course for students of Mathematics and other subjects</td>
<td>10-M-PRG-082-m01</td>
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<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
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<td>undergraduate</td>
<td>Admission prerequisite to assessment: regular attendance (attendance monitored, a maximum of one incident of unexcused absence).</td>
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</tbody>
</table>

**Contents**

Basics of a modern programming language (e. g. C or Fortran) taking into account the particular needs in mathematics.

**Intended learning outcomes**

The student is able to work independently on small programming exercises and standard programming problems in mathematics.

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

P (no information on SWS (weekly contact hours) and course language available)

**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)

Project in the form of programming exercises (as specified at the beginning of the course)

Language of assessment: German, English if agreed upon with the examiner

**Allocation of places**

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**Additional information**

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

§ 73 (1) 5. Mathematik Angewandte Mathematik
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<td>Research project</td>
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<tbody>
<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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<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
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**Contents**

This module gives students the opportunity to work independently on experiments on a topic in functional materials.

**Intended learning outcomes**

Students are able to independently work on a defined topic in functional materials and to present their findings in written form.

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

R (no information on SWS (weekly contact hours) and course language available)

**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. 10 to 15 pages)
Language of assessment: German 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>Research project 2</td>
<td>08-PR2-122-m01</td>
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<tr>
<td>holder of the Chair of Chemical Technology of Material Synthesis</td>
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<th>Module level</th>
<th>Other prerequisites</th>
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<tr>
<td>1 semester</td>
<td>graduate</td>
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</table>

**Contents**

This module gives students the opportunity to work independently on experiments on a topic in functional materials.

**Intended learning outcomes**

Students are able to independently work on a defined topic in functional materials and to present their findings in written form.

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

R (no information on SWS (weekly contact hours) and course language available)

**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. 10 to 15 pages)
Language of assessment: German or English

**Allocation of places**

--

**Additional information**

--

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

--
Module title: Quantum Transport in Semiconductor Nanostructures
Abbreviation: 11-QTH-102-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: Certain prerequisites must be met to qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the course. Registration for the course will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew.

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

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

Courses (type, number of weekly contact hours, language — if other than German)
V + R (no information on SWS (weekly contact hours) and course language available)

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 or oral examination in groups (approx. 30 minutes per candidate, for modules with less than 4 ECTS credits approx. 20 minutes) or c) project report (approx. 8 to 10 pages, time to complete: 1 to 4 weeks) or d) presentation/seminar presentation (approx. 30 minutes)
Assessment offered: When and how often assessment will be offered depends on the method of assessment and will be announced in due form under observance of Section 32 Subsection 3 ASPO (general academic and examination regulations) 2009.
Language of assessment: German, English

Allocation of places
--

Additional information
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Referred to in LPO I (examination regulations for teaching-degree programmes)
--
Module title | Abbreviation
--- | ---
Technology of Sensor and Actor Materials including Smart Fluids | 08-SAM-122-m01

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<tbody>
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<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>
<th>Duration</th>
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<th>Other prerequisites</th>
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</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>graduate</td>
<td>Admission prerequisite to assessment: successful completion of lab course.</td>
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</table>

**Contents**

Fabrication, effects and applications of sensory and actuator materials such as piezoelectrics, shape memory materials and magnetostrictive materials. Electrorheological and magnetorheological fluids, magnetofluids.

**Intended learning outcomes**

Students have developed fundamental knowledge in the area of sensory and actuator materials.

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

V + P (no information on SWS (weekly contact hours) and course language available)

**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)

**Allocation of places**

--

**Additional information**

--

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

--
### Module title
Carrier materials and devices for therapeutic compounds

### Abbreviation
03-SP3A1-101-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
Integration and binding of active agents in particles, functionalisation of particles for (intracellular) transport processes, targeting and release of the active agents.

## Intended learning outcomes
Students have developed a knowledge of the integration and binding of active agents in particles and of the functionalisation of particles for (intracellular) transport processes, targeting and release of active agents.

### Courses (type, number of weekly contact hours, language — if other than German)
V + Ü + P (no information on SWS (weekly contact hours) and course language available)

### 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)
placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (approx. 10 pages) and a) written examination (approx. 90 minutes) or b) presentation (approx. 30 minutes)

## Allocation of places
--

## Additional information
--

## Referred to in LPO I (examination regulations for teaching-degree programmes)
--
### Module title
Materials for biosensors, tissue engineering and tissue regeneration

### Abbreviation
03-SP2A2-101-m01

### Module coordinator
holder of the Chair of Orthopaedics and 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
Interaction of biosystems with materials, biodegradation versus inert materials, protein adsorption on surfaces as an information broker for sensors, biological materials, structure-function interaction (nano-microstructures).

### Intended learning outcomes
Students have developed a knowledge of the interaction of the biosystem with materials.

### Courses
V + Ü + P (no information on SWS (weekly contact hours) and course language available)

### Method of assessment
placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (approx. 10 pages) and a) written examination (approx. 90 minutes) or b) presentation (approx. 30 minutes)

### Allocation of places
--

### Additional information
--

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

--
### Module title
Materials used for surgical implants

### Abbreviation
03-SP2A1-101-m01

### Module coordinator
holder of the Chair of Orthopaedics (Jakob/Ebert)

### 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
Function and application of different medical implants (cardiovascular system, catheter systems, organs of perception, bones, teeth).

### Intended learning outcomes
Students have developed a knowledge of the application of implants in different organs and tissues and their compatibility and interaction with the organism.

### Courses
(type, number of weekly contact hours, language — if other than German)
V + Ü + P (no information on SWS (weekly contact hours) and course language available)

### 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)
placement report / fieldwork report / report on practical training / report on practical course / project report / report on technical course (approx. 10 pages) and a) written examination (approx. 90 minutes) or b) presentation (approx. 30 minutes)

### Allocation of places
--

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