Module Catalogue
for the Subject
Functional Materials
as a Bachelor’s with 1 major
with the degree "Bachelor of Science"
(180 ECTS credits)

Examination regulations version: 2015
Responsible: Faculty of Chemistry and Pharmacy
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Molecular Materials (Practical Course)

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Engineering

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Construction, Calculation and Assembly of Technical Products

Physics

Introduction to Nanoscience
Laboratory Course Physical Technology of Material Synthesis
Data and Error Analysis

Mathematics and Computer Science

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Content and Objectives of the Programme

The Bachelor of Science program Functional Materials at the faculty of Chemistry and Pharmacy prepares students for research and development occupations of both a scientific and a practical nature in the field of materials and natural sciences. Students learn the basic methodical principles of scientific work. The study program’s interdisciplinary focus enables students to obtain extensive fundamental knowledge of the fields of chemistry, physics and mathematics. In addition, they acquire expert knowledge of the following engineering and natural sciences subjects: electronics, engineering mechanics, materials science, molecular materials, and compound materials. Close cooperation with the Fraunhofer Institute for Silicate Research ISC, Würzburg-Schweinfurt University of Applied Sciences, the Bavarian Center for Applied Energy Research and the SKZ plastics center guarantees an interdisciplinary education. Thanks to this, students are introduced to multifaceted topics relating to modern functional materials. By means of their bachelor's thesis, students show that they have the ability to act largely independently to solve a specific, time-limited experimental or theoretical assignment of engineering or natural sciences tasks. The results of the bachelor's thesis are presented and defended in a colloquium. The Bachelor of Science degree qualifies students for an occupation of both a scientific and a practical nature in the field of materials and natural sciences in general and of functional materials in particular. However, this generally requires a further qualification to be acquired either through practical experience in industry or through a consecutive master's degree.
Abbreviations used

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

Term: \( SS = \text{summer semester}, \ WS = \text{winter semester} \)

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

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

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

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:

\( \text{ASPO2015} \)

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

\( 12-\text{Aug-2015 (2015-82)} \)

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.
Compulsory Courses
(128 ECTS credits)
Mathematics
(26 ECTS credits)
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<td>10-M-FUN1-152-m01</td>
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<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
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<td>Dean of Studies Mathematik (Mathematics)</td>
<td>Institute of Mathematics</td>
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<th>ECTS</th>
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<td>1 semester</td>
<td>undergraduate</td>
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**Contents**

Basics on numbers and functions, sequences and series, differential and integral calculus in one variable, vector spaces, simple differential equations.

**Intended learning outcomes**

The students get acquainted with fundamental concepts of mathematics. They learn how to apply these methods to simple problems in natural and engineering sciences, in particular in the technology of functional materials, and is able to interpret the results.

**Courses**

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

V (5) + Ü (2)

Module taught in: Ü: German or English

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups of 2 candidates (approx. 15 minutes per candidate)

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

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## Module Catalogue for the Subject
Functional Materials
Bachelor’s with 1 major, 180 ECTS credits

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<th>Abbreviation</th>
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### Contents
Linear maps and systems of linear equations, matrix calculus, eigenvalue theory, differential and integral calculus in several variables, differential equations, Fourier analysis.

### Intended learning outcomes
The students get acquainted with fundamental concepts of advanced mathematics. They learn to apply these methods to problems in natural and engineering sciences, in particular in the technology of functional materials, and is able to interpret the results.

### Courses (type, number of weekly contact hours, language — if other than German)
V (5) + Ü (2)
Module taught in: Ü: German or English

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

- a) written examination (approx. 90 to 120 minutes, usually chosen) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups of 2 candidates (approx. 15 minutes per candidate)

Language of assessment: German and/or English

- creditable for bonus

### Allocation of places
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### Additional information
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### Referred to in LPO I (examination regulations for teaching-degree programmes)
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### Module title
Mathematics 3 for Students of Physics and related Disciplines (Differential Equations)

### Abbreviation
11-M-D-152-m01

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<td>11-M-D-152-m01</td>
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<tr>
<td>Managing Director of the Institute of Theoretical Physics and Astrophysics</td>
<td>Faculty of Physics and Astronomy</td>
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<tr>
<td>1 semester</td>
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### Contents
Basics of ordinary differential equations in physics.
Ordinary differential equations and systems of differential equations.
Fundamentals of function theory.

1. Ordinary differential equations
   1.1 Solution methods
   1.2 Existence and uniqueness theorem
   1.3 Systems of differential equations
   1.4 Greens function for inhomogeneous problems
   1.5 Hermitsche DGL, Legendre DGL

2. Function theory
   2.1 Complex functions
   2.2 Differentiation, holomorphic functions
   2.3 Singularities in the complex
   2.4 Complex integration and the Cauchy integral theorem
   2.5 Laurent series, residual theorem, Fourier transformation
   2.6 Analytical continuation, meromorphic functions, whole functions
   2.7 gamma, beta, hypergeometric functions, sets of Weierstrasse and Mittag-Leffler

2.8 Differential equations in the complex, Bessel differential equation
2.9 Saddle point method

3. (quasi) linear differential equations of 1st order

### Intended learning outcomes
The student has basic knowledge of mathematics to understand the dynamic equations and knowledge of solution methods for ordinary differential equations as well as the theory of the functions of a complex variable and is proficient in the required computing techniques.

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

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<thead>
<tr>
<th>Type</th>
<th>Number of Weekly Contact Hours</th>
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<tr>
<td>V</td>
<td>(4) + Ü (2)</td>
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Module taught in: Ü: German or English

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

- written examination (approx. 120 minutes)
- Language of assessment: German and/or English

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

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Modules Mathematics/Statistics

(26 ECTS credits)
Module title | Abbreviation
---|---
Classical Physics 1 for Students of Physics related Disciplines | 11-ENNF1-152-m01

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

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<th>ECTS</th>
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<th>Other prerequisites</th>
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<tr>
<td>7</td>
<td>numerical grade</td>
<td>Admission prerequisite to assessment: completion of exercises (approx. 13 exercise sheets per semester). Students who successfully completed approx. 50% of exercises will qualify for admittance to assessment. The lecturer will inform students about the respective details at the beginning of the semester.</td>
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### Contents

1. Principles: Physical quantities, prefactors, derived quantities, dimensional analysis, time / length / mass (definition, measurement procedures, SI), importance of metrology;
2. Point Mechanics: Kinematics, motion in 2D and 3D / vectors, special cases: Uniform and constant accelerated motion, free fall, slate litter; circular motion in polar coordinates;
3. Newton’s laws: Forces and momentum definition, weight vs. mass forces on the pendulum, forces on an atomic scale, isotropic and anisotropic friction. Preparation of the equations of motion and solutions;
4. Work and energy: (Kinetic) performance, examples;
5. Elastic, inelastic and super-elastic collision: Energy and momentum conservation, surges in centre of mass and balance system, rocket equation;
6. Conservative and non-conservative force fields: Potential, potential energy; law, weight scale, field strength and potential of gravity (general relations);
7. Rotational motion: Angular momentum, angular velocity, torque, rotational energy, moment of inertia, analogies to linear translation, applications, satellites (geostationary and interstellar), escape velocities, trajectories in the central potential;
8. Tidal forces: Inertial system, reference systems, apparent forces, Foucault pendulum, Coriolis force, centrifugal force;
9. Galilean transformation: Brief digression to Maxwell’s equations, ether, Michelson interferometer, Einstein’s postulates, problem of simultaneity, Lorentz transformation, time dilation and length contraction, relativistic impulse;
10. Rigid body and gyroscope: Determining the centre of mass, inertia tensor and -ellipsoid, principal axes and their stability, tensor on the example of the elasticity tensor, physics of the bike; gyroscope: Precession and nutation, the Earth as a spinning top;
11. Friction: Static and dynamic friction, stick-slip motion, rolling friction, viscous friction, laminar flow, eddy formation;
12. Vibration: Representation by means of complex e-function, equation of motion (DGL) on forces, torque and power approach, Taylor expansion, harmonic approximation; spring and pendulum, physical pendulum, damped vibration (resonant case, Kriechfall, aperiodic limit), forced vibration, Fourier analysis;
13. Coupled vibrations: Eigenvalues and eigenfunctions, double pendulum, deterministic vs. chaotic motion, non-linear dynamics and chaos;
14. Waves: Wave equation, transverse and longitudinal waves, polarisation, principle of superposition, reflection at the open and closed end, speed of sound; interference, Doppler effect; phase and group velocity, dispersion relation;
15. Elastic deformation of solid bodies: Elastic modulus, general Hooke’s law, elastic waves;
16. Fluids: Hydrostatic pressure and buoyancy, surface tension and contact angle, capillary forces, steady flows, Bernoulli equation; Boyle-Mariotte, gas laws, barometric height formula, air pressure, compressibility and compressive modulus;
17. Kinetic theory of gases: ideal and real gas, averages, distribution functions, equipartition theorem, Brownian motion, collision cross section, mean free path, diffusion and osmosis, degrees of freedom, specific heat
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<td>The students understand the basic contexts and principles of mechanics, vibration, waves and kinetic theory of gases. They are able to apply mathematical methods to the formulation of physical contexts and autonomously apply their knowledge to the solution of mathematical-physical tasks.</td>
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<tr>
<td>Registration: If a student registers for the exercises and obtains the qualification for admission to assessment, this will be considered a declaration of will to seek admission to assessment pursuant to Section 20 Subsection 3 Sentence 4 ASPO (general academic and examination regulations). If the module coordinators subsequently find that the student has obtained the qualification for admission to assessment, they will put the student’s registration for assessment into effect. Only those students that meet the respective prerequisites can successfully register for an assessment. Students who did not register for an assessment or whose registration for an assessment was not put into effect will not be admitted to the respective assessment. If a student takes an assessment to which he/she has not been admitted, the grade achieved in this assessment will not be considered.</td>
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</table>
Module title: Classical Physics 2 for Students of Physics related Disciplines
Abbreviation: 11-ENNF2-152-m01

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

ECTS: 7
Method of grading: Only after succ. compl. of module(s)
Numerical grade: --

Duration: 1 semester
Module level: undergraduate
Other prerequisites: Admission prerequisite to assessment: completion of exercises (approx. 13 exercise sheets per semester). Students who successfully completed approx. 50% of exercises will qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the semester.

Contents:

1. Thermodynamics (linked to 11-E-M); temperature and quantity of heat, thermometer, Kelvin scale;
2. Heat conduction, heat transfer, diffusion, convection, radiant heat;
3. Fundamental theorems of thermodynamics, entropy, irreversibility, Maxwell’s demon;
4. Heat engines, working diagrams, efficiency, example: Stirling engine;
5. Real gases and liquids, states of matter (also solids), van der Waals, critical point, phase transitions, critical phenomena (opalescence), coexistence region, Joule-Thomson;
6. Electrostatics, basic concepts: Electrical charge, forces; electric field, reps. field concept, field lines, field of a point charge;
7. Gaussian sentence, related to Coulomb’s law, definition of "river"; Gaussian surface, divergence theorem; special symmetries; divergence and GS in differential form;
8. Electrical potential, working in the E-box, electric. potential, potential difference, voltage; potential equation, equipotential surfaces; several important examples: Sphere, hollow sphere, capacitor plates, electric dipole; lace effects, Segner wheel;
9. Matter in the E-field, charge in a homogeneous field, Millikan experiment, Braun tube; electron: Field emission, thermonic emission, dipole in homogeneous and inhomogeneous field; induction, Faraday cage;
10. Capacitor, mirror charge, definition, capacity; plate and spherical capacitor; combination of capacitors; media in the capacitor; electrical polarisation, displacement and orientation polarisation, microscopic image; dielectric displacement; electrolytic capacitor; Piezoelectric effect;
11. Electricity, introduction, current density, drift velocity, conduction mechanisms;
12. Resistance and conductivity, resistivity, temperature dependence; Ohm’s law; realisations (resistive and non-ohmic, NTC, PTC);
13. Circuits, electrical networks, Kirchhoff’s rules (meshes, nodes); internal resistance of a voltage source, measuring instruments; Wheatstone bridge;
14. Power and energy in the circuit; Capacitor charge; galvanic element; thermovoltage;
15. Transfer mechanisms, conduction in solids: Band model, semiconductor; line in liquids and gases;
16. Magnetostatics, fundamental laws; permanent magnet, field properties, definitions and units; Earth’s magnetic field; Amper’s Law, analogous to e-box, magn. river, swirl;
17. Vector potential, formal derivation, analogous to electric scalar potential; calculation of fields, examples, Helmholtz coils;
18. Moving charge in the static magnetic field, current balance, Lorentz force, right-hand rule, electric motor; dipole field; movement paths, mass spectrometer, Wien filters, Hall effect; electron: e / m determination;
19. Matter in the magnetic field, effects of the field on matter, relative permeability, susceptibility; para-, dia-, ferromagnetism; magn. moment of the electron, behaviour at interfaces;
20. Induction, Faraday’s law of induction, Lenz’s rule, flux change, eddy electric field, Waltenhofen’s pendulum; inductance, self-induction; applications: Transformer, generator;
21. Maxwell’s displacement current, choice of integration area, displacement current; Maxwell’s extension, wave equation; Maxwell equations;
22. AC: Fundamentals, sinusoidal vibrations, amplitude, period and phase; power and RMS value, ohmic resistance; Capacitive & inductive resistor, capacitor and coil, phase shift and frequency dependence; impedance: Complex resistance; performance of the AC;
23. Resonant circuits, combinations of RLC; series and parallel resonant circuit; forced vibration, damped harmonic oscillator (related to 11-E-M);
24: Hertz dipole, characteristics of irradiation, near field, far field; Rayleigh scattering; accelerated charge, synchrotron radiation, X-rays; 25. Electromagnetic waves: Principles, Maxwell's determination to electromagnetism, radiation pressure (Poynting vector, radiation pressure).

### Intended learning outcomes

The students understand the basic principles and contexts of thermodynamics, science of electricity and magnetism. They know relevant experiments to observe and measure these principles and contexts. They are able to apply mathematical methods to the formulation of physical contexts and autonomously apply their knowledge to the solution of mathematical-physical tasks.

### Courses

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<th>Type</th>
<th>Number of Weekly Contact Hours</th>
<th>Language — If Other Than German</th>
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Module taught in: Ü: German or English

### Method of assessment

<table>
<thead>
<tr>
<th>Type</th>
<th>Scope</th>
<th>Language — If Other Than German</th>
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<th>Whether Module Is Creditable For Bonus</th>
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<tr>
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<td>If Not Every Semester</td>
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written examination (approx. 120 minutes)

Language of assessment: German and/or English

### Allocation of places

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### Additional information

Registration: If a student registers for the exercises and obtains the qualification for admission to assessment, this will be considered a declaration of will to seek admission to assessment pursuant to Section 20 Subsection 3 Sentence 4 ASPO (general academic and examination regulations). If the module coordinators subsequently find that the student has obtained the qualification for admission to assessment, they will put the student's registration for assessment into effect. Only those students that meet the respective prerequisites can successfully register for an assessment. Students who did not register for an assessment or whose registration for an assessment was not put into effect will not be admitted to the respective assessment. If a student takes an assessment to which he/she has not been admitted, the grade achieved in this assessment will not be considered.

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>Laboratory Course Physics for Students of Physics Related Disciplines</td>
<td>11-PNNF-152-m01</td>
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<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>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
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</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</tbody>
</table>

**Contents**

Simple experiments in the fields of mechanics, vibration theory, thermodynamics, optics, X-rays, nuclear magnetic resonance, Atomic and Nuclear Physics, imaging methods.

**Intended learning outcomes**

The students have detected and understood physical contexts on the basis of the implementation of own experiments. They have a basic understanding of physical phenomena and know the basic ideas and ways of functioning of different measuring and imaging methods as well as their applications, especially in the field of Biomedicine.

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

P (4)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) practical assignment with oral test (approx. 15 minutes, during experiments) and b) written examination (90 minutes).

Each experiment comprises preparation, performance and evaluation. Test as well as performance of experiments can each be repeated once.

**Allocation of places**

--

**Additional information**

--

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

--
### Module title
**Introduction to the Physics of Functional Materials**

### Abbreviation
11-TMS-152-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
Undergraduate

### Other prerequisites
--

### Contents
Theoretical and practical principles of physical material properties and semiconductor process technology, dielectrics, metals and oxides. Principles of structuring technology, growth and coating procedures.

### Intended learning outcomes
The students have knowledge of the theoretical and practical principles of physical material properties and technology for material synthesis.

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

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

### Method of assessment
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

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

Assessment offered: Once a year, summer semester

Language of assessment: German and/or English

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

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Chemistry

(55 ECTS credits)
<table>
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<tr>
<th>Module title</th>
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<tbody>
<tr>
<td>Experimental Chemistry</td>
<td>08-AC-ExChem-152-m01</td>
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</tr>
</thead>
<tbody>
<tr>
<td>lecturer of lecture &quot;Experimentalchemie&quot; (Experimental Chemistry)</td>
<td>Institute of Inorganic Chemistry</td>
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<table>
<thead>
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<th>ECTS</th>
<th>Method of grading</th>
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<th>Module level</th>
<th>Other prerequisites</th>
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<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</table>

**Contents**

The module provides an overview of the fundamental knowledge of chemistry. Emphasis is placed on the material and particle level, metals, acid-base reactions, the periodic table, chemical equilibrium and complexometry.

**Intended learning outcomes**

The student understands the principles of the periodic table and can obtain information from it. He/she is proficient in basic models of the structure of matter and can describe them properly. He/she can depict chemical reactions using typical chemical formula language and interpret them by identifying the type of reaction.

**Courses**

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

V (4)

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 90 minutes)
Language of assessment: German and/or English

**Allocation of places**

--

**Additional information**

--

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

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<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>General and analytical Chemistry Lab for engineering students</td>
<td>08-ACP1-FU-152-m01</td>
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<th>Module coordinator</th>
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<tbody>
<tr>
<td>holder of the Chair of Anorganic Chemistry</td>
<td>Institute of Inorganic Chemistry</td>
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<td>1 semester</td>
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</table>

**Contents**

The module provides the opportunity to apply the knowledge of the introductory lectures in a practical course. After a safety introduction the students experiment independently in the laboratory. Focuses are laboratory safety, basic laboratory techniques, synthesis of basic compounds and analysis of an unknown compound.

**Intended learning outcomes**

The student is able to identify basic chemical issues and to solve them experimentally. Therefore he/she can carry out the necessary stoichiometric calculations and correctly outline the chemical processes written and verbal.

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

P (5)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Vortestate/Nachtestate (pre and post-experiment examination talks approx. 15 minutes each, log approx. 5 to 10 pages each) and assessment of practical performance (2 to 4 random examinations)

Assessment offered: Once a year, summer semester

Language of assessment: German and/or English

**Allocation of places**

--

**Additional information**

--

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

--
Module title | Abbreviation
---|---
Organic Chemistry 1 | 08-OC1-152-m01

Module coordinator | Module offered by
holder of the Professorship of Organic Chemistry | Institute of Organic Chemistry

<table>
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<th>ECTS</th>
<th>Method of grading</th>
<th>Other prerequisites</th>
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<td>numerical grade</td>
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</tbody>
</table>

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

Contents

German contents available but not translated yet.

Das Modul bietet einen Überblick über die elementaren Grundkenntnisse der organischen Chemie. Dazu wird die Bindungssituation am Kohlenstoff betrachtet und in die Nomenklatur einfacher und mäßig komplexer organischer Verbindungen eingeführt. Es werden Grundlagen der Stereochemie, Substitutions-, Additions- und Eliminierungsreaktionen sowie der Syntheseplanung vermittelt.

Intended learning outcomes

German intended learning outcomes available but not translated yet.


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

V (3) + Ü (1)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Language of assessment: German and/or English

Allocation of places

--

Additional information

--

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

§ 62 I Nr. 2
## Module title

**Organic Chemistry 2**

**Abbreviation**

08-OC2-VL-152-m01

## Module coordinator

Holder of the Chair of Physically Organic Chemistry

## Module offered by

Institute of Organic Chemistry

## ECTS

6

## Method of grading

Numerical grade

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

--

## Duration

1 semester

## Module level

Undergraduate

## Other prerequisites

--

## Contents

German contents available but not translated yet.


## Intended learning outcomes

German intended learning outcomes available but not translated yet.


## Courses

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

V (3) + Ü (1)

## Method of assessment

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Language of assessment: German and/or English

## Allocation of places

--

## Additional information

--

## Referred to in LPO I

(examination regulations for teaching-degree programmes)

§ 42 I Nr. 2 and § 22 II Nr. 1 h

§ 62 I Nr. 2
Module title

Organic Chemistry for engineering students (practical course)

Abbreviation

08-OCP1-FU-152-m01

Module coordinator

holder of the Chair of Organic Chemistry II

Module offered by

Institute of Organic Chemistry

ECTS

2

Method of grading

(Not) successfully completed

Only after succ. compl. of module(s)

08-OC1

Duration

1 semester

Module level

undergraduate

Other prerequisites

--

Contents

German contents available but not translated yet.


Intended learning outcomes

German intended learning outcomes available but not translated yet.


Courses

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

P (4)

Method of assessment

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Vortestate/Nachtestate (pre and post-experiment examination talks approx. 15 minutes each, log approx. 5 to 10 pages each) and assessment of practical performance (2 to 4 random examinations)

Assessment offered: Once a year, winter semester

Language of assessment: German and/or English

Allocation of places

--

Additional information

--

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

--
Module title | Abbreviation
---|---
Thermodynamics, Kinetics, Electrochemistry | 08-PC-TKE-152-m01

Module coordinator | Module offered by
lecturer of lecture "Thermodynamik, Kinetik, Elektrochemie" | Institute of Physical and Theoretical Chemistry

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</table>

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

Contents

German contents available but not translated yet.


Intended learning outcomes

German intended learning outcomes available but not translated yet.

Die Studierenden sind in der Lage, die Hauptsätze der Thermodynamik zu erklären. Er/Sie kann thermodynamische Aspekte von Lösungen, Gasen, Mischphasen sowie elektrochemischen Reaktionen darstellen. Die Studierenden können chemische Reaktionen auf kinetischer Ebene interpretieren.

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

V (4) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Language of assessment: German and/or English creditable for bonus

Allocation of places

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Additional information

--

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

§ 62 I Nr. 1
## Module title

**Principles of quantum mechanics and spectroscopy for engineering students**

**Abbreviation** 08-PC-QMS-FU-152-m01

## Module coordinator

Lecturer of lecture "Grundlagen der Quantenmechanik and Spektroskopie" (Principles of Quantum Mechanics and Spectroscopy)

## Module offered by

Institute of Physical and Theoretical Chemistry

## ECTS

8

## Method of grading

Numerical grade

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

--

## Duration

1 semester

## Module level

Undergraduate

## Other prerequisites

--

## Contents

*German contents available but not translated yet.*


## Intended learning outcomes

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

Die Studierenden sind in der Lage, grundlegende Modelle der Quantenmechanik zu erklären und bei Molekülen anzuwenden. Er/Sie kann unterschiedliche spektroskopische Methoden darstellen. Die Studierenden können die mathematischen Grundlagen der elementaren der Quantenmechanik anwenden.

## Courses

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

V (4) + Ü (2)

## Method of assessment

(***type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus**)

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

Language of assessment: German and/or English creditable for bonus

## Allocation of places

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## Additional information

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## Referred to in LPO I

(examination regulations for teaching-degree programmes)

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<td>Physical Chemistry (lab) for engineering students</td>
<td>08-PCP-FU-152-m01</td>
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<th>Module offered by</th>
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<tbody>
<tr>
<td>lecturer of lecture “Thermodynamik, Kinetik, Elektrochemie”</td>
<td>Institute of Physical and Theoretical Chemistry</td>
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<tbody>
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### Contents

German contents available but not translated yet.


### Intended learning outcomes

German intended learning outcomes available but not translated yet.


### Courses

<table>
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<th>type, number of weekly contact hours, language — if other than German</th>
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<td>P (4)</td>
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### Method of assessment

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<tr>
<td>Vorlesung/Nachtseminar (pre and post-experiment examination talks approx. 15 minutes each, log approx. 5 to 10 pages each) and assessment of practical performance (2 to 4 random examinations)</td>
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<tr>
<td>Assessment offered: Once a year, summer semester</td>
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<tr>
<td>Language of assessment: German and/or English</td>
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### 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
Molecular Materials (Lecture)

### Abbreviation
08-FU-MoMaV-152-m01

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

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

### ECTS
5

### Method of grading
numerical grade

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

### Duration
1 semester

### Module level
undergraduate

### Other prerequisites
--

### Contents
Chemical bonds and molecular interactions, supramolecular chemistry, molecular materials, colloids, nano particles, thin films.

### Intended learning outcomes
The students gain fundamental knowledge in the relationships of physical, chemical and technological properties of materials and their structure. They understand the significance of various inter- and intramolecular interactions and how they determine the properties of molecular materials. They learn how to familiarize themselves with a scientific topic including a literature search, and how to give a presentation including discussion and feedback.

### Courses
(type, number of weekly contact hours, language — if other than German)
V (3) + S (1)

### Method of assessment
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

(a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes) as well as talk (approx. 30 minutes), weighted 3:1

Language of assessment: German and/or English

### Allocation of places
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### Additional information
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### Referred to in LPO I
(examination regulations for teaching-degree programmes)
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<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tr>
<td>Molecular Materials (Practical Course)</td>
<td>08-FU-MoMaP-152-m01</td>
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<td>degree programme coordinator Funktionswerkstoffe (Functional Materials)</td>
<td>Chair of Chemical Technology of Material Synthesis</td>
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<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</table>

**Contents**

Laboratory course to familiarise the students with experimental procedures in molecular materials including chemical synthesis, chemical and physical characterisation methods, as well as analysis of experimental data and scientific documentation, such as mesoporous, piezoelectric and electrochromic materials, polymer-based superabsorbers and nanoparticle based antireflex-coatings.

**Intended learning outcomes**

The students gain practical knowledge in the area of chemical synthesis, characterization methods, data analysis, as well as scientific documentation. By attending the experimental lab course the students consolidated their understanding of the relationship of structure and function of molecular materials.

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

P (5)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Vortestate/Nachtestate (pre and post-experiment examination talks approx. 15 minutes each, log approx. 5 to 10 pages each) and assessment of practical performance (2 to 4 random examinations)

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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

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Engineering
(8 ECTS credits)
<table>
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<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Basics of Electronics 1</td>
<td>99-EL1-152-m01</td>
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**Module coordinator**
Dean of the Faculty of Electrical Engineering at the University of Applied Sciences Würzburg-Schweinfurt

**Module offered by**
University of Applied Sciences Würzburg-Schweinfurt (FHWS)

<table>
<thead>
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<th>ECTS</th>
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<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</table>

**Contents**
Theoretical and practical principles of science of electricity, passive linear networks, principles of semiconductors.

**Intended learning outcomes**
The students have basic knowledge of theoretical and practical science of electricity, especially of passive linear networks and semiconductors.

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

V (3) + Ü (1)

**Method of assessment**
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Language of assessment: German and/or English

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

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<table>
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<th>Abbreviation</th>
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<td>Basics of Electronics 2</td>
<td>99-EL2-152-m01</td>
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<th>Module offered by</th>
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<tbody>
<tr>
<td>Dean of the Faculty of Electrical Engineering at the University of Applied Sciences Würzburg-Schweinfurt</td>
<td>University of Applied Sciences Würzburg-Schweinfurt (FHWS)</td>
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</tr>
</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</table>

**Contents**

Theoretical and practical principles of the components of electrical engineering, basic circuits, basic elements of digital technology, combinatorial circuits and sequential circuits.

**Intended learning outcomes**

The students have theoretical and practical knowledge of the components of electrical engineering, basic circuits, basic elements of digital technology, combinatorial circuits and sequential circuits.

**Courses**

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

V (3) + Ü (1)

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Language of assessment: German and/or English

**Allocation of places**

--

**Additional information**

--

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--
Biology / Medicine
(12 ECTS credits)
Module title
Principles of Cell Biology and Tissue Regeneration

Abbreviation
03-FU-Zell-152-m01

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

Module offered by
Faculty of Medicine

ECTS
5

Method of grading
numerical grade

Duration
1 semester

Module level
undergraduate

Other prerequisites
--

Contents
Foundations of cell biology (cell structure, organelles, DNA, replication, protein biosynthesis, signal transduction, cell metabolism, stem cells, viruses and prokaryotes, immune system).

Intended learning outcomes
Students acquire fundamental knowledge in cell and molecular biology.

Courses (type, number of weekly contact hours, language — if other than German)
V (4)

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

Allocation of places
--

Additional information
--

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

**Biomaterials (Lecture and Practical Course / Seminar)**

**Abbreviation:** 03-FU-BM-152-m01

### Module coordinator

holder of the Chair of Functional Materials in Medicine and Dentistry

### Module offered by

Faculty of Medicine

### ECTS

<table>
<thead>
<tr>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
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<tr>
<td>7 numerical grade</td>
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### Duration

<table>
<thead>
<tr>
<th>Module level</th>
<th>Other prerequisites</th>
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<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</tbody>
</table>

### Contents

Fundamental and specific knowledge about biomaterials out of metals, ceramics and polymers with surface modification and characterisation. Fabrication as well as examples for application will be addressed. Modern approaches in biomaterial research including hydrogels, additive manufacturing, 3D cell scaffolds and materials for tissue engineering will also be discussed.

### Intended learning outcomes

Students acquire fundamental knowledge in the field of biomaterials, their use in clinics as well as methods for biomaterial fabrication.

### Courses

<table>
<thead>
<tr>
<th>Type, number of weekly contact hours, language — if other than German</th>
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<tbody>
<tr>
<td>V (4) + P (2)</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 is creditable for bonus</th>
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</thead>
<tbody>
<tr>
<td>a) assessment and b) Vortestate/Nachtestate (pre and post-experiment examination talks approx. 15 minutes each, log approx. 5 to 10 pages each) and assessment of practical assignments (2 to 4 random examinations) Assessment offered: Once a year, summer semester Language of assessment: German and/or English creditable for bonus</td>
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</tbody>
</table>

### Allocation of places

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### Additional information

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

--
Advanced Laboratory Course

(3 ECTS credits)
### Module Catalogue for the Subject
Functional Materials
Bachelor’s with 1 major, 180 ECTS credits

<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Advanced Laboratory Course of Functional Materials</td>
<td>08-FU-VP-152-m01</td>
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<table>
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<tr>
<th>Module coordinator</th>
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<tbody>
<tr>
<td>degree programme coordinator Funktionswerkstoffe (Functional Materials)</td>
<td>Chair of Chemical Technology of Material Synthesis</td>
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<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</table>

**Contents**
Practical work with the intention of topical and methodological preparation for the bachelor thesis.

**Intended learning outcomes**
The students are familiar with procedures and methods in research.

**Courses** (type, number of weekly contact hours, language — if other than German)
P (3)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
talk (approx. 15 minutes)
Language of assessment: German and/or English

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

(20 ECTS credits)
Engineering

(ECTS credits)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Basics of Applied Mechanics</td>
<td>99-TM-152-m01</td>
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</table>

<table>
<thead>
<tr>
<th>Module coordinator</th>
<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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<td>1 semester</td>
<td>undergraduate</td>
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</table>

**Contents**

Basics of statistics, strength of materials and dynamics.

**Intended learning outcomes**

The students gain methodological competence in determining forces and stress resultants, in calculating tensions and deformations and in dimensioning components.

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

V (3) + Ü (1)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Assessment offered: Once a year, winter semester

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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

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<table>
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<tbody>
<tr>
<td>Laboratory Course of Mechanical and Electrical Engineering</td>
<td>99-IP-152-m01</td>
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**Module coordinator**

Deans of the Faculties of Electrical Engineering and Mechanical Engineering at the University of Applied Sciences Würzburg-Schweinfurt

**Module offered by**

University of Applied Sciences Würzburg-Schweinfurt (FHWS)

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</table>

**Duration**

1 semester

**Module level**

undergraduate

**Contents**

Engineering laboratory and internship experiments.

**Intended learning outcomes**

The students have practical experiences in applying engineering methods in electrical and mechanical engineering.

**Courses**

(P (5))

**Method of assessment**

- report on practical course (15 to 30 pages)
- Assessment offered: Once a year, summer semester
- Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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**Referred to in LPO I**

(examination regulations for teaching-degree programmes)
**Module title** | **Abbreviation**
---|---
Construction, Calculation and Assembly of Technical Products | 99-CA-152-m01

**Module coordinator**
Dean of the Faculty of Mechanical Engineering at the University of Applied Sciences Würzburg-Schweinfurt

**Module offered by**
University of Applied Sciences Würzburg-Schweinfurt (FHWS)

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</table>

**Contents**
Comprehensive view of the process of product development, including the corresponding specialist subjects based on a selected example.

**Intended learning outcomes**
The students have professional and methodological competencies in the development of products with a focus on construction (CAD), calculation (CAE) and production (CAM), including prototyping and product validation.

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

V (2) + Ü (2)

**Method of assessment**
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes) or b) oral examination of one candidate each (20 to 30 minutes) or c) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or d) log (approx. 20 pages) or e) presentation (approx. 30 minutes)
Assessment offered: Once a year, summer semester
Language of assessment: German and/or English creditable for bonus

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

(ECTS credits)
Module title: Introduction to Nanoscience
Abbreviation: 11-N-EIN-152-m01

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

ECTS: 7
Method of grading: numerical grade
Only after succ. compl. of module(s): --

Duration: 2 semester
Module level: undergraduate
Other prerequisites: Admission prerequisite to assessment: regular attendance (minimum 85% of sessions).

Contents:
Introduction to the principles of producing, characterising and applying nanostructures.

Intended learning outcomes:
The students have knowledge of the fundamental properties, technologies, characterising methods and functions of nanostructures.

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

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus):
a) talk (30 to 45 minutes) with discussion and b) written examination (approx. 120 minutes)
Language of assessment: German and/or English

Allocation of places:
--

Additional information:
Registration: If a student registers for the exercises and obtains the qualification for admission to assessment, this will be considered a declaration of will to seek admission to assessment pursuant to Section 20 Subsection 3 Sentence 4 ASPO (general academic and examination regulations). If the module coordinators subsequently find that the student has obtained the qualification for admission to assessment, they will put the student’s registration for assessment into effect. Only those students that meet the respective prerequisites can successfully register for an assessment. Students who did not register for an assessment or whose registration for an assessment was not put into effect will not be admitted to the respective assessment. If a student takes an assessment to which he/she has not been admitted, the grade achieved in this assessment will not be considered.

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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<tr>
<td>Laboratory Course Physical Technology of Material Synthesis</td>
<td>11-PPT-152-m01</td>
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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>Duration</th>
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<tr>
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<td>Students of Funktionswerkstoffe (Functional Materials, Bachelor’s) are recommended to take module 11-P-FR1.</td>
</tr>
</tbody>
</table>

**Contents**

Physical material properties, growth and coating procedures, methods of characterisation and structuring technologies.

**Intended learning outcomes**

The students have knowledge of the practical basics of material characterisation and physical technology for material synthesis.

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

P (5)

Module taught in: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Preparation of the experiment will be considered successfully completed if a pre-experiment oral test (approx. 15 minutes) is passed. Performing and evaluating the experiments will be considered successfully completed if a Testat (exam) is passed. An experiment log (approx. 8 pages) must be prepared. Each component of the assessment can be repeated once in the respective semester. Only if both components of the assessment have been successfully completed in the same semester will the module component be considered successfully completed.

Assessment offered: Once a year, winter semester

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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

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<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tr>
<td>Data and Error Analysis</td>
<td>11-P-FR1-152-m01</td>
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<td>Managing Director of the Institute of Applied Physics</td>
<td>Faculty of Physics and Astronomy</td>
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<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
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<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
<td>Admission prerequisite to assessment: completion of exercises (approx. 13 exercise sheets per semester). Students who successfully completed approx. 50% of exercises will qualify for admission to assessment. The lecturer will inform students about the respective details at the beginning of the semester.</td>
</tr>
</tbody>
</table>

**Contents**

Types of errors, error approximation and propagation, graphic representations, linear regression, mean values and standard deviation.

**Intended learning outcomes**

The students are able to evaluate measuring results on the basis of error propagation and of the principles of statistics and to draw, present and discuss the conclusions.

**Courses**

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

V (1) + Ü (1)

Module taught in: Ü: German or English

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 120 minutes)

Language of assessment: German and/or English

**Allocation of places**

--

**Additional information**

Registration: If a student registers for the exercises and obtains the qualification for admission to assessment, this will be considered a declaration of will to seek admission to assessment pursuant to Section 20 Subsection 3 Sentence 4 ASPO (general academic and examination regulations). If the module coordinators subsequently find that the student has obtained the qualification for admission to assessment, they will put the student’s registration for assessment into effect. Only those students that meet the respective prerequisites can successfully register for an assessment. Students who did not register for an assessment or whose registration for an assessment was not put into effect will not be admitted to the respective assessment. If a student takes an assessment to which he/she has not been admitted, the grade achieved in this assessment will not be considered.

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

§ 53 I Nr. 1 c)
§ 77 I Nr. 1 d)
Mathematics and Computer Science

(ECTS credits)
## Computational Mathematics

<table>
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<tbody>
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<td>Computational Mathematics</td>
<td>10-M-COM-152-m01</td>
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### Module coordinator
Dean of Studies Mathematik (Mathematics)

### Module offered by
Institute of Mathematics

### ECTS
4

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

### Duration
1 semester

### Module level
undergraduate

### Other prerequisites
--

### 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-G and 10-M-LNA-G). 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
V (1) + Ü (2)

### Method of assessment
Project in the form of programming exercises (approx. 20 to 25 hours)
Assessment offered: Once a year, winter semester
Language of assessment: German and/or English

### Allocation of places
--

### Additional information
--

### Referred to in LPO I
§ 22 II Nr. 3 f)
Module title
Ordinary Differential Equations for students of other subjects

Abbreviation
10-M-DGLaf-152-m01

Module coordinator
Dean of Studies Mathematik (Mathematics)

Module offered by
Institute of Mathematics

ECTS
10

Method of grading
numerical grade

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

Duration
1 semester

Module level
undergraduate

Other prerequisites
--

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 (4) + Ü (2)

Method of assessment
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English creditable for bonus

Allocation of places
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Additional information
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Referred to in LPO 1 (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>Introduction to Functional Analysis for Students of other Subjects</td>
<td>10-M-FANaf-152-m01</td>
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**Module coordinator**
- Dean of Studies Mathematik (Mathematics)

**Module offered by**
- Institute of Mathematics

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</table>

**Duration**
- 1 semester

**Module level**
- undergraduate

**Other prerequisites**
- --

**Contents**
- Banach spaces and Hilbert spaces, bounded operators, principles of functional analysis.

**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 (4) + Ü (2)

**Method of assessment**
- (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
- a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
- Language of assessment: German and/or English creditable for bonus

**Allocation of places**
- --

**Additional information**
- --

**Referred to in LPO I**
- (examination regulations for teaching-degree programmes)
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<table>
<thead>
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<th>Module title</th>
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<tbody>
<tr>
<td>Numerical Mathematics 1 for students of other subjects</td>
<td>10-M-NUM1af-152-m01</td>
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**Module coordinator**

Dean of Studies Mathematik (Mathematics)

**Module offered by**

Institute of Mathematics

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

**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 (4) + Ü (2)

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Language of assessment: German and/or English

creditable for bonus

**Allocation of places**

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**Additional information**

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

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<table>
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<tr>
<td>Numerical Mathematics 2 for students of other subjects</td>
<td>10-M-NUM2af-152-m01</td>
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**Module coordinator**
Dean of Studies Mathematik (Mathematics)

**Module offered by**
Institute of Mathematics

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<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</tr>
</tbody>
</table>

**Contents**
Eigenvalue problems, linear programming, methods for 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 (4) + Ü (2)

**Method of assessment**
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Language of assessment: German and/or English creditable for bonus

**Allocation of places**
--

**Additional information**
--

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

--
### Module title
Programming course for students of Mathematics and other subjects

### Abbreviation
10-M-PRG-152-m01

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

### Module offered by
Institute of Mathematics

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

### (not) successfully completed
--

### Duration Module level
1 semester undergraduate

### Other prerequisites
--

### Contents
Basics of a modern programming language (e. g. C).

### 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 (2)

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
project in the form of programming exercises (approx. 20 to 25 hours)
Assessment offered: Once a year, summer semester
Language of assessment: German and/or English

### Allocation of places
--

### Additional information
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### Referred to in LPO I (examination regulations for teaching-degree programmes)
§ 22 II Nr. 3 f)
# Module Catalogue for the Subject

## Functional Materials

Bachelor's with 1 major, 180 ECTS credits

<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Data Bases</td>
<td>10-I-DB-152-m01</td>
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<table>
<thead>
<tr>
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<th>Module offered by</th>
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<tbody>
<tr>
<td>Dean of Studies Informatik (Computer Science)</td>
<td>Institute of Computer Science</td>
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<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
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<tr>
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<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
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<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</tbody>
</table>

**Contents**

Relational algebra and complex SQL statements; database planning and normal forms; transaction management.

**Intended learning outcomes**

The students possess knowledge about database modelling and queries in SQL as well as transactions.

**Courses**

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

V (2) + Ü (2)

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

§ 49 I Nr. 1b

§ 69 I Nr. 1b
### Module title
Introduction to Computer Science for Students of all Faculties

### Abbreviation
10-I-EIN-152-m01

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

### Module offered by
Institute of Computer Science

### ECTS
10

### Method of grading
numerical grade

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

### Duration
1 semester

### Module level
undergraduate

### Other prerequisites
--

### Contents
Foundations of computer science including representation of information and websites (HTML, XML, EBNF), databases, algorithms and data structures, programming (Java).

### Intended learning outcomes
The students are familiar with the fundamentals of computer science, e.g. in the areas of representation of information and websites (HTML, XML, EBNF), databases, algorithms and data structures, programming in Java.

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

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<thead>
<tr>
<th>Type</th>
<th>Number of Weekly Contact Hours</th>
<th>Language</th>
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<td>Ü</td>
<td>2</td>
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### Method of assessment
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 120 minutes)
Language of assessment: German and/or English

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

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Chemistry
(ECTS credits)
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<tr>
<td>Programming and numerical methods</td>
<td>08-PKC-152-m01</td>
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<th>Module offered by</th>
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<tr>
<td>lecturer of lecture &quot;Programmierkurs für Chemiker&quot;</td>
<td>Institute of Physical and Theoretical Chemistry</td>
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<tr>
<td>1 semester</td>
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</tbody>
</table>

**Contents**

The module introduces students to the basics of a programming language and gives applications to problems related to chemistry.

**Intended learning outcomes**

German intended learning outcomes available but not translated yet.

Die Studierenden können einfach Grundlagen der Programmiersprache beschreiben und auf chemierelevante Probleme anwenden.

**Courses**

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

S (2) + Ü (2)

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Assessment offered: Once a year, summer semester

Language of assessment: German and/or English

**Allocation of places**

--

**Additional information**

--

**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

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<table>
<thead>
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<th>Module title</th>
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<td>Biochemistry 1</td>
<td>08-BC1-152-m01</td>
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<th>Module offered by</th>
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<tr>
<td>holder of the Chair of Biochemistry</td>
<td>Chair of Biochemistry</td>
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<tbody>
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</table>

**Contents**

The module imparts the basic knowledge of biochemistry by lectures and tutorials. Main topics of the module Biochemistry 1 are particularly the biochemistry of proteins (amino acids, peptide bond, primary, secondary, tertiary and quaternary structure), catalytic strategies and enzyme kinetics, carbohydrate metabolism (glycolysis, gluconeogenesis, citric acid cycle, cellular respiration, photosynthesis), fatty acid metabolism (beta-oxidation, fatty acid synthesis), nucleotide metabolism, urea cycle and metabolism of amino acids. Additionally the module conveys basic knowledge about the structure of DNA and the basics of passing and transformation of genetic information (central dogma).

**Intended learning outcomes**

The student has basic knowledge in the covered subject areas of biochemistry. He/She is able to describe the basic biochemical processes in cellular systems.

**Courses**

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

V (2) + Ü (1)

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 90 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)

§ 42 I Nr. 2
§ 62 I Nr. 2
Module title: Quantum Chemistry
Abbreviation: 08-TC-152-m01

Module coordinator: lecturer of lecture "Quantenchemie"
Module offered by: Institute of Physical and Theoretical Chemistry

ECTS: 3
Method of grading: numerical grade
Duration: 1 semester
Module level: undergraduate
Other prerequisites: --

Contents

German contents available but not translated yet.


Intended learning outcomes

German intended learning outcomes available but not translated yet.

Die Studierenden sind in der Lage, mit Hilfe grundlegender Konzepte und Modelle angeregte Zustände von Molekülen zu beschreiben.

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

V (2) + Ü (1)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Language of assessment: German and/or English creditable for bonus

Allocation of places

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Additional information

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

§ 22 II Nr. 1 h)
§ 22 II Nr. 2 f)
§ 22 II Nr. 3 f)
### Module title
Applied Spectroscopy 3

### Abbreviation
08-PS3-152-m01

### Module coordinator
Lecturer of lecture “Praktische Spektroskopie 3”

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

### ECTS
5

### Method of grading
Numerical grade

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

### Duration
1 semester

### Module level
Undergraduate

### Other prerequisites
--

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

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

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

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

### Courses
V (3)

### Method of assessment
A) written examination (approx. 90 to 180 minutes) or B) oral examination of one candidate each (20 to 30 minutes) or C) oral examination in groups of up to 3 candidates (approx. 15 minutes per candidate) or D) log (approx. 20 pages) or E) presentation (approx. 30 minutes)

Language of assessment: German and/or English

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

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Module title | Practical spectroscopy 1
---|---
Abbreviation | 08-OC-Spec-152-m01

Module coordinator

Module offered by

Practical spectroscopy 1

lecturer of lecture "Organische Chemie 2"

Institute of Organic Chemistry

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

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

Contents

German contents available but not translated yet.

Das Modul führt in die spektroskopischen Methoden der Infrarotspektroskopie, Massenspektrometrie und NMR-Spektroskopie ein.

Intended learning outcomes

German intended learning outcomes available but not translated yet.

Die Studierenden können wichtige spektroskopische Methoden darstellen sowie ein Spektrum auswerten und Rückschlüsse auf die Molekülstruktur ziehen.

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

V (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Language of assessment: German and/or English

Allocation of places

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Additional information

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

§ 22 II Nr. 1 h
§ 22 II Nr. 2 f
§ 62 I Nr. 2
### Module title
Chemically and bio-inspired Nanotechnology for Material Synthesis

### Abbreviation
08-FU-NT-152-m01

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

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

#### ECTS
5

#### Method of grading
numerical grade

#### Duration
1 semester

#### Module level
undergraduate

#### Contents
Synthesis methods and parameters in sol-gel chemistry as well as characterisation and application of created materials. Basic principles of bio-mineralisation, structure of biomaterials and introduction to bio-inspired materials synthesis.

#### Intended learning outcomes
The student possesses profound knowledge about sol-gel chemistry and biomineralisation.

#### Courses
(V (4)

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

Language of assessment: German and/or English
Medicine

(ECTS credits)
## Module title

Physical Technology of Material Synthesis (Lecture and Practical Course)

## Abbreviation

03-FU-TV-152-m01

<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
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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>
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<th>Other prerequisites</th>
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<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</table>

### Contents

Theoretical and practical fundamental knowledge of the fabrication and evaluation of composite respectively sandwich materials.

### Intended learning outcomes

Students gain fundamental knowledge about the fabrication and evaluation of composite materials.

### Courses

<table>
<thead>
<tr>
<th>type, number of weekly contact hours, language — if other than German</th>
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<tr>
<td>V (2) + P (2)</td>
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</tbody>
</table>

### Method of assessment

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) assessment and b) Vortestate/Nachtestate (pre and post-experiment examination talks approx. 15 minutes each, log approx. 5 to 10 pages each) and assessment of practical assignments (2 to 4 random examinations)

Assessment offered: Once a year, summer semester

Language of assessment: German and/or English creditable for bonus

### Allocation of places

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### Additional information

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

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<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<td>Polymer Chemistry 1 (Lecture and Practical Course)</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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<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</table>

**Contents**

Basic methods of polymerisation: free radical polymerisations, polyadditions, ionic polymerisations, controlled radical polymerisations; characterisation of polymers and polymer analytics: gel permeation chromatography, endgroup analysis, mass spectrometry, rheology.

**Intended learning outcomes**

The students acquire fundamentals of polymer chemistry and the related methods for their characterisation.

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

V (2) + P (2)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) assessment and b) Vortestate/Nachtestate (pre and post-experiment examination talks approx. 15 minutes each, log approx. 5 to 10 pages each) and assessment of practical assignments (2 to 4 random examinations)

Assessment offered: Once a year, winter semester

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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

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<table>
<thead>
<tr>
<th>Module title</th>
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<tbody>
<tr>
<td>Principles of Tissue Engineering</td>
<td>03-FU-TE-152-m01</td>
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**Module coordinator**
holder of the Chair of Regenerative Medicine

**Module offered by**
Faculty of Medicine

<table>
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</table>

**Duration**
1 semester

**Module level**
undergraduate

**Other prerequisites**
--

**Contents**
Medical foundations of organ and tissue damage, medical implants, xenotransplantation, cell culture technology, principles of tissue engineering, 2D and 3D tissue models, stem cell technology.

**Intended learning outcomes**
The students acquire knowledge in the medical fundamentals of organ and tissue damage, medical implants, xenotransplantation, cell culture technology, principles of tissue engineering, 2D and 3D tissue models, stem cell technology.

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

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**Method of assessment**
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Assessment offered: Once a year, summer semester

Language of assessment: German and/or English

**Allocation of places**
--

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

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Additional Qualifications

(ECTS credits)
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<td>degree programme coordinator Funktionswerkstoffe (Functional Materials)</td>
<td>Chair of Chemical Technology of Material Synthesis</td>
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<td>1 semester</td>
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<td>Please consult with course advisory service in advance.</td>
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</tbody>
</table>

**Contents**
Internship in an industrial firm related to functional materials.

**Intended learning outcomes**
The students acquire basic knowledge about the procedures and methods in industry.

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

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<th>P (4)</th>
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</table>

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
report (5 to 10 pages)
Language of assessment: German and/or English

**Allocation of places**
--

**Additional information**
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**Referred to in LPO I** (examination regulations for teaching-degree programmes)
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<table>
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<td>Foreign Studies (Short)</td>
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</table>

**Contents**

Practical work related to functional materials in a foreign country.

**Intended learning outcomes**

The students apply their knowledge in practical laboratory work and gain basic understanding of the language and the culture of the country visited.

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

P (4)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

report (approx. 2 pages); proof of having completed lab course

Language of assessment: German and/or English or potentially language of the respective country

**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>
<th>Module title</th>
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<td>1 semester</td>
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</table>

**Contents**

Education in a field other than the natural sciences with relevance for the study of functional materials

**Intended learning outcomes**

The students acquire skills in other fields than the natural sciences.

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

Ü (0)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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

--
## Module title
Courses Related to Functional Materials inside of the Natural Sciences

## Abbreviation
08-FU-WP2-152-m01

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

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

## ECTS
5

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

## (not) successfully completed
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## Duration
1 semester

## Module level
undergraduate

## Other prerequisites
Please consult with course advisory service in advance.

### Contents
Education in a field within the natural sciences with relevance for the study of functional materials

### Intended learning outcomes
The students acquire further qualification in the fields of natural science.

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

| Ü (o) |

### Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

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

### Referred to in LPO I (examination regulations for teaching-degree programmes)
--
Key Skills Area
(20 ECTS credits)
General Key Skills
(5 ECTS credits)

Students may select modules offered as part of the pool of general transferable skills (ASQ) of JMU.
Subject-specific Key Skills

(15 ECTS credits)
<table>
<thead>
<tr>
<th>Module title</th>
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<tbody>
<tr>
<td>Material Science 1 (Basic introduction)</td>
<td>08-FU-MaWi1-152-m01</td>
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### Contents

- Uncertainty analysis, process engineering: mixing, comminution, agglomeration, separation, drying, conveying.
- Vacuum technology, coating processes, sintering.

### Intended learning outcomes

The students possess comprehensive knowledge about various techniques from different areas of the field of chemical process engineering. For a given objective they are able to weigh the pros and cons of different techniques and can suggest ways of fabrication, processing and treatment of materials. Furthermore they are confident in handling of measurement data as well as statistical and systematic errors and possess extensive knowledge about nomenclature, significance as well as practically determining characteristic material properties.

### Courses

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

V (3) + Ü (1)

### Method of assessment

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

Language of assessment: German and/or English

### Allocation of places

--

### Additional information

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

--
Module Catalogue for the Subject
Functional Materials
Bachelor's with 1 major, 180 ECTS credits

Module title
Material Science 2 (The Material Groups)

Abbreviation
08-FU-MaWi2-152-m01

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

Module offered by
Chair of Chemical Technology of Material Synthesis

ECTS
5

Method of grading
numerical grade

Duration
1 semester

Module level
undergraduate

Only after succ. compl. of module(s)
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Other prerequisites
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Contents

Intended learning outcomes
The students acquire fundamental knowledge about fabrication and properties of the major classes of materials and are able to apply this to scientific problems.

Courses
(type, number of weekly contact hours, language — if other than German)
V (3) + Ü (1)

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

Allocation of places
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Additional information
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<tr>
<td>Modern Bio Analytical Methods (Lecture and practical course)</td>
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**Contents**
Basics of analytics, gravimetric techniques, titrations, chromatography, spectroscopy (UV-VIS, IR, Raman, emission, fluorescence, NMR etc.), surface and structure analytics.

**Intended learning outcomes**
The students acquire basic knowledge in modern analytical and bio-analytical methods.

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

**Method of assessment**
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

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

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

**Allocation of places**
--

**Additional information**
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**Referred to in LPO I**
(examination regulations for teaching-degree programmes)
--
Thesis
(12 ECTS credits)
### Module title
Bachelor Thesis Functional Materials Research

### Abbreviation
08-FU-BT1-152-m01

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### Contents
Working on a defined problem from the field 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
No courses assigned to module

### Method of assessment
Bachelor’s thesis (20 to 40 pages)
Language of assessment: German and/or English

### Allocation of places
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### Additional information
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### Referred to in LPO I
(examination regulations for teaching-degree programmes)
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<td>Bachelor Thesis Functional Materials Defense</td>
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**Contents**

Presentation and defense of a scientific paper.

**Intended learning outcomes**

The students are able to present and defend their scientific work.

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

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**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

talk (approx. 20 minutes) with discussion (approx. 20 minutes)

Language of assessment: German and/or English

**Allocation of places**

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**Additional information**

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

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