Module Catalogue
for the Subject

FOKUS Chemistry
as a Bachelor’s with 1 major
with the degree "Bachelor of Science"
(180 ECTS credits)

Examination regulations version: 2011
Responsible: Faculty of Chemistry and Pharmacy
## Contents

The subject is divided into

Content and Objectives of the Programme  

Abbreviations used, Conventions, Notes, In accordance with

**Compulsory Courses**

General and Inorganic Chemistry

- Inorganic Chemistry 1
- Inorganic Chemistry 2
- Inorganic Chemistry 3
- Chemistry of the Elements and Analytical Chemistry

Organic Chemistry

- Organic Chemistry 1
- Organic Chemistry 2
- Organic Chemistry 3
- Organic Chemistry 4

Physical and Theoretical Chemistry

- Physical Chemistry 1
- Physical Chemistry 2: Thermodynamics, Kinetics, Electrochemistry
- Physical and Theoretical Chemistry 3: Symmetry and Quantum Chemistry
- Physical Chemistry 4: Statistical Thermodynamics
- Theoretical Models in Chemistry

Basics of Natural Sciences

- Biochemistry
- Mathematics for students in Chemistry and Biology
- Introduction to Physics for Students of Non-physics-related Minor Subjects
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Scientific Discussion

- Scientific Discussion

**Thesis**

- Bachelor Thesis FOKUS Chemistry

**Subject-specific Key Skills**

Compulsory Courses

- Toxicology and legal studies
- Programming course for Chemistry Major

Compulsory Electives

- Advanced research lab course
- FOKUS Foreign Studies
- FOKUS Industrial work experience
The subject is divided into

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Content and Objectives of the Programme

No translation available.
Abbreviations used

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

Term: SS = summer semester, WS = winter semester

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

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

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

Conventions

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

Notes

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

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

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

In accordance with

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

ASPO2009

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

29-Aug-2011 (2011-71)

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
(150 ECTS credits)
General and Inorganic Chemistry
(47 ECTS credits)
**Module title** | **Abbreviation**
--- | ---
Inorganic Chemistry 1 | 08-AC1-102-m01

**Module coordinator** | **Module offered by**
--- | ---
lecturer of lecture "Experimentalchemie" (Experimental Chemistry) | Institute of Inorganic Chemistry

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

**Duration** | **Module level** | **Other prerequisites**
--- | --- | ---
1 semester | undergraduate | By way of exception, additional prerequisites are listed in the section on assessments.

**Contents**
This module provides students with an overview of the fundamental principles of chemistry. It focuses on particles, metals, acid-base reactions, the periodic table, chemical equilibrium and complexometry. In addition, the module introduces fundamental models of chemistry and principles of inorganic chemistry. It includes practical exercises based on the lecture on experimental chemistry and its extension. After a safety briefing, the students autonomously conduct experiments in the laboratory. The course focuses on laboratory safety, simple lab techniques, the synthesis of simple substances and analyses of unknown substances. In addition, students have the opportunity to advance their laboratory knowledge.

**Intended learning outcomes**
Students are able to explain the principles of the periodic table and to extract information from it. They are able to explain basic models of the structure of matter. They have developed the ability to use the language of chemical formulas to describe chemical reactions and to interpret them by identifying the type of reaction. Students are able to describe the main quantitative and qualitative analytical methods and their application areas. They are able to identify fundamental problems in chemistry and perform experiments to solve them. They have developed the ability to perform the necessary stoichiometric calculations and describe the chemical processes in an appropriate manner, both in written and oral form.

**Courses** (type, number of weekly contact hours, language — if other than German)
This module has 4 components; information on courses listed separately for each component.
- 08-AC1-1-102: V + V + Ü (no information on language and number of weekly contact hours available)
- 08-AC1-2-102: P (no information on language and number of weekly contact hours available)
- 08-AC1-3-102: V (no information on language and number of weekly contact hours available)
- 08-AC1-4-102: P (no information on language and number of weekly contact hours available)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
This module has the following 4 assessment components. Unless stated otherwise, students must pass all of these assessment components to pass the module as a whole.

**Assessment in module component 08-AC1-2-102:** Praktikum Anorganische Chemie 1 (Lab Course Inorganic Chemistry 1)
- 6 ECTS credits, pass / fail
- pre/post-experiment examination talks (Vor-/Nachtestate, approx. 15 minutes each), log (approx. 5 to 10 pages)
- Assessment offered: once a year, winter semester
- Language of assessment: German, English
- Only after successful completion of module components: Module component 08-AC1-2 can only be taken by students who successfully completed module component 08-AC1-4.

**Assessment in module component 08-AC1-3-102:** Erläuterungen zum Praktikum Anorganische Chemie 1 (Discussion of Experiments Performed in Lab Course Inorganic Chemistry 1)
- 4 ECTS credits, numerical grading
- a) 1 to 3 written examinations (approx. 45, 60 or 90 minutes each) or x) oral examination of one candidate each (approx. 20 minutes) or x) oral examination in groups of 2 candidates (approx. 30 minutes total)
• Language of assessment: German, English

**Assessment in module component 08-AC1-4-102:** Sicheres Arbeiten in chemischen Laboratorien (Chemical Laboratory Safety)
  • 1 ECTS credit, pass / fail
  • Assessment of practical assignments
  • Language of assessment: German, English

**Assessment in module component 08-AC1-1-102:** Grundlagen der Allgemeinen und Anorganischen Chemie (Fundamental Principles of General and Inorganic Chemistry)
  • 10 ECTS credits, numerical grading
  • a) 1 to 3 written examinations (1 written examination: approx. 90 minutes, 2 written examinations: 60 minutes or 90 minutes each, 3 written examinations: 60 minutes each) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups of 2 candidates (approx. 30 minutes)
  • Language of assessment: German or English
  • Additional prerequisites: admission prerequisite to assessment: successful completion of exercises in the respective classes as specified at the beginning of the course (usually 70% of exercises to be successfully completed) as well as regular attendance of exercises (usually no more than 2 incidents of unexcused absence).

**Allocation of places**

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<td>08-AC2-102-m01</td>
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<th>Module offered by</th>
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<tr>
<td>lecturer of lecture &quot;Festkörperchemie&quot; (Solid State Chemistry)</td>
<td>Institute of Inorganic Chemistry</td>
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<td>1 semester</td>
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**Contents**

This module equips students with an advanced knowledge of metals, alloys and saline compounds. It focuses on their structures and properties, special material classes, reactivity and technical processes.

**Intended learning outcomes**

Students are able to describe the structure and properties of metals, alloys and saline compounds in an appropriate manner. They are able to systemise them and characterise their structure and reactivity. They can list spectroscopic methods that can be used for the structural analysis of solids and can describe them in an appropriate manner.

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

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

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

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

Language of assessment: German, 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 Catalogue for the Subject
#### Bachelor’s with 1 major, FOKUS Chemistry

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<th>Module offered by</th>
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<tr>
<td>lecturer of lecture &quot;Elementorganische Chemie&quot; (Elemental Organic Chemistry)</td>
<td>Institute of Inorganic Chemistry</td>
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#### ECTS | Method of grading | Only after succ. compl. of module(s) |
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<td>9</td>
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<td>08-AC1 (module component 08-AC1-4 only) and 08-OC3 (module component 08-OC3-2 only)</td>
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<th>Duration</th>
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<td>1 semester</td>
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<td>By way of exception, additional prerequisites are listed in the section on assessments.</td>
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### Contents

This module equips students with an advanced knowledge of organometallics. It focuses on their structures and properties, special material classes, reactivity and technical processes. The module gives students the opportunity to do some autonomous research and plan and conduct complex syntheses. The course focuses on the handling of organometallic compounds, their synthesis and working with protective atmospheres. Spectroscopy is used for the exact determination of products.

### Intended learning outcomes

Students are able to describe the structure and properties of organometallics in an appropriate manner. They are able to systemise them and characterise their structure and reactivity. In addition, they are able to develop and explain principles for the synthesis of elementary organic compounds. Students are able to conduct autonomous research and perform experiments to solve complex problems. They are able to describe the technical principles in oral and written form using appropriate scientific terminology. They are able to independently plan and carry out the synthesis of a substance using advanced lab techniques.

### Courses

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

- **08-AC3-1-102**: V + Ü (no information on SWS (weekly contact hours) and course language available)
- **08-AC3-2-102**: P (no information on SWS (weekly contact hours) and course language available)

### Method of assessment

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

**Assessment in module component 08-AC3-1-102: Elemental Organic Chemistry**
- 4 ECTS, Method of grading: numerical grade
  - a) 1 to 3 written examinations (1 written examination: approx. 90 minutes; 2 written examinations: approx. 60 or 90 minutes each; 3 written examinations: approx. 60 minutes each) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes)
  - Language of assessment: German, English
  - Other prerequisites: Admission prerequisite to assessment: successful completion of exercises in the respective classes as specified at the beginning of the course (usually 70% of exercises to be successfully completed) as well as regular attendance of exercises (usually a maximum of 2 incidents of unexcused absence).

**Assessment in module component 08-AC3-2-102: Inorganic Chemistry 2 (lab)**
- 5 ECTS, Method of grading: (not) successfully completed
- pre/post-experiment examination talks (Vor-/Nachtestate, approx. 15 minutes each), log (approx. 5 to 10 pages)
- Language of assessment: German, English
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### Module title
Chemistry of the Elements and Analytical Chemistry

### Abbreviation
08-AS1-102-m01

### Module coordinator
lecturer of lecture "Chemie der Hauptgruppenelemente" (Chemistry of Main-group Elements)

### Module offered by
Institute of Inorganic Chemistry

### ECTS
11

### Method of grading
numerical grade

### Only after succ. compl. of module(s)
o8-AC1 (module component 08-AC1-4 only) and 08-OC3 (module component 08-OC3-2 only)

### Duration
1 semester

### Module level
undergraduate

### Other prerequisites
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### Contents
This module equips students with an advanced knowledge of the periodic table and selected elements. It focuses on bonding conditions, trends in the periodic table and the description and structure of elements. In addition, it introduces students to elementary organic chemistry, coordination chemistry and complex chemistry. The module gives students the opportunity to apply in practice the knowledge they have gained through the related lecture(s). After a safety briefing, the students autonomously conduct experiments in the laboratory. These experiments focus on different methods for the analysis of unknown substances.

### Intended learning outcomes
Students are able to characterise main group elements and transition metal elements in terms of their structure, reactivity and fabrication. They are able to identify the coordination of the atoms. In addition, they have learned how to use the periodic table, an essential tool for chemists. Students are able to use different methods to analyse unknown substances. In addition, they are able to separate and analyse mixtures.

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

- **08-AN1-2-102**: P (no information on SWS (weekly contact hours) and course language available)
- **08-AS1-1-102**: V + V (no information on SWS (weekly contact hours) and course language available)

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

**Assessment in module component 08-AN1-2-102: Analytical Chemistry (lab)**
- 5 ECTS, Method of grading: (not) successfully completed
- Vor- and Nachtestate (pre-experiment exams, assessment of practical performance, post-experiment exams, log (5 to 10 pages)
- Assessment offered: once a year, summer semester
- Language of assessment: German, English

**Assessment in module component 08-AS1-1-102: Chemistry of the elements**
- 6 ECTS, Method of grading: numerical grade
- a) 1 to 3 written examinations (1 written examination: approx. 90 minutes; 2 written examinations: approx. 60 or 90 minutes each; 3 written examinations: approx. 60 minutes each) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes)
- Language of assessment: German or English

### Allocation of places
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Organic Chemistry
(39 ECTS credits)
### Module title

Organic Chemistry 1

### Abbreviation

08-OC1-092-m01

### Module coordinator

holder of the Professorship of Organic Chemistry

### Module offered by

Institute of Organic Chemistry

### ECTS

5

### Method of grading

numerical grade

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

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### Duration

1 semester

### Module level

undergraduate

### Other prerequisites

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

### Contents

This module provides students with an overview of the fundamental principles of organic chemistry. It examines the bonding situation of carbon and introduces students to the nomenclature of simple and moderately complex organic compounds. The module also discusses the fundamental principles of stereochemistry, substitution, addition and elimination reactions as well as synthesis planning.

### Intended learning outcomes

Students know important categories of substances in organic chemistry. They are able to use different systems of nomenclature to determine simple substance names. Students are able to analyse the stereochemistry of molecules. They are able to describe and formulate some of the most important reactions in organic chemistry. For that purpose, they can analyse and categorise the characteristic reaction conditions and can use them for simple syntheses.

### Courses

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

### Method of assessment

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

### Allocation of places

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### Additional information

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### Referred to in LPO I

§ 62 (1) 2. Chemie "Organische und Bioorganische Chemie"
Module title | Abbreviation
---|---
Organic Chemistry 2 | 08-OC2-102-m01

Module coordinator | Module offered by
holder of the Chair of Physically Organic Chemistry | Institute of Organic Chemistry

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

Contents

This module introduces students to the rules of aromaticity and discusses specific reactions of aromatics. Using the example of carbonyl compounds, it extends the students’ knowledge of substitution, elimination and addition reactions to complex reaction mechanisms. The course also focuses on oxidation and reduction reactions as well as rearrangement. In addition, it introduces students to the spectroscopic methods of infrared spectroscopy, mass spectrometry and NMR spectroscopy.

Intended learning outcomes

Students have become familiar with the criteria for aromaticity. They can analyse the varying reactivity of carbonyl compounds. They are able to describe specific reactions of carbonyls and aromatics. For that purpose, they can plan and formulate multi-stage syntheses with complex reaction mechanisms and can transfer them to unknown reactions. Students are able to describe important spectroscopic methods, to evaluate a spectrum and to draw conclusions regarding the molecular structure.

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

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

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

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

Language of assessment: German, 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: Organic Chemistry 3
Abbreviation: o8-OC3-102-m01

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

ECTS: 15
Method of grading: numerical grade
Only after success completion of module(s): o8-OC1 and o8-AC1 (module component o8-AC1-2 only) or o8-OC1 and o8-AN1 (module component o8-AN1-2 only), o8-OC1 may be replaced by o8-OC1-GHR

Duration: 1 semester
Module level: undergraduate
Other prerequisites: By way of exception, additional prerequisites are listed in the section on assessments.

Contents
This module focuses on polar rearrangements, olefination reactions, pericyclic reactions, carbenes, nitriles and radicals. It discusses the fundamental principles of stereoselective synthesis, asymmetric catalysis, organometallic chemistry and retrosynthesis. The module gives students the opportunity to apply in practice the knowledge they have gained through the related lecture(s). After a safety briefing, students autonomously conduct experiments in the laboratory. In addition to those experiments, students will be expected to take oral tests and write lab reports to demonstrate their knowledge. The course focuses on the safe handling of hazardous substances, simple experimental unit operations of organic chemistry, simple to multi-level syntheses and the analysis of the products.

Intended learning outcomes
Students are able to formulate olefination reactions. They are able to develop stereoselective syntheses and asymmetric catalyses. Students are able to describe organometallic reactions. They are able to conduct retrosynthetic analyses of molecules. Students know how to safely handle hazardous substances. They are able to conduct simple experimental operations of organic chemistry. They are able to analyse the yield and purity of the products and identify possible error sources. They are able to connect the theoretical aspects covered in the lecture with practical experiments in the laboratory.

Courses
This module comprises 2 module components. Information on courses will be listed separately for each module component.
- o8-OC3-1-102: V + Ü (no information on SWS (weekly contact hours) and course language available)
- o8-OC3-2-102: P (no information on SWS (weekly contact hours) and course language available)

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

Assessment in module component o8-OC3-1-102: Organic Chemistry 3 Organic Chemistry 3
- 6 ECTS, Method of grading: numerical grade
- a) 1 to 3 written examinations (1 written examination: approx. 90 minutes; 2 written examinations: approx. 60 or 90 minutes each; 3 written examinations: approx. 60 minutes each) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes)
- Language of assessment: German, English
- Other prerequisites: Admission prerequisite to assessment: successful completion of exercises in the respective classes as specified at the beginning of the course (usually 70% of exercises to be successfully completed) as well as regular attendance of exercises (usually a maximum of 2 incidents of unexcused absence).

Assessment in module component o8-OC3-2-102: Organic Chemistry - lab 1
- 9 ECTS, Method of grading: (not) successfully completed
- pre/post-experiment examination talks (Vor-/Nachtestate, approx. 15 minutes each), log (approx. 5 to 10 pages)
- Assessment offered: once a year, summer semester
- Language of assessment: German, English

### Allocation of places

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### Additional information

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

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Module title | Abbreviation
---|---
Organic Chemistry 4 | 08-OC4-102-m01

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

**Module offered by**
Institute of Organic Chemistry

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<td>10</td>
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<td>Only after succ. compl. of module(s)</td>
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**Duration**
1 semester

**Module level**
undergraduate

**Contents**
This module focuses on heterocyclic compounds, dyes, naturally occurring substances, biopolymers and protecting group techniques. Students enhance their experimental skills by working with special hazardous substances, using complicated working and synthesis techniques as well as extensive purification methods and performing elaborate product analyses.

**Intended learning outcomes**
Students are able to name important heteroaromatics and to formulate their reactions and syntheses. They are able to characterise and categorise dyes. Students are able to describe the structure and selective synthesis of proteins. In addition, they are able to describe the structure of the DNA, carbohydrates, fats, terpenes and steroids. Students know how to safely and responsibly handle special hazardous substances. They are able to perform complex syntheses, purification methods and product analyses. They are able to use specialist literature to plan experiments.

**Courses**

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

- 08-OC4-1-102: V + Ü (no information on SWS (weekly contact hours) and course language available)
- 08-OC4-2-102: P (no information on SWS (weekly contact hours) and course language available)

**Method of assessment**

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

**Assessment in module component 08-OC4-1-102:** Organic Chemistry 4 Organic Chemistry 4
- 5 ECTS, Method of grading: numerical grade
- a) 1 to 3 written examinations (1 written examination: approx. 90 minutes; 2 written examinations: approx. 60 or 90 minutes each; 3 written examinations: approx. 60 minutes each) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes)
- Language of assessment: German or English
- Only after successful completion of module components: 08-OC1 or 08-OC1-GHR
- Other prerequisites: Admission prerequisite to assessment: successful completion of exercises in the respective classes as specified at the beginning of the course (usually 70% of exercises to be successfully completed) as well as regular attendance of exercises (usually a maximum of 2 incidents of unexcused absence).

**Assessment in module component 08-OC4-2-102:** Organic Chemistry - advanced laboratory course for students of chemistry
- 5 ECTS, Method of grading: (not) successfully completed
- pre/post-experiment examination talks (Vor-/Nachtestate, approx. 15 minutes each), log (approx. 5 to 10 pages)
- Assessment offered: once a year, winter semester
- Language of assessment: German, English
Only after successful completion of module components: 08-OC3 (module component 08-OC3-2 only) or 08-OC3P

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</table>
Physical and Theoretical Chemistry
(38 ECTS credits)
### Module title
Physical Chemistry 1

### Abbreviation
08-PC1-092-m01

### Module coordinator
lecturer of lecture "Grundlagen der Quantenmechanik und 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

### Content
This module introduces students to the fundamental principles of quantum mechanics. It analyses molecules on the basis of the following models: particle in a box, harmonic oscillator and rigid rotor. As regards spectroscopy, the module focuses on vibrational spectroscopy, angular momentum quantisation, microwave spectroscopy and UV-VIS spectroscopy. In addition, the module discusses linear operators, eigenvalue problems, matrix representation, differential equations, Fourier transform and orthogonal functions as mathematical bases of the topics listed above.

### Intended learning outcomes
Students are able to explain key models of quantum mechanics and to apply them to molecules. They are able to describe different spectroscopic methods. In addition, students know how to apply the mathematical bases of quantum mechanics.

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

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

### Allocation of places
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### Additional information
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### Referred to in LPO I
(examination regulations for teaching-degree programmes)
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**Module title**
Physical Chemistry 2: Thermodynamics, Kinetics, Electrochemistry

**Abbreviation**
08-PC2-092-m01

**Module coordinator**
Lecturer of lecture "Thermodynamik, Kinetik, Elektrochemie"

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

**ECTS**
18

**Method of grading**
Numerical grade

**Duration**
1 semester

**Module level**
Undergraduate

**Other prerequisites**
By way of exception, additional prerequisites are listed in the section on assessments.

**Contents**
This module introduces students to the principles of thermodynamics. It focuses on the laws of thermodynamics, chemical equilibria, ideal and real gasses/solutions/mixed phases and electrochemistry. In addition to thermodynamic processes, it discusses the fundamental principles of kinetics. The module gives students the opportunity to apply in practice the knowledge they have gained through the related lecture(s). After a safety briefing, the students autonomously conduct experiments in the laboratory. In addition to those experiments, students will be expected to take oral tests and write lab reports to demonstrate their knowledge.

**Intended learning outcomes**
Students are able to explain the laws of thermodynamics. They are able to describe thermodynamic aspects of solutions, gases, mixed phases and electrochemical reactions. Students are able to interpret the kinetic aspects of chemical reactions. They are able to connect the theoretical principles of thermodynamics, kinetics, electrochemistry and spectroscopy with practical laboratory experiments. They are able to analyse the resulting measurements.

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

- **08-PC2-2-092: P** (no information on SWS (weekly contact hours) and course language available)
- **08-PC2-1-092: V + Ü** (no information on SWS (weekly contact hours) and course language available)

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

**Assessment in module component 08-PC2-2-092: Physical Chemistry (lab)**
- 9 ECTS, Method of grading: (not) successfully completed
- 9 ECTS, Method of grading: numerical grade
- 9 ECTS, Method of grading: numerical grade
- Assessment offered: once a year, winter semester
- Only after successful completion of module components: 08-PC1-1 or 08-PC2-1

**Assessment in module component 08-PC2-1-092: Thermodynamics, Kinetics, Electrochemistry Thermodynamics, Kinetics, Electrochemistry**
- 9 ECTS, Method of grading: numerical grade
- Assessment offered: once a year, winter semester
- Only after successful completion of module components: 08-PC1-1 or 08-PC2-1

**Other prerequisites:** Admission prerequisite to assessment: successful completion of exercises in the respective classes as specified at the beginning of the course (usually 70% of exercises to be successfully completed) as well as regular attendance of exercises (usually a maximum of 2 incidents of unexcused absence).
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<td>Physical and Theoretical Chemistry 3: Symmetry and Quantum Chemistry</td>
<td>08-PC3-092-m01</td>
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**Module coordinator**
lecturer of lecture "Quantenchemie"

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

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**Duration**
1 semester

**Module level**
undergraduate

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

**Contents**
This module deals with basics of quantum chemistry and symmetry in chemistry.

**Intended learning outcomes**
Students have become familiar with the fundamental principles of quantum chemistry and symmetry in chemistry and are able to apply the knowledge they have developed.

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

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

**Allocation of places**
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**Additional information**
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**Referred to in LPO I**
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<td>Physical Chemistry 4: Statistical Thermodynamics</td>
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<tr>
<td>lecturer of lecture &quot;Statistische Thermodynamik&quot;</td>
<td>Institute of Physical and Theoretical Chemistry</td>
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</table>

**Contents**

This module deals with basics of statistical thermodynamics.

**Intended learning outcomes**

Students have become familiar with the fundamental principles of statistical thermodynamics and are able to apply the knowledge they have developed.

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

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

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

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

**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 | Theoretical Models in Chemistry
---|---
Abbreviation | 08-TC-092-m01

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

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

Duration | Module level | Other prerequisites
---|---|---
1 semester | undergraduate | Admission prerequisite to assessment: successful completion of exercises in the respective classes as specified at the beginning of the course (usually 70% of exercises to be successfully completed) as well as regular attendance of exercises (usually a maximum of 2 incidents of unexcused absence).

Contents
This module provides students with deeper insights into advanced topics in quantum chemistry. It focuses on spin, the Pauli principle, Slater determinants, the Hartree-Fock method, correlation energy, configuration interaction and excited states, the Born-Oppenheimer approximation and bonding models of H2+.

Intended learning outcomes
Students are able to describe excited states of molecules with the help of key concepts and models.

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

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
a) 1 to 3 written examinations (1 written examination: approx. 90 minutes; 2 written examinations: approx. 60 or 90 minutes each; 3 written examinations: approx. 60 minutes each) or b) oral examination of one candidate each (approx. 20 minutes) or c) oral examination in groups (groups of 2, approx. 30 minutes)

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

**Contents**

The module imparts the basic knowledge of biochemistry by lectures and in-depth tutorials.

**Intended learning outcomes**

Students have become familiar with the fundamental principles of biochemistry. They are able to describe the key biochemical processes in cellular systems.

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

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

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

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

**Allocation of places**

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**Additional information**

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

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Module title | Abbreviation
---|---
Mathematics for students in Chemistry and Biology | 10-M-MCB-101-m01

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

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Duration | Module level | Other prerequisites
---|---|---
1 semester | undergraduate | Registration for the exercise must be made via SB@home at the beginning of the course or as announced by the lecturer in accordance with the specified registration deadlines. Certain prerequisites must be met to qualify for admission to assessment (e.g. successful completion of a certain percentage of exercises). The lecturer will inform students about the respective details at the beginning of the course. Registration for the exercise will be considered a declaration of will to seek admission to assessment. If students have obtained the qualification for admission to assessment over the course of the semester, the lecturer will put their registration for assessment into effect. Students who meet all prerequisites will be admitted to assessment in the current or in the subsequent semester. For assessment at a later date, students will have to obtain the qualification for admission to assessment anew and have to register anew, too.

Contents

Functional relations, differentiation and integration of functions in one variable, curve sketching, differentiation of functions in several variables, power series, ordinary differential equations, systems of linear equations, basic notions in statistics.

Intended learning outcomes

The student is able to recognise and phrase simple questions from natural sciences as mathematical problems, apply basic mathematical methods to them and interpret the results.

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

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

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

written examination (approx. 90 to 120 minutes)

Allocation of places

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Additional information

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

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<tr>
<td>Introduction to Physics for Students of Non-physics-related Minor Subjects</td>
<td>11-EFNF-072-m01</td>
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<td>Faculty of Physics and Astronomy</td>
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<tr>
<td>2 semester</td>
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</table>

**Contents**

Mechanics, vibration theory, thermodynamics, optics, science of electricity, Atomic and Nuclear Physics.

**Intended learning outcomes**

The students have knowledge of the principles of Physics.

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

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

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

written examination (approx. 120 minutes)

**Allocation of places**

Only as part of pool of general key skills (ASQ): 10 places. Places will be allocated by lot.

**Additional information**

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

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<th>Duration</th>
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</table>

**Contents**

Mechanics, vibration theory, thermodynamics, optics, X-rays, nuclear magnetic resonance, Atomic and Nuclear Physics.

**Intended learning outcomes**

The students have knowledge of the principles of Physics.

**Courses**

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

**Method of assessment**

a) oral test (approx. 15 minutes) during experiment and b) ungraded written examination (approx. 90 minutes)

**Allocation of places**

Only as part of pool of general key skills (ASQ): 10 places. Places will be allocated by lot.

**Additional information**

--

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

--
Scientific Discussion

(5 ECTS credits)
Module title
Scientific Discussion

Abbreviation
08-WD-FOKUS-112-m01

Module coordinator
degree programme coordinator FOKUS Chemie (Chemistry)

Module offered by
Faculty of Chemistry and Pharmacy

ECTS
5

Method of grading
numerical grade

Only after succ. compl. of module(s)
Where applicable, specific modules/module components as specified by supervisor (cf. Section 12 Subsection 4 FSB (subject-specific provisions)).

Duration
1 semester

Module level
undergraduate

Other prerequisites
--

Contents
This module gives students the opportunity to deliver presentations on and discuss topics in a range of research fields.

Intended learning outcomes
Students are able to present scientific information in a manner that is tailored to their target group as well as to discuss topical research problems.

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

Method of assessment
a) oral examination of one candidate each (approx. 45 minutes) or b) 2 oral examinations of one candidate each (approx. 30 minutes each) or c) 3 oral examinations of one candidate each (approx. 20 minutes each)

Language of assessment: German, English

Allocation of places
--

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

(10 ECTS credits)
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**Contents**

The module enables the processing of a defined problem within a specified period by applying the scientific methods learned in the course of study.

**Intended learning outcomes**

The student has the ability to deal with a defined problem/issue using scientific methods and to document the results.

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

- no courses assigned

**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 thesis (approx. 40 pages)
- Language of assessment: German, English

**Allocation of places**

- --

**Additional information**

- Additional information on module duration: 8 weeks.
- Referred to in LPO I (examination regulations for teaching-degree programmes)
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Subject-specific Key Skills
(17 ECTS credits)
Compulsory Courses
(8 ECTS credits)
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<td>lecturer of lecture &quot;Toxikologie und Rechtskunde&quot;</td>
<td>Faculty of Medicine</td>
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<td>1 semester</td>
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</table>

**Contents**

Basics of legal regulations for chemists (handling and transportation of hazardous materials), fundamentals of toxicology.

**Intended learning outcomes**

The students master the basics of legal regulations for chemists (handling and transport of hazardous substances) as well as the fundamentals of toxicology.

**Courses**

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

**Method of assessment**

Written examination (approx. 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)

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</table>

**Contents**

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

**Intended learning outcomes**

Students are able to describe the fundamentals of the programming language and to apply them to problems in chemistry.

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

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

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

practical examination: completion of programming exercises and oral description of algorithms used

Language of assessment: German, English

**Allocation of places**

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**Additional information**

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

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Compulsory Electives
(9 ECTS credits)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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</thead>
<tbody>
<tr>
<td>Advanced research lab course</td>
<td>08-FOP-112-m01</td>
</tr>
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<table>
<thead>
<tr>
<th>Module coordinator</th>
<th>Module offered by</th>
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</thead>
<tbody>
<tr>
<td>head of the research group offering the module</td>
<td>Faculty of Chemistry and Pharmacy</td>
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<table>
<thead>
<tr>
<th>ECTS</th>
<th>Method of grading</th>
<th>Only after succ. compl. of module(s)</th>
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<tbody>
<tr>
<td>9</td>
<td>(not) successfully completed</td>
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<table>
<thead>
<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
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</thead>
<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</tbody>
</table>

### Contents

This module gives students the opportunity to explore a research topic and apply the methods commonly used in the discipline in question.

### Intended learning outcomes

The student is able to deeply acquaint himself/herself with a specific research topic, and to process and to present the results in a written report or a talk.

### Courses

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

### Method of assessment

- talk (approx. 15 minutes) or written report (approx. 10 to 20 pages)
- Language of assessment: German, English

### Allocation of places

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### Additional information

Additional information on module duration: 8 weeks.

**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>FOKUS Foreign Studies</td>
<td>08-FAP-112-m01</td>
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<td>degree programme coordinator FOKUS Chemie (Chemistry)</td>
<td>Faculty of Chemistry and Pharmacy</td>
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**Contents**

The internship is carried out at universities abroad and can be embedded within offered study programs (eg Erasmus). The content requirements should comply with those of the electives of the Chemistry Bachelor program at the University of Würzburg (what has to be ascertained in advance under discussion with the module coordinator).

**Intended learning outcomes**

The students are familiar with working methods at universities abroad. Besides professional competences they have also acquired language and social skills.

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

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

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

Talk (approx. 15 minutes) or written report (approx. 10 to 20 pages)

Language of assessment: German, English

**Allocation of places**

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**Additional information**

Additional information on module duration: 8 weeks.

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

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<table>
<thead>
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<td>FOKUS Industrial work experience</td>
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**Contents**

A placement in industry. The contents of the placement should correspond to the contents of a lab course offered in the context of the Bachelor’s programme in Chemistry (180 ECTS credits); please consult with the competent coordinator in advance.

**Intended learning outcomes**

Students are familiar with procedures and processes used in industry. They have developed both subject-specific and interpersonal skills.

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

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

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

Talk (approx. 15 minutes) or written report (approx. 10 to 20 pages)  
Language of assessment: German, English

**Allocation of places**

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**Additional information**

Additional information on module duration: 8 weeks.

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

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