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**Modulbezeichnung:** **Molecular synthesis (MSM-ME1)** **15 ECTS**  
 (Molecular synthesis)

Modulverantwortliche/r: Andreas Hirsch

Lehrende: Marcus Speck, Jürgen Schatz, Die Dozenten der Anorg. Chemie, Ivana Ivanovic-Burmazovic, Sjoerd Harder, Julien Bachmann, Andreas Hirsch, N.N., Nicolai Burzlaff, Andreas Scheurer, Norbert Jux, Milan Kivala, Assistenten, Karsten Meyer, Frank Hampel, Svetlana Tsogoeva, Rik Tykwinski, Frank Wilhelm Heinemann

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Startsemester: WS 2015/2016	Dauer: 2 Semester	Turnus: halbjährlich (WS+SS)
Präsenzzeit: 210 Std.	Eigenstudium: 240 Std.	Sprache: Englisch

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**Lehrveranstaltungen:**

Check for other alternatives in **UnivIS**

**NB:** no overlap with courses in Mandatory Module allowed

**A. LAB course Molecular Synthesis**

either in Inorganic or Organic Chemistry (6LAB/1S)

Praktikum Anorganische Molekülsynthesen - Masterstudium / Lab Course Molecular Synthesis IC - Master-level program (WS 2015/2016, Praktikum, Karsten Meyer et al.)

Praktikum Organische Molekülsynthesen - Masterstudium / Lab Course Molecular Synthesis OC - Master-level program (WS 2015/2016, Praktikum, 7 SWS, Svetlana Tsogoeva et al.)

**Lectures & Seminars:**

**B. Advanced Inorganic Chemistry I (2L/1S)**

Advanced Inorganic Chemistry (WS 2015/2016, Vorlesung, 2 SWS, Ivana Ivanovic-Burmazovic et al.)

Advanced Inorganic Chemistry - Seminar (WS 2015/2016, Seminar, 1 SWS, Ivana Ivanovic-Burmazovic et al.)

Advanced Inorganic Chemistry - Seminar Talk (Vortragsseminar zum Fortgeschrittenenpraktikum Anorganische Chemie ) (WS 2015/2016, Seminar, 1 SWS, Andreas Scheurer)

Advanced Inorganic Chemistry - Seminar Talk (SS 2016, Seminar, 1 SWS, Die Dozenten der Anorg. Chemie)

**C. Advanced Inorganic Chemistry II (1L)**

choice of 1 course from

C1: Bioinorganic chemistry I (1L)

C2: Metals in medicine (1L)

C3: Nanoparticles and nanostructured thin films (1L)

C4: Modern X-Ray structure determination of single crystals

Bioinorganic Chemistry I, Metalloenzymes and Metals in Medicine (WS 2015/2016, Vorlesung, 2 SWS, Nicolai Burzlaff)

Seminar zur Vorlesung 'Metalle in der Medizin' (WS 2015/2016, Seminar, 1 SWS, Nicolai Burzlaff)

Nanoparticles and Nanostructured Thin Films / Nanopartikel und nanostrukturierte dünne Schichten (WS 2015/2016, Vorlesung, 2 SWS, Julien Bachmann)

Modern X-ray structure determination of single crystals/Einführung i. d. Kristallstrukturbestimmung von Molekülverbindungen (WS 2015/2016, Vorlesung mit Übung, 2 SWS, Frank Wilhelm Heinemann et al.)

Modern X-ray structure determination of single crystals/Einführung i. d. Kristallstrukturbestimmung von Molekülverbindungen (SS 2016, Vorlesung mit Übung, 2 SWS, Frank Wilhelm Heinemann et al.)

**D. Advanced Organic Chemistry I (2L)**

Advanced Organic Chemistry I - Synthesis and Catalysis/Fortgeschrittene Organische Chemie I - Synthese und Katalyse (WS 2015/2016, Vorlesung, 2 SWS, Svetlana Tsogoeva et al.)

**E. Advanced Organic Chemistry II (2L)**

choice of 1 course from

E1: Organocatalysis (2L)

E2: Chemie der Naturstoffe (2L)

E3: Radical Chemistry (2L)

Organocatalysis (SS 2016, Vorlesung, 2 SWS, Svetlana Tsogoeva)

Seminar: Chemie der Naturstoffe (SS 2016, Hauptseminar, 2 SWS, Marcus Speck et al.)

**Empfohlene Voraussetzungen:**

Admission to the M. Sc. program Molecular Science or Chemistry

**Inhalt:**

**A:** Advanced chemical synthesis and molecular analysis

**B:** Inorganic and coordination chemistry principles; application of spectroscopic methods; advanced reaction mechanisms and experimental methods; important catalytic processes driven by metal complexes; design and synthesis of catalysts, physiologically active substances and new materials based on transition metals compounds

**D:** Modern synthetic methods in organic chemistry: pericyclic reactions, heterocycle syntheses, modern catalytic methodologies (metal-, organo- and biocatalysis), strategies in stereoselective synthesis

**C1:** Metal binding to proteins and DNA; functions of metal ions in enzymes; O<sub>2</sub> transport, storage and activation; electron transfer in proteins; heme and non-heme iron containing oxygenases; zinc peptidases and proteases; superoxide dismutases; copper containing enzymes; biological function of nickel, molybdenum and tungsten; concepts and synthesis of model complexes; basics of Photosynthesis

**C2:** Platinum based anticancer drugs; Ruthenium and gold based metallotherapeutics; silapharmaca; Li therapeutics; boron neutron capture therapy; MnSOD; insulin mimetic vanadium containing compounds; magnetic resonance imaging (MRI); cobalamin; metal poisoning; Hg in the biosphere; metallotherapeutic arsenic compounds; technetium radiodiagnostics; antimony in medicine; bismuth based pharmaceuticals

**C3:** Synthesis of n-dimensional nano-materials. Systematic approaches towards nano-particles of defined size and structure are the basis to prepare materials with tailor-made electronic, optical or catalytic properties. The interplay between nano-particles, nano-rods, nano-wires, 2- and 3-dimensional materials are highlighted.

**E1:** General concepts of organocatalysis. Enamine/iminiumion activation by Lewis basic amines. Non-covalent catalysis with ureas, thioureas and diols. Brønsted- and Lewis-acid catalysis. Phase-transfer catalysis. Bi- and multi-functional catalysts. Iminium/Enamine cascade catalysis. Organocatalytic domino reactions; natural product and chiral drug synthesis.

**E2:** Structure, isolation and structure elucidation of natural products; biosynthesis and degradation of carbon hydrates, lipids, peptides and terpenoids; biological and medicinal aspects of tetrapyrrols and alkaloids; technical synthesis of vitamins

**E3:** Radical reactivity; time scales and radical clock experiments; electrophilic and nucleophilic radicals; radical initiators; radical generation by oxidation or reduction; tin hydrides and modern replacements; atom and group transfer reactions; generation of various carbon-centered radicals; generation of oxygen- and nitrogencentered radicals.

**Lernziele und Kompetenzen:**

The students are able

- to understand and to explain the principles of advanced chemical synthesis routes and molecular analysis in organic and inorganic chemistry
- to understand the functionality of various molecular systems
- to participate in planning, developing and executing of experimental routes for the synthesis of more complex molecular systems
- to characterize molecular samples (natural compounds, e.g., peptides or vitamins, or metal-based drugs) using modern experimental methods and techniques
- to interpret and critically summarize experimental results in written form (lab report in paper-style format)
- to work in smaller research teams (team ability).

**Literatur:**

Manuscripts available online for most lectures

Check respective information and docket ("Laufzettel") on the Molecular Science web page

**Verwendbarkeit des Moduls / Einpassung in den Musterstudienplan:**

Das Modul ist im Kontext der folgenden Studienfächer/Vertiefungsrichtungen verwendbar:

**[1] Molecular Science (Master of Science)**

(Po-Vers. 2013 | Wahlpflichtmodul Molecular Science)

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**Studien-/Prüfungsleistungen:**

Molekülsynthesen - Molecular Synthesis (Prüfungsnummer: 30801)

(englische Bezeichnung: Molecular Synthesis)

Prüfungsleistung, mündliche Prüfung, Dauer (in Minuten): 45

Anteil an der Berechnung der Modulnote: 100%

weitere Erläuterungen:

Assessment and examinations: Portfolio: LAB (SL, AP) Lab course protocol(s) without marks + oral examination (45 min) 2 Examiners

Calculation of the grade for the module: 100% from oral examination

Prüfungssprache: Englisch

Erstablingung: SS 2016, 1. Wdh.: keine Angabe

1. Prüfer: Karsten Meyer

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**Organisatorisches:**

**Intended stage in the degree course:** Mandatory elective module (Wahlpflichtmodul) or Elective module (Wahlmodul), semester 1-3

**Frequency of offer:** annually/start of studies is available in summer and winter term

A: upon appointment with contact persons

B & D: winter term

E1/E2: summer term; E2 also winter term;

E3: winter term

C1/C2/C3: winter term

**Bemerkungen:**

**Courses of study for which the module is acceptable:** M.Sc. Molecular Nanoscience or M.Sc. Molecular Lifescience