

Module Catalogue

Bachelor of Science Chemistry

University of Regensburg

13.1.2014

The Bachelor of Science Chemistry at the University of Regensburg comprises the following modules:

1. Compulsory Courses:

CHE-BSc-M 1	General Chemistry
CHE-BSc-M 2	Mathematics
CHE-BSc-M 3	Physics
CHE-BSc-M 4	Chemistry of Aqueous Solutions
CHE-BSc-M 5	Chemistry of Matter
CHE-BSc-M 5	Theory: Energetics
CHE-BSc-M 7	Lab: Energetics
CHE-BSc-M 8	Analysis of Matter
CHE-BSc-M 9	Theory: Chemical Synthesis
CHE-BSc-M 10	Lab: Chemical Synthesis
CHE-BSc-M 11	Structure of Matter
CHE-BSc-M 12	Chemistry of Life
CHE-BSc-M 13	Contexts and Concepts in Chemistry

2. Compulsory Elective Courses:

CHE-BSc-M 14	Biochemistry
CHE-BSc-M 15	Theoretical Chemistry
CHE-BSc-M 16	Nanoscience
CHE-BSc-M 17	Pharmaceutical Bioanalytics
CHE-BSc-M 18	Synthesis Techniques

1. Compulsory Courses:

CHE-BSc-M 01

1. Module Name:	General Chemistry
2. Field / Person in Charge:	Chemistry / Prof. Dr. Frank-Michael Matysik
3. Synopsis:	<ul style="list-style-type: none">• atom theory, empirical gas laws and kinetic gas theory, microscopic structure of matter: elemental particles, atoms, particle-wave dualism and quantum theoretical approach for description of electrons in atoms, discussion of results for simple one-particle systems, one- and many-electron atoms, principles behind the PSE, radioactive decay• basics of stoichiometry, chemical equilibrium and mass action law, solution process and solubility product, acids and bases, definition and quantitative treatment of acid-base equilibria and buffer systems, electrochemical potential, electrochemical series, redox- and complex equilibrium• chemical bonding: ionic substances, metals, metalloids and band model, covalent bonding, electronegativity, polarity and dipole moment, description of simple molecules by MO-theory, molecular shape, weak interactions• basic knowledge of preparation and reactivity of selected non-metals and simple compounds – will be illustrated by impressive experiments• knowledge of legal rules according to § 17 section 1 Nr.2(d) law on chemical substances (ChemG)
4. Competences Acquired:	<p>Having completed this module students</p> <ul style="list-style-type: none">• are able to distinguish empirical descriptions and theoretical approaches in natural science;• understand the necessity of quantum mechanics for the description of the atomistic structure of nature and can apply its results to chemical bonding;• understand the relation between electronic structure and molecular shape of chemical compounds;• are able to perform stoichiometric calculations for reactions and equilibrium processes in solution;• are familiar with basic security-relevant and legal bearings of chemical substances

5. Prerequisites for Participation:	
a) Recommended:	basic knowledge of physics and chemistry obtained at school
b) Compulsory Certificates: to be submitted instantly <input type="checkbox"/> to hand in till <input type="checkbox"/>	none
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, starting in WS
8. Module Duration:	1 semester
9. Recommended Semester in Major:	1 st semester in major
10. Total workload of the module / credit points:	270 hours/ 9 credit points* (120 h attendance time, 150 h home study including preparation for exam)

*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	L + T	General Chemistry	4 + 3	
2	P	L	Experimental Chemistry	1	
Remarks:					

* P = compulsory course; WP = compulsory elective course; W = elective course

12. Module Examination:					
<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission **</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
T	Exam on General and Experimental Chemistry		2 h	end of lecture period WS	graded
Remarks: Every module partial examination has to be taken in order to gain a claim on an oral examination in case of failure for two times in one or more partial examinations (see under 14.). The time limit for the oral repetition of the module final examination will depend on the last partial examination delivered.					

* A = module final examination; T = module partial examination ** optional

13. Module Grade:

<input checked="" type="checkbox"/>	The module grade is given by the grade obtained in the final module exam.
<input type="checkbox"/>	The module grade is calculated as follows:
<input type="checkbox"/>	The module will not be graded.

14. Other:

If either one or more module partial examinations or the module final examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners. In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.

If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010)

CHE-BSc-M 02

1. Module Name:	Mathematics
2. Field / Person in Charge:	Chemistry / Prof. Dr. Martin Schütz
3. Synopsis:	<ul style="list-style-type: none"> • functions with one variable: theory of numbers, sequences and series, differential and integral calculus, complex numbers, ordinary differential equations • function of several variables: total differential and partial differential equations, curves and differential forms • linear algebra: vectors and matrices, linear equation systems, basis and basis transformations, eigenvalue problems • vector analysis: confined integrals, divergence, rotation, line- and area integrals, theorems of Gauss and Stokes • Fourier- and Laplace transformation
4. Competences Acquired:	<p>Having completed this module students are able</p> <ul style="list-style-type: none"> • to express simple relationships (e.g. between experimentally determined data) in mathematical terms • to connect mathematical expressions in a suitable way and to analyse them • to understand mathematical considerations and deductions in theoretical chemistry subjects
5. Prerequisites for Participation:	
a) Recommended:	none
b) Compulsory Certificates: to be submitted instantly <input type="checkbox"/> to hand in till <input type="checkbox"/>	none
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, starting in WS
8. Module Duration:	2 semesters
9. Recommended Semester in Major:	1 st and 2 nd semester in major
10. Total Workload of the Module / Credit Points:	300 hours/ 10 credit points* (120 h attendance time, 180 h home study including preparation for exam)

**The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.*

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	L + T	Mathematics I	3+1	
2	P	L + T	Mathematics II	3+1	
remarks:					

* P = compulsory course; WP = compulsory elective course; W = elective course

12. Module Examination:					
<i>A/T*</i>	<i>mode and content of examination</i>	<i>prerequisites for admission**</i>	<i>duration</i>	<i>time</i>	<i>mode of grading</i>
T	Exam Mathematics I	None	2 h	end of lecture period WS	graded
T	Exam Mathematics II	None	2 h	end of lecture period SS	graded
remarks:					

* A = module final examination; T = module partial examination ** optional

13. Module Grade:		
<input type="checkbox"/>	The module grade is the grade obtained in the final module exam.	
<input checked="" type="checkbox"/>	The module grade is calculated as follows:	
	Exam Mathematics I	50 %
	Exam Mathematics II	50 %
<input type="checkbox"/>	The module will not be graded.	

14. Other:

CHE-BSc-M 03

1. Module Name:	Physics
2. Field / Person in Charge:	Chemistry / Prof. Dr. Hubert Motschmann
3. Synopsis:	<ul style="list-style-type: none"> • movement in one dimension, vectors, movement in two or three dimensions, force and movement, energy, momentum, systems of particles, collision processes, gravitation, rotation, vibrations, electrostatics, electric current, Ohm's law, electromagnetism, waves and quanta, theory of specific relativity
4. Competences Acquired:	<p>Having completed this module students</p> <ul style="list-style-type: none"> • know the essential basics, phenomena and concepts of physics necessary for the study of natural sciences • have gained the necessary basics to understand mathematical considerations and deductions in theoretical chemical subjects • are able to solve simple problems in mechanics, electricity and optics • will be able to acquire more special knowledge from literature in the course of their studies
5. Prerequisites for Participation:	
a) Recommended:	basic knowledge of physics obtained at school
b) Compulsory Certificates: to be submitted instantly <input type="checkbox"/> to hand in till <input type="checkbox"/>	none
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, starting in WS
8. Module Duration:	2 semesters
9. Recommended Semester in Major:	1 st and 2 nd semester in major
10. Total workload of the module / credit points:	420 hours/ 14 credit points* (195 h attendance time, 225 h home study including preparation for exam)

**The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.*

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	L + T	Physics I	3+1	
2	P	L + T	Physics II	3+1	
	P	LC + S	Physics lab course	4+1	course attendance certificates (passed / not passed)
Remarks:					

* P = compulsory course; WP = compulsory elective course; W = elective course

12. Module Examination:					
<i>A/T*</i>	<i>mode and content of examination</i>	<i>prerequisites for admission **</i>	<i>duration</i>	<i>time</i>	<i>mode of grading</i>
T	exam physics I		2 h	end of lecture period WS	graded
T	exam physics II		2 h	end of lecture period SS	graded
Remarks: The lab will not be graded, successful completion will be documented by the course attendance certificates					

* A = module final examination; T = module partial examination ** optional

13. Module Grade:	
<input type="checkbox"/>	The module grade is given by the grade obtained in the final module exam.
<input checked="" type="checkbox"/>	The module grade is calculated as follows:
	Exam Physics I 50 %
	Exam Physics II 50 %
<input type="checkbox"/>	The module will not be graded.

14. Other:

CHE-BSc-M 04

1. Module Name:	Chemistry of Aqueous Solutions
2. Field / Person in Charge:	Chemistry / Prof. Dr. Arno Pfitzner
3. Synopsis:	<ul style="list-style-type: none">• first practical steps in the chemistry lab This first practice module introduces into safe and proper work in a chemistry lab.• quantitative determinations of concentrations of known ions or compounds in aqueous solution• qualitative determinations of cations and anions in unknown mixtures• titrations (acid-base titration, redox- and precipitation titration)• simple instrumental analysis (gravimetry, quantitative electrolysis, photometry)• qualitative and preliminary tests up to separation sequence by H₂S;• general principles of reactions in aqueous solution, like dissociation equilibrium, constants of complex formation and solubility products will be shown in practical examples• synthesis of simple inorganic compounds will introduce into techniques, build-up of laboratory glassware, handling of laboratory equipment etc.
4. Competences Acquired:	<ul style="list-style-type: none">• Basics of safe and proper laboratory work, application of chemical equilibrium• understanding of the chemistry of aqueous solutions• ability to write down chemical equations considering electron balance <p>Having completed this module students</p> <ul style="list-style-type: none">• are able to write down simple reaction equations;• recognize the relations of chemical equilibrium and ongoing reactions;• are able to apply simple theoretical concepts to practical problems;• are able to build up simple glassware and to conduct chemical experiments by the book
5. Prerequisites for Participation	
a) Recommended:	Basics in chemistry

b) Compulsory Certificates: to be submitted instantly <input type="checkbox"/> to hand in till <input type="checkbox"/>	none
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, starting in WS
8. Module Duration:	2 semesters
9. Recommended Semester in Major:	1 st and 2 nd semester in major
10. Total workload of the module / credit points:	330 hours/ 11 credit points* (285 h attendance time, 45 h home study)

*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h</i>	<i>Deliverables</i>
1	P	LC + S	Lab Chemistry of Aqueous Solutions (inorganic part I)	5+2	colloquia (passed / not passed)
2	P	LC + S	Lab Chemistry of Aqueous Solutions (inorganic part II)	5+1	colloquia (passed / not passed)
3	P	LC + S	Lab Chemistry of Aqueous Solutions (analytical part)	5+1	colloquia (passed / not passed)
Remarks: The colloquia serve to discuss the theory of experiments, experimental issues and especially safety aspects. The respective colloquium has to be passed before the experiment can be started, but will be ungraded.					

* P = required course; WP = compulsory elective course; W = elective course

12. Module Grade:	
<input type="checkbox"/>	The module grade is given by the grade obtained in the final module exam.
<input type="checkbox"/>	The module grade is calculated as follows:
<input checked="" type="checkbox"/>	The module will not be graded

CHE-BSc-M 05

1. Module Name:	Chemistry of Matter
2. Field / Person in Charge:	Chemistry / Prof. Dr. Robert Wolf
3. Synopsis:	<ul style="list-style-type: none">• principles of organic chemistry: structure and chemical bonds, functional groups, stereochemistry, electron delocalization, mesomeric effects, catalysis;• relation between substance class, characteristic functional group and reactivity: alkanes / radical substitution, alkenes / electrophilic addition, carbonyl compounds / nucleophilic acyl substitution and addition, oxidations / reductions• introduction to bioorganic chemistry: carbohydrates / proteins / enzymes / coenzymes, nucleic acids• advanced treatment of organic reaction mechanisms and new mechanisms: rearrangements, cycloadditions, pericyclic reactions• important reactions in syntheses, principle of stereoselective syntheses, planning of simple multistep syntheses• chemistry of inorganic matter: occurrence, structures, properties and preparation of elements; technical processes in industry• properties of transition metals, demarcation versus main group metals; terms & concepts in coordination chemistry, nomenclature of complexes, coordination number and –geometry, models describing geometric and electronic properties of complexes; groupwise discussion of occurrence, extraction, structures and properties of important transition metal compounds; clusters and metal-metal-multiple bonds
4. Competences Acquired:	<p>Having completed this module students</p> <ul style="list-style-type: none">• gained survey over the chemistry of the elements;• can deduce formula for simple inorganic compounds based on the element's position in the PSE• know and understand organic substance classes and their properties, functional groups and their typical reaction mechanisms, parameters of influence, principles of stereo isomerism and stereoselectivity <ul style="list-style-type: none">• gained insight in bioorganic substance classes and their importance in chemical biology• have understood the special position of transition

	metals and their electronic properties <ul style="list-style-type: none"> • can use models to deduce shape and electronic structure in transition metal complexes • are able to use this knowledge to classify unknown inorganic and organic compounds and to suggest their properties and reactivity • can suggest and assess different ways for syntheses of simple organic and inorganic compounds
5. Prerequisites for Participation:	
a) Recommended:	None
b) Compulsory Certificates: to be submitted instantly <input type="checkbox"/> to hand in till <input type="checkbox"/>	none
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, starting in SS
8. Module Duration:	2 semesters
9. Recommended Semester in major:	2 nd and 3 rd semester in major
10. Total workload of the module / credit points:	570 hours/ 19 credit points* (195 h attendance time, 375 h home study including preparation for exam)

*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	L + T	Basic Organic Chemistry	4+1	
2	P	L	Chemistry of Main Group Elements	3	
3	P	L	Chemistry of Transition Metals and Complexes	3	
4	P	L + T	Reaction Mechanisms in Organic Chemistry	3	

* P = compulsory course; WP = compulsory elective course; W = elective course

12. Module examination:					
<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission **</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
T	Exam Basic Organic Chemistry	None	2 h	end of lecture period SS	graded
T	Exam Main Groups and Transition Metals / Complexes	None	2 h	end of lecture period WS	graded
T	Exam Organic Reaction Mechanisms	None	2 h	end of lecture period WS	graded

Remarks: Every module partial examination has to be taken in order to gain a claim on an oral examination in case of failure for two times in one or more partial examinations (see under 14.). The time limit for the oral repetition of the module final examination will depend on the last partial examination delivered. Passing the exam covering organic reaction mechanisms (required mark at least 4.0) is mandatory to get access to module CHE-BSc-M10 "Lab: Chemical Synthesis".

* A = module final examination; T = module partial examination ** optional

13. Module Grade:	
<input type="checkbox"/>	The module grade corresponds to the grade of the module final exam.
<input checked="" type="checkbox"/>	The module grade is calculated as follows:
	Exam Basic Organic Chemistry 25 %
	Exam Main Groups and Transition Metals / Complexes 50 %
	Exam Organic Reaction Mechanisms 25 %
<input type="checkbox"/>	The module will not be graded.

14. Other:
<p>If either one or more module partial examinations or the module final examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners. In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.</p> <p>If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010)</p>

CHE-BSc-M 6

1. Module Name:	Theory: Energetics
2. Field / Person in charge	Chemistry / Prof. Dr. Hubert Motschmann
3. Synopsis:	<ul style="list-style-type: none"> • <u>Thermodynamics:</u> Heat and work, total differential, mathematical basics, laws of thermodynamics, reversibility, cyclic processes, entropy, Gibbs' energy, introduction to statistical thermodynamics and Boltzmann distribution, Maxwell relations, intermolecular forces, phase diagrams, phase transitions and –equilibrium, thermodynamics of mixed phases, Raoult's and Henry's law, heat of reaction, chemical equilibrium and law of mass action, dependence on pressure and temperature • <u>Electrochemistry:</u> Nernst equation and electrochemical series, transport properties , electrodes and electrode processes; Pourbaix diagrams, technical applications • <u>Kinetics:</u> differential and integrated rate equations, consecutive reactions and steady state, Arrhenius equation, Eyring, activation enthalpy and –entropy, reactions on surfaces Transport properties: electric conductivity, diffusion, viscosity • Introduction to Debye-Hückel Theory • <u>Basic course in symbolic language:</u> (Mathematica or Maple): language structure, visualisation of functions, selected examples in linear algebra, roots of transcendental equations, differential and integral calculus, differential equations
4. Competences Acquired:	Having completed this module students <ul style="list-style-type: none"> • have basic understanding of the terms energy, entropy, work and heat • are able to calculate chemical equilibrium states and simple reaction under different conditions; • are able to find thermodynamic data in literature, to connect and to convert them • understand the relationship between molecular and macroscopic properties of matter • understand basic transport properties and energetics of reactions • The basic course in symbolic language: (Mathematica or Maple) discusses the essential elements of a symbolic language as a

	precondition for exercises in physical and theoretical chemistry in form of notebooks. Thus, realistic examples can be calculated instead of idealized models like the ideal gas. Complex dependencies can be visualized quickly to achieve deeper understanding
5. Prerequisites for Participation:	
a) Recommended:	Mathematics I, Module CHE-BSc-M 01 "General chemistry"
b) Compulsory Certificates: to be submitted instantly <input type="checkbox"/> to hand in till <input type="checkbox"/>	none
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, starting in SS
8. Module Duration:	2 semesters
9. Recommended semester in major:	2 nd and 3 rd semester in major
10. Total workload of the module / credit points:	360 hours/ 12 credit points* (150 h attendance time, 210 h home study including preparation for exam)

*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	L + T	Thermodynamics I	2+1	
2	P	L + T	Thermodynamics II	2+1	
3	P	L + T	Electrochemistry and Kinetics	2+1	
4	P	#	Symbolic Language	1	
Remarks:					

* P = Compulsory course; WP = compulsory elective course; W = elective course; # online course

12. Module Examination:					
<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission**</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
T	Final Exam on the courses of 11.1		2 h	end of lecture period SS	graded
T	Final Exam on the courses of 11.2 and 11.3		3 h	end of lecture period WS	graded

Remarks: The final module examination covers the two partial examinations "Thermodynamics I" and "Thermodynamics II / Electrochemistry / Kinetics". The grades of the partial examinations will contribute to the final grade as follows: Thermodynamics I: 20 %; "Thermodynamics II / Electrochemistry / Kinetics": 80 % with the topics Thermodynamics II and Electrochemistry / Kinetics contributing 40 % each.

Every module partial examination has to be taken in order to gain a claim on an oral examination in case of failure for two times in one or more partial examinations (see under 14.).

The time limit for the oral repetition of the module final examination will depend on the last partial examination delivered.

** A = module final examination; T = module partial examination ** optional*

13. Module Grade:		
<input type="checkbox"/>	The module grade corresponds to the grade of the module final exam.	
<input checked="" type="checkbox"/>	The module grade is calculated as follows:	
	Exam Thermodynamics I	20 %
	Exam "Thermodynamics II / Electrochemistry / Kinetics"	80 %

14. Other:
<p>If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners.</p> <p>In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.</p> <p>If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010)</p>

CHE-BSc-M 07

1. Module Name:	Lab Course: Energetics
2. Field / Person in charge	Chemistry / Prof. Dr. Werner Kunz
3. Synopsis:	<ul style="list-style-type: none">• Basics presented in the theory module will be consolidated and extended during this lab course; the experiments require crosslinking of the different subjects:• Determination of the vapour-liquid phase diagram for a binary mixture; the p(V)-diagram of a real gas, the vapour pressure of a pure component and the heat of a reaction (calorimetry) as examples of thermodynamic properties.•• Electrochemistry will be represented by the determination of current transport in electrolytic chains, the measurement of electromotoric force, as well as construction of a simple fuel cell• ; Determination of molecular mass of polyvinyl alcohol by viscosimetry;• Kinetics is represented by the determination of the rate constant and the activation enthalpy of a pseudo-first order reaction (inversion of saccharose).• Spectroscopy will include the determination of electronic transitions in atoms and molecules and an introduction to infrared spectroscopy • Lecture Technical chemistry: The lecture starts with a general overview on chemical industry, basic technical large scale procedures, products and upscaling. Both economical and ecological issues will be addressed. Next, the application of classic physico-chemical concepts of thermodynamics, kinetics, transport of heat and matter to the conceptual design of industrial large scale procedures will be discussed. The following chapter deals with types and basic properties of chemical reactors, followed by a detailed discussion of thermal separation procedures, especially distillation, rectification, extraction and adsorption. After a short presentation of criteria for an optimal choice of the technical procedure oil-based basic chemicals, their production in refineries and their refinement is discussed. Next, technically important polymers (plastics and functional, mostly soluble polymers) will be presented. Several fine chemicals of both technical and economic importance will be addressed, with special consideration of detergents and emulgators. The lecture will finish with a discussion of sustainable resources and their present and prospective relevance for the chemical industry.

	<ul style="list-style-type: none"> • •
4. Competences Acquired:	<p>Lab course: By selected experiments students</p> <ul style="list-style-type: none"> • learn basic of thermodynamics, kinetics, electrochemistry and interfacial chemistry • learn to correlate macroscopic and microscopic parameters of a condensed phase • get used to detailed error analysis <p>The experimental design will be open and transparent.</p> <p>Lecture Technical chemistry: Competing this lecture students</p> <ul style="list-style-type: none"> • will start to understand the language of a chemical engineer and the challenges of chemistry on an industrial scale. • get insight to upscaling and the differences between laboratory and industrial synthesis • understand the practical importance of thermodynamics and kinetics in industrial chemistry • will understand chemistry as a part of society and recognize the responsibility of chemists for humans and environment and the related economical and ecological issues • will be able to apply the addressed issues at least in an exemplary way, also interdisciplinary •
5. Prerequisites for Participation:	
a) Recommended:	Mathematics I, Module CHE-BSc-M 01 "General chemistry"
b) Compulsory Certificates: to be submitted instantly <input checked="" type="checkbox"/> to hand in till <input type="checkbox"/>	
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, in WS
8. Module Duration:	2 semesters
9. Recommended Semester in Major	3 rd and 4 th semester in major
10. Total workload of the module / credit points:	210 hours/ 7 credit points* (105 h attendance time, 105 h home study including preparation for exam)

**The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.*

11. Courses:

	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	LC	Physical Chemistry Lab I:	5	Lab reports
2	P	L	Technical Chemistry	2	

Remarks:

* *P = required course; WP = elective compulsory course; W = elective course***12. Module examination:**

<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission**</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
A	Final Exam in Technical Chemistry	none	2 h	end of lecture period WS	graded

Remarks:

* *A = module final examination; T = module partial examination ** optional***13. Module Grade:**

<input checked="" type="checkbox"/>	The module grade corresponds to the grade of the module final exam.
<input type="checkbox"/>	The module grade is calculated as follows:
<input type="checkbox"/>	The module grade is not graded.*

14. Other:

If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners.

In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.

If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010)

CHE-BSc-M 08

1. Module Name:	Analysis of Matter
2. Field / Person in Charge:	Chemistry / Prof. Dr. Antje Bäumner
3. Synopsis:	<ul style="list-style-type: none">• Lecture Analytical Chemistry: sample preparation, analytical strategies, photometry, chromogenic reactions and complexation, labelling and derivatisation, chromatographic methods, radioanalytics, potentiometry, amperometry, mass spectrometry, coupled analytical procedures, atomic absorption and γ-emission, electrophoresis, lab automation, data assessment and statistics, analytical process as a whole.• Analytical Chemistry Lab: photometric analysis, fluorescence spectroscopy, atomic spectroscopy, kinetic enzymatic assay, sample preparation, β- and γ-spectrometry, amperometry, coulometry, GC, HPLC, lab automation.• Lecture Spectroscopy (NMR): Theory of one-dimensional ^1H- and ^{13}C-NMR spectroscopy, structural analysis using NMR-spectroscopy, IR- and UV/VIS-spectroscopy.• Physical Chemistry Lab II: cryoscopy, hydrolysis and buffer capacity monomolecular films, surface tension, differential thermoanalysis, rheology, potentiometry, melting diagram, kinetics of fast reactions, absorption and luminescence, excimer formation.
4. Competences Acquired:	Having completed this module students <ul style="list-style-type: none">• are able to perform measurements in physical chemistry precisely;• knows the important methods in (instrumental) analytical chemistry, especially regarding determination of concentration and structural analytics• are able to identify possible sources of error and interpret experimental results with respect to accuracy and precision• know advantages and disadvantages of given methods and are able to judge their applicability, also considering viewpoint of costs• are able to discuss results and present them clearly both written or orally

5. Prerequisites for Participation:	
a) Recommended:	basics in experimental chemistry (use of laboratory equipment) and physics lab
b) Compulsory Certificates: to be submitted instantly <input checked="" type="checkbox"/> to hand in till <input type="checkbox"/>	Module CHE-BSc-M 01 „General Chemistry“
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, starting in WS
8. Module Duration:	2 semesters
9. Recommended Semester in Major:	3 rd and 4 th semester in major
10. Total workload of the module / credit points:	450 hours/ 15 credit points* (210 h attendance time, 240 h home study including preparation for exam))

*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	L	Analytical Chemistry	3	
2	P	L	Lab Analytical Chemistry II	4	Lab Report
3	P	L + T	NMR-Spectroscopy	2	
4	P	LC + S	Lab Physical Chemistry II	4+1	Lab Report
remarks:					

* P = compulsory course; WP = compulsory elective course; W = elective course

12. Module Examination:					
<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission**</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
T	Exam <i>Analytical Chemistry</i>		2 h	end of lecture period WS	graded
T	Exam <i>NMR-Spectroscopy</i>		2 h	end of lecture period WS	graded
Remarks: Every module partial examination has to be taken in order to gain a claim on an oral examination in case of failure for two times in one or more partial examinations (see under 14.). The time limit for the oral repetition of the module final examination will depend on the last partial examination delivered.					

* A = module final examination; T = module partial examination ** optional

13. Module Grade:

<input type="checkbox"/>	The module grade corresponds to the grade of the module final exam.	
<input checked="" type="checkbox"/>	The module grade*is calculated as follows:	
	Exam Analytical Chemistry	50 %
	Exam NMR-Spectroscopy	50 %
<input type="checkbox"/>	The module will not be graded.	

14. Others:

If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners.

In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.

If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010).

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CHE-BSc-M 09

1. Module Name:	Theory: Chemical Synthesis
2. Field / Responsible Docent:	Chemistry / Prof. Dr. Manfred Scheer
3. Synopsis:	<ul style="list-style-type: none"> • basic concepts: 18 electron rule, Wade-Mingos-rules, isolobal concept. • syntheses, chemical bond and properties of lithium- and magnesium organic compounds • syntheses, structure and bonding of alkane, organyl-, carbene-, carbene- and carbonyl complexes as well as σ, π-donor/π-acceptor ligand complexes of alkenes and aromatic compounds with different sized rings and hetero cycles. • historic aspects in respect to emergence of substance classes and their importance in nature and society, especially with respect to catalysis. • inorganic solid state chemistry: basics in solid state chemistry with focus on crystalline materials; specific properties of solids based on structural and chemical background • modern organic syntheses: modern concepts like stereoselective methods, cyclo additions, organometallic reagents, catalysis
4. Competences Acquired:	Having completed this module students <ul style="list-style-type: none"> • understand basic concepts of organic and inorganic syntheses with special emphasis on organometallic reagents; • are able to classify structure and bonding of different type of materials • are able to assess the use of organometallic reagents regarding technically relevant catalysis • are able to understand the principles in the build-up of inorganic solids and are familiar with assessment of criteria of thermodynamic and kinetic stability • can judge relations concerning structure, properties and effect • are able to study further literature in both german and english language on their own
5. Prerequisites for Participation:	
a) Recommended:	
b) Compulsory Certificates: to be submitted instantly <input type="checkbox"/> to hand in till <input type="checkbox"/>	

6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, starting in SS
8. Module Duration:	2 semesters
9. Recommended Semester in Major:	4 th and 5 th semester in major
10. Total workload of the module / credit points:	300 hours/ 10 credit points* (120 h attendance time, 180 h home study including preparation for exam))

*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	L	AC Organometallic Chemistry	2	
2	P	L	AC Solid State Chemistry II	2	
3	P	L + T	OC Modern Methods in Synthesis	2 + 2	
Remarks:					

* P = compulsory course; WP = compulsory elective course; W = elective course

12. Module Examination:					
<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission**</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
A	Exam covering the courses of the module	None	2 h	end of lecture period WS	graded
Remarks: The module final exam comprises the three parts „AC Organometallic Chemistry“, „AC Solid state Chemistry“ and „OC Modern methods in synthesis“ The parts „AC Organometallic Chemistry“, „A the remaining 50 %.C Solid state Chemistry“ will contribute 25 % each, the part „OC Modern methods in synthesis“					
Every module partial examination has to be taken in order to gain a claim on an oral examination in case of failure for two times in one or more partial examinations (see under 14.). The time limit for the oral repetition of the module final examination will depend on the last partial examination delivered.					

* A = module final examination; T = module partial examination ** optional

13. Module Grade:	
<input checked="" type="checkbox"/>	The module grade corresponds to the grade of the module final exam.
<input type="checkbox"/>	The module grade is calculated as follows:
<input type="checkbox"/>	The module will not be graded.

14. Others:

If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners.

In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.

If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010).

CHE-BSc-M 10

1. Module Name:	Lab Course: Chemical Synthesis
2. Field / Person in Charge:	Chemistry / Prof. Dr. Burkhard König
3. Synopsis:	<ul style="list-style-type: none"> • synthesis of organic molecules of low to medium complexity, of organometallic compounds, also with exclusion of air and moisture and of inorganic solid state compounds • systematic learning of basic laboratory methods like sublimation, distillation, extraction or chromatography, partially under inert gas atmosphere to exclude oxygen and moisture • planning of experiments according to literature; safe handling and professional disposal of hazardous substances; analytical monitoring of reaction progress by simple techniques and characterization of products by common analytical techniques like determination of melting point and refractive index, IR- and NMR spectroscopy; in case of solid state materials by x-ray, thermoanalytical and spectroscopic methods • documentation of course of reaction and results
4. Competences Acquired:	<p>Having completed this module students</p> <ul style="list-style-type: none"> • are able to plan and to conduct safely organic syntheses, including multi-step syntheses, simple organometallic syntheses using inert gas techniques as well as simple preparations of solid state compounds on their own according to literature procedures • master and use basic lab- and analysis techniques as well as handling and safe disposal of hazardous substances; <p>are able to analyse reaction products by routine procedures</p>
5. Prerequisites for Participation:	
a) Recommended:	Module CHE-BSc-M 05 "Chemistry of matter"
b) Compulsory Certificates: to be submitted instantly <input checked="" type="checkbox"/> to hand in till 5. semester <input type="checkbox"/>	Passing the exam "OC Reaction mechanisms" (Module CHE-BSc-M 05 "Chemistry of matter") is required.
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, starting in SS
8. Module Duration:	2 semesters

9. Recommended Semester in Major:	4 th and 5 th semester in major
10. Total workload of the module / credit points:	570 hours/ 19 credit points* (420 h attendance time, 150 h home study)

*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	LC + S	OC Basic Lab	12+2	seminar talk about an experiment assigned to the student; course attendance certificates (passed / not passed)
2	P	LC + S	AC/OC Advanced Lab	12+2	seminar talk about an experiment assigned to the student; course attendance certificates (passed / not passed)
Remarks: Each experiment includes a colloquium addressing theory, experimental details and all relevant safety issues. The colloquium has to be passed, before experimental work may start.					

* P = required course; WP = compulsory elective course; W = elective course

12. Module Grade:	
<input type="checkbox"/>	The module grade corresponds to the grade of the module final exam.
<input type="checkbox"/>	The module grade*is calculated as follows:*
<input checked="" type="checkbox"/>	The module will not be graded.

13. Others:

CHE-BSc-M 11

1. Module Name:	Structure of Matter
2. Field / Person in Charge:	Chemistry / Prof. Dr. Bernhard Dick
3. Synopsis:	<ul style="list-style-type: none"> • Basic quantum theory of matter: Schrodinger equation, solvable single particle problems (box, oscillator, rotor, hydrogen atom), variation theorem, Hueckel method; • Introduction to symmetry: symmetry elements and symmetry operations, group theory, irreducible representation; • Introduction to optical molecular spectroscopy: rotational and vibrational spectroscopy (MW, IR, Raman), UV/VIS-spectroscopy, electron configuration of coordination compounds; • Introduction to theoretical chemistry: many-electron systems, spin correlation, Hartree-Fock method, density functional theory.
4. Competences Acquired:	<p>Having completed this module students</p> <ul style="list-style-type: none"> • are familiar with the quantum nature of matter and its consequences; • have knowledge of the relations between the quantum properties of matter and spectroscopic phenomena which enables them to choose suitable spectroscopic tools for different problems of structure determination of compounds and to analyse respective experimental results • have met and understood the fundamental methods of modern theories of electron structure (numerical quantum chemistry)
5. Prerequisites for Participation:	
a) Recommended:	Module CHE-BSc-M 02 „Mathematics“ Module CHE-BSc-M 03 „Physics“
b) Compulsory Certificates: to be submitted instantly <input type="checkbox"/> to hand in till <input type="checkbox"/>	none
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, starting in SS
8. Module Duration:	2 semesters
9. Recommended Semester in Major:	4 th and 5 th semester in major

10. Total workload of the module / credit points:	390 hours/ 13 credit points* (150 h attendance time, 240 h home study)
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*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	L	Quantum Chemistry	3	
2	P	L	Spectroscopy	4	
3	P	L	Theoretical Chemistry	3	

Remarks: Every module partial examination has to be taken in order to gain a claim on an oral examination in case of failure for two times in one or more partial examinations (see under 14.). The time limit for the oral repetition of the module final examination will depend on the last partial examination delivered.

* P = Compulsory course; WP = compulsory elective course; W = elective course

12. Module Examination:					
<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission**</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
T	Exam Quantum Chemistry		2 h	end of lecture period SS	graded
T	Exam Spectroscopy + Theoretical Chemistry		2 h	end of lecture period WS	graded

Remarks:

* A = module final examination; T = module partial examination ** optional

13. Module Grade:		
<input type="checkbox"/>	The module grade corresponds to the grade of the module final exam.	
<input checked="" type="checkbox"/>	The module grade is calculated as follows:	
	Exam Quantum Chemistry	1/3
	Exam Spectroscopy + Theoretical Chemistry	2/3
<input type="checkbox"/>	The module will not be graded.	

14. Others:

If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners.

In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.

If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010).

CHE-BSc-M 12

1. Module Name:	Chemistry of Life
2. Field / Person in Charge:	Chemistry / Prof. Dr. Joachim Wegener
3. Synopsis:	<ul style="list-style-type: none"> • chemistry of biologically relevant heterocycles; • structure / chemistry of amino acids and peptides; peptid syntheses; biosyntheses of amino acids and proteins; protein folding; protein function; enzymes and enzyme kinetics; protein degradation and -metabolism; • structure / chemistry of mono-, oligo- and polysaccharides; syntheses and chemical modification of sugars; generating metabolic energy from sugars (general overview); sugar metabolism; regulation of metabolism; • structure / chemistry of nucleotides / DNA / RNA; syntheses; biosyntheses of DNA (replication) and RNA (transcription); basic techniques in microbiology; • structure / chemistry of lipids;; • basics of toxicology; toxicological test methods; toxico-dynamics (dose-response curves); toxicokinetics (uptake, distribution, metabolism, elimination); modes of action and targets of poisons; toxicity of substance classes;
4. Competences Acquired:	<p>Having completed this module students are able to</p> <ul style="list-style-type: none"> • compare the chemistry of the most important biomolecules <i>in vitro</i> and <i>in vivo</i> and to analyse the different strategies of syntheses; • to take into account special properties of biomolecules in laboratory and production ; • to judge the use of organisms for the syntheses of biomolecules; • to describe basic processes of microbiology and to analyse their importance and failure in an organism • to describe important anabolic and catabolic pathways, to recognize regulatory mechanisms and to assess the importance of metabolic pathways in different scenarios; • to handle harmful substances competently and responsibly; • to judge ways of action of harmful substances on organisms and ecosystems
5. Prerequisites for Participation:	None
a) Recommended:	Basics in organic chemistry; Basic knowledge of cell structure
b) Compulsory Certificates:	

to be submitted instantly to hand in till	<input type="checkbox"/> <input type="checkbox"/>	none
6. Module Accepted in:	Chemistry B.Sc.	
7. Module Start:	annual, starting in SS	
8. Module Duration:	2 semesters	
9. Recommended Semester in Major	4 th and 5 th semester in major	
10. Total workload of the module / credit points:	270 hours/ 9 credit points* (90 h attendance time, 180 h home study including preparation for exam)	

*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	L + T	Bioorganic Chemistry	2	
2	P	L	Biochemistry	3	
3	P	L	Toxicology	1	Exam (passed / not passed)
Remarks: The lecture Toxicology will be finished up by a 60 minutes exam, which will not be graded but must be passed (passed / not passed)					

* P = compulsory course; WP = compulsory elective course; W = elective course

12. Module Examination:					
<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission**</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
A	Exam comprising contents of lectures Bioorganic chemistry and Biochemistry	None	2 h	end of lecture period SS	graded
Remarks: The module final examination will comprise the contents from the lectures Bioorganic chemistry and Biochemistry to equal parts. Every module partial examination has to be taken in order to gain a claim on an oral examination in case of failure for two times in one or more partial examinations (see under 14.). The time limit for the oral repetition of the module final examination will depend on the last partial examination delivered.					

* A = module final examination; T = module partial examination ** optional

13. Module Grade:

<input checked="" type="checkbox"/>	The module grade corresponds to the grade of the module final exam.
<input type="checkbox"/>	The module grade is calculated as follows:
<input type="checkbox"/>	The module will not be graded.

14. Other:

If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners.

In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.

If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010).

If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners. The grade obtained in this examination will correspond to the module grade.

CHE-BSc-M 13

1. Module Name:	Chemical Contexts
2. Field / Person in Charge:	Chemistry / Prof. Dr. Joachim Wegener
3. Synopsis:	<ul style="list-style-type: none"> • The module <i>Chemical Contexts</i> will comprise an interdisciplinary lecture covering topics in inorganic, organic and physical chemistry and the bachelor thesis. The contents of the interdisciplinary lecture will build on the modules of the preceding 5 semesters in major and will stress interrelations between their contents and competences, respectively. Selected case studies will demonstrate the coherence of chemistry. An outlook to current topics in basic as well as applied research will be given. • During the bachelor thesis a scientific problem will be worked on and the results put into writing.
4. Competences Acquired:	<p>Having completed this module students</p> <ul style="list-style-type: none"> • are able to address chemical problems requiring combination and integration of knowledge of the different chemical disciplines • can develop own approaches for work on interdisciplinary scientific problems • are able to work on a chemical problem on their own and can write down results according <i>lege artis</i>. • can represent the field of chemistry appropriately in the context of business.
5. Prerequisites for Participation:	
a) Recommended:	
b) Compulsory Certificates: to be submitted instantly <input checked="" type="checkbox"/> to hand in till <input type="checkbox"/>	Module CHE-BSc-M 01 „General Chemistry“ Module CHE-BSc-M 02 „Mathematics“ Module CHE-BSc-M 03 „Physics“ Module CHE-BSc-M 04 „Chemistry of Aqueous Solutions“ Module CHE-BSc-M 05 „Chemistry of Matter“
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, starting in SS

8. Module Duration:	1 semester
9. Recommended:	6 th semester in major (earliest possible start)
10. Total workload of the module / credit points:	690 hours/ 23 credit points* (255 h attendance time, 435 h home study including preparation for examination)

*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	L	Interdisciplinary lecture	4	
2	P		Bachelor thesis		Delivery of bachelor thesis (graded)
3	P	L	Law	1	Exam (passed / not passed)
Remarks:					

* P = required course; WP = elective compulsory course; W = elective course

12. Module Examination:					
<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission**</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
A	Oral examination to the interdisciplinary lecture		2 h (4 × 30 min)	last four weeks of lecture time	graded
Remarks: The oral examination will cover four parts of 30 minutes each: inorganic chemistry, organic chemistry, physical chemistry and analytical chemistry. The grades of the individual parts will make up 23 % of the total grade of the module each. Each part of the examination has to be passed (grade at least 4.0) and can be repeated twice as partial examination in the case of failure.					

* A = module final examination; T = module partial examination ** optional

13. Module Grade:		
<input type="checkbox"/>	The module grade corresponds to the grade of the module final exam.	
<input checked="" type="checkbox"/>	The module grade is calculated as follows:	
	Module final examination	92 %
	Bachelor thesis	8 %
<input type="checkbox"/>	The module will not be graded	

14. Others:

If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners.

In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.

If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010).

2. Compulsory Elective Courses:

CHE-BSc-M 14

1. Module Name:	Elective compulsory course Biochemistry
2. Field / Person in Charge	Chemistry / Prof. Dr. Joachim Wegener
3. Synopsis:	<ul style="list-style-type: none"> • basic methods in biochemistry for isolation, characterization and quantification of lipids, proteins and nucleic acids • enzyme kinetics and mechanisms of enzyme inhibition • plasmid isolation and restriction analysis • separation methods in protein biochemistry (gel electrophoresis, gel filtration) • functional investigations on biomembranes • current topics in molecular physiology
4. Competences Acquired:	<p>Having completed this module students are able</p> <ul style="list-style-type: none"> • to isolate and handle safely the most important biomolecules (lipids, proteins, nucleic acids) from intact organisms • to characterize biomolecules by basic bioanalytical techniques • to investigate and quantify the activity of biomolecules or their ability of molecular recognition • to use biomolecules for quantification of other, mostly low molecular mass compounds
5. Prerequisites for Participation:	
a) Recommended:	
b) Compulsory Certificates: to be submitted instantly <input checked="" type="checkbox"/> to hand in till <input type="checkbox"/>	CHE-BSc-M 12 „Chemistry of Life“ (Maximum number of participants limited to 24: the module will be offered only for a minimum of 5 participants.)
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, block course between WS and SS
8. Module Duration:	1 semester
9. Recommended Semester in Major:	5 th or 6 th semester in major
10. Total workload of the module / credit points:	270 hours/ 9 credit points* (105 h attendance time, 165 h home study)

**The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.*

11. Courses:

	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	S	Biochemical seminar accompanying lab course	30 h	oral presentation
2	P	LC	Biochemistry lab	75 h	Colloquia (passed / not passed), lab reports

Remarks: Every experiment includes a colloquium and the completion of a lab report. The maximum number of participants is limited to 24 students. If more than 24 students would like to participate, the course will be filled up according to the grades earned in CHE-BSc-M 12 *Chemistry of Life*.

* *P = compulsory course; WP = compulsory elective course; W = elective course*

12. Module Examination:					
<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission**</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
A	Module diary			Delivery within 1 week after end of module	Graded

Remarks:

* *A = module final examination; T = module partial examination ** optional*

13. Module Grade:

<input checked="" type="checkbox"/>	The module grade corresponds to the grade of the module final exam.	
<input type="checkbox"/>	The module graded is calculated as follows:	
<input type="checkbox"/>	The module will not be graded	

14. Other:

If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners.

In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.

If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010).

CHE-BSc-M 15

1. Module Name:	Elective compulsory course Theoretical Chemistry
2. Field / Person in Charge:	Chemistry / Prof. Dr. Martin Schütz
3. Synopsis:	Computer exercises using the <i>ab initio</i> program package MOLPRO: specification of Z-matrix, simple calculations of electronic structure using Hartree-Fock, DFT and correlated methods, optimizations of geometry, analysis of normal coordinates, visualization of molecular orbitals, densities, normal modes, reaction energies and –enthalpies, MOLPRO script coding and LINUX commands, calculation of reaction pathways, dissociation, excited states using simple methods (CIS, MCSCF), solvation effects (COSMO), intermolecular interactions (BSSE, size consistence, etc.)
4. Competences Acquired:	During this module students <ul style="list-style-type: none"> • gain competence in performing basic ab initio calculations of electronic structure and their application to chemical problems Computer exercises <ul style="list-style-type: none"> • will use the widespread program package MOLPRO, significantly developed in Regensburg • will be accompanied by seminars qualitatively discussing correlation procedures not covered in the theoretical chemistry lecture
5. Prerequisites for Participation:	
a) Recommended:	Basics in quantum theory of matter and theoretical chemistry
b) Compulsory Certificates: to be submitted instantly <input checked="" type="checkbox"/> to hand in till <input type="checkbox"/>	Module CHE-BSc-M 11 „Structure of Matter“
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, block course between WS and SS
8. Module Duration:	1 semester
9. Recommended Semester in Major:	5 th or 6 th semester in major
10. Total workload of the module / credit points:	270 hours/ 9 credit points* (105 h attendance time, 165 h home study)

*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	S + T	Computer exercises in theoretical chemistry		Report
Remarks:					

* P = compulsory course; WP = compulsory elective course; W = elective course

12. Module Examination:					
<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission**</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
A	Defence of Lab Report			after end of seminar series	graded
Remarks:					

* A = module final examination; T = module partial examination ** optional

13. Module Grade:	
<input checked="" type="checkbox"/>	The module grade corresponds to the grade of the module final exam.
<input type="checkbox"/>	The module grade is calculated as follows:
<input type="checkbox"/>	The module will not be graded

14. Others:
<p>If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners.</p> <p>In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.</p> <p>If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010).</p> <p>If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners. The grade obtained in this examination will correspond to the module grade.</p>

CHE-BSc-M 16

1. Module Name:	Elective compulsory course Nanoscience
2. Field / Person in Charge:	Chemistry / Prof. Dr. Werner Kunz, Prof. Dr. Arno Pfitzner
3. Synopsis:	<ul style="list-style-type: none"> • Lecture: introduction to supramolecular chemistry, self assembly, modes of interaction, host-guest-compounds; self assembly of tensides and lipids in solution (micelles, liquid crystals, vesicles); preparation, crystalline structure and properties of solid nanoparticles (shape, color, electric conductivity, magnetic behaviour, surface reactivity, electronic structure etc.) • Lab: Experiments covering the following topics: scanning force microscopy, microemulsions, Ostwald ripening, ,quantum dots, ferrofluids, gold nanoparticles, Application of nanoparticles in organic synthesis and analysis
4. Competences Acquired:	<p>Having completed this module students</p> <ul style="list-style-type: none"> • understand basic interactions and causes leading to self assembly of matter • know and understand special properties of mesoscopic structure and their origin • are to be able to classify the dimensions in which properties of matter will no longer be determined by single molecular properties, but also not yet by their macroscopic character of material
5. Prerequisites for Participation:	
a) Recommended:	Contents of the courses in semesters 1–5
b) Compulsory Certificates:	
to be submitted instantly <input type="checkbox"/>	
to hand in till <input type="checkbox"/>	
6. Module Accepted in:	Chemistry B.Sc., M. Sc. Physics
7. Module Start:	annual, block course between WS and SS
8. Module Duration:	1 semester
9. Recommended Semester in Major:	5 th or 6 th semester in major
10. Total workload of the module / credit points:	270 hours/ 9 credit points* (105 h attendance time, 165 h home study)

**The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.*

11. Courses:

	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	S	Lecture and Seminar Nanoscience	60 h	
2	P	LC	Lab course Nanoscience	45 h	Lab report

Remarks:

* *P = required course; WP = elective compulsory course; W = elective course***12. Module Examination:**

<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission**</i>	<i>Duration</i>	<i>tTme</i>	<i>Mode of grading</i>
A	Exam covering contents of course listed under 11.		2 h	During first 4 weeks of lecture time	graded

Remarks:

** *A = module final examination; T = module partial examination ** optional***13. Module Grade:**

<input checked="" type="checkbox"/>	The module grade corresponds to the grade of the module final exam.
<input type="checkbox"/>	The module grade*is calculated as follows:
<input type="checkbox"/>	The module will not be graded

14. Others:

If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners.

In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.

If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010).

CHE-BSc-M 17

1. Module Name:	Elective compulsory course Pharmaceutical Bioanalytics
2. Field / Person in Charge:	Pharmacy / Prof. Dr. Jörg Heilmann
3. Synopsis:	<p>The methods and issues listed in the following will be discussed theoretically in an accompanying seminar and applied practically in selected experiments.</p> <ul style="list-style-type: none"> • Extraction methods for isolation of plant ingredients • Chromatographic methods of separation for purification of plant ingredients • Methods for identification (chromatographic profile, HPLC fingerprint) • Checks for purity • Content analysis <p>Investigation of biological activity of purified plant ingredients (cytotoxicity, antiinflammatory activity, antioxidative activity)</p>
4. Competences Acquired:	<p>Having completed this module students are able to</p> <ul style="list-style-type: none"> • name, judge and carry out practically the most important methods for extraction of plant ingredients • develop strategies for purification of selected classes of compounds • judge the purity of plant ingredients based on chromatographic profiles • quantify the content of selected ingredients know and understand special properties of mesoscopic structure and their origin • determine and judge the cytotoxicity of selected ingredients
5. Prerequisites for Participation:	(Maximum number of participants limited to 20: the module will be offered only for a minimum of 5 participants)
a) Recommended:	Basics in Analytical Chemistry
b) Compulsory Certificates: to be submitted instantly <input checked="" type="checkbox"/> to hand in till <input type="checkbox"/>	CHE-BSc-M 08"Analysis of Matter"
6. Module Accepted in:	Chemistry B.Sc.,
7. Module Start:	annual, block course between WS and SS
8. Module Duration:	1 semester
9. Recommended Semester in Major:	5 th or 6 th semester in major

10. Total workload of the module / credit points:	270 hours/ 9 credit points* (105 h attendance time, 165 h home study)
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*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	Seminar "Pharmaceutical Bioanalytics"	Basic issues and techniques in Pharmaceutic Bioanalytics	30 h	Depending on number of participants: Oral presentation
2	P	Lab Course "Pharmaceutical Bioanalytics"	Selected experiments in Pharmaceutic Bioanalytics	75 h	Colloquia (passed / not passed), lab reports (to be handed in latest 4 weeks after the lab)
Remarks: The maximum number of participants is limited to 20 students by capacity. If more than 24 students would like to participate, the course will be filled up according to the grades earned in CHE-BSc-M 08 "Analysis of Matter" For each experiment a colloquium has to be passed and a report is to be handed in.					

* P = required course; WP = elective compulsory course; W = elective course

12. Module Examination:					
<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission**</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
A	Exam		60 min	One week after end of the module	graded
Remarks:					

** A = module final examination; T = module partial examination ** optional

13. Module Grade:	
<input checked="" type="checkbox"/>	The module grade corresponds to the grade of the module final exam.
<input type="checkbox"/>	The module grade is calculated as follows:
<input type="checkbox"/>	The module will not be graded

14. Others:

If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners.

In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.

If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010).

CHE-BSc-M 18

1. Module Name:	Elective compulsory course Synthesis Techniques
2. Field / Person in Charge:	Chemistry / Prof. Dr. Robert Wolf
3. Synopsis:	<p>The module imparts knowledge of technical features in good laboratory practice of reactions in/with special media, in high vacuum and with gases under pressure. The practical part will be carried out as a multi-level lab course with focus on acquisition of demanding preparative methods beyond general lab courses as used in technical chemistry. These include, among others, high vacuum- and inert gas-techniques for the synthesis of air-sensitive compounds, application of special reaction media (solvents, liquid gases etc.) and the execution of reactions under high pressure and the use of reactive gases. Besides preparative work under special reaction conditions the safe use of equipment for vacuum-, gas- and refrigeration engineering will be mediated.</p> <p>The practical part of the module will be accompanied by a two-week seminar introducing basic theoretical issues of the mentioned preparative and technical methods.</p>
4. Competences Acquired:	<p>Having completed this module students will have gained deeper insight into technical aspects of laboratory practice and will have become acquainted with demanding preparative methods.(high pressure, gases, special media). The participants will be able to practice these methods safely und to judge risks connected with them. Students have learnt to build up and run technical devices, to fix important parameters as well as their documentation by scientific protocols and short talks.</p>
5. Prerequisites for Participation:	The number of participants is limited to 25 due to reasons of capacitance.
a) Recommended:	Contents of the courses in semesters 1–5
b) Compulsory Certificates: to be submitted instantly <input checked="" type="checkbox"/> to hand in till <input type="checkbox"/>	Module CHE-BSc-M 09 and CHE-BSc-M 10 “
6. Module Accepted in:	Chemistry B.Sc.
7. Module Start:	annual, block course between WS and SS
8. Module Duration:	1 semester
9. Recommended Semester in Major:	5 th or 6 th semester in major
10. Total workload of the module / credit points:	270 hours/ 9 credit points* (105 h attendance time, 165 h home study including preparation for exam)

*The CP for the module will not be awarded before the final module exam or all parts of the module exam have been passed.

11. Courses:					
	<i>P / WP / W *</i>	<i>Type of course</i>	<i>Topic</i>	<i>Required time of attendance in SWS o. h.</i>	<i>Deliverables</i>
1	P	Lab "Synthesis Techniques"		85 h	Reports
2	P	Seminar "Synthesis Techniques"		20 h	
Remarks:					

* P = compulsory course; WP = compulsory elective course; W = elective course

12. Module Examination:					
<i>A/T*</i>	<i>Mode and content of examination</i>	<i>Prerequisites for admission**</i>	<i>Duration</i>	<i>Time</i>	<i>Mode of grading</i>
A	Module diary			Delivery latest 4 weeks after end of the module	graded
Remarks:					

* A = module final examination; T = module partial examination ** optional

13. Module Grade:	
<input checked="" type="checkbox"/>	The module grade corresponds to the grade of the module final exam.
<input type="checkbox"/>	The module grade is calculated as follows:
<input type="checkbox"/>	The module will not be graded

14. Others:
<p>If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners.</p> <p>In case of one or several partial examinations failed twice the grade obtained in the oral module examination (2. repetition) will be incorporated into the module grade according to its weight scheduled for the respective partial examination.</p> <p>If the oral module final examination is failed this will result in the final failure of the Bachelor examination according to § 29, paragraph 4 sentence 1 item 2 (PO Bachelor of Science Chemistry, 14.06.2010).</p> <p>If the module examination is not passed successfully after the first repetition, a second repetition can be awarded. Generally, the second repetition is an oral examination covering the complete module and will be conducted by an examining board of at least two examiners. The grade obtained in this examination will correspond to the module grade.</p>