Module handbook

for the degree programme

Master of Science (M.Sc.)

Life Science

version no.: 2025-1
valid as of WiSe 2026/27

Outline

1. Abbreviations

Forms of teaching:

- Final thesis (A)
- Feldübung (FÜ)
- Laboratory course (LÜ)
- Practical course (P)
- Seminar (S)
- Excercise / Übung (Ü)
- Lecture (V)
- Lecture combined with excercise (VÜ)

Credit points and Work load, etc.:

- Credit Points (CP)
- ECTS-Credit Points (ECTS-CP)
- European Credit Transfer and Accumulation System (ECTS)
- Hours (h)
- Leistungspunkte (LP)
- Minutes / Minuten (min)
- Semesterwochenstunden (SWS)
- Sommersemester (SoSe)
- Summer semester (SuSe)
- Wintersemester / Winter Semester (WiSe)

Others:

- Federal Institute of Hydrology, Bundesanstalt für Gewässerkunde (BfG)

2. Programme description and structure of the degree programme

The Master degree programme 'M.Sc. Life Science' is a research-oriented scientific degree programme and teaches subject-specific and interdisciplinary knowledge, skills and methods. It prepares students for a further scientific qualification within the own faculty, as, for example, a doctorate in the field of life sciences (biology, chemistry) or a job in the field of life science.

The degree programme comprises 120 ECTS-credit points (ECTS-CP) and has a standard period of study of four semesters. The Master programme, which is designed to be studied internationally, offers an English-language study pathway in the compulsory and elective areas.

The courses offered in the M.Sc. Life Science programme are structured as follows (**Fig. 1**):

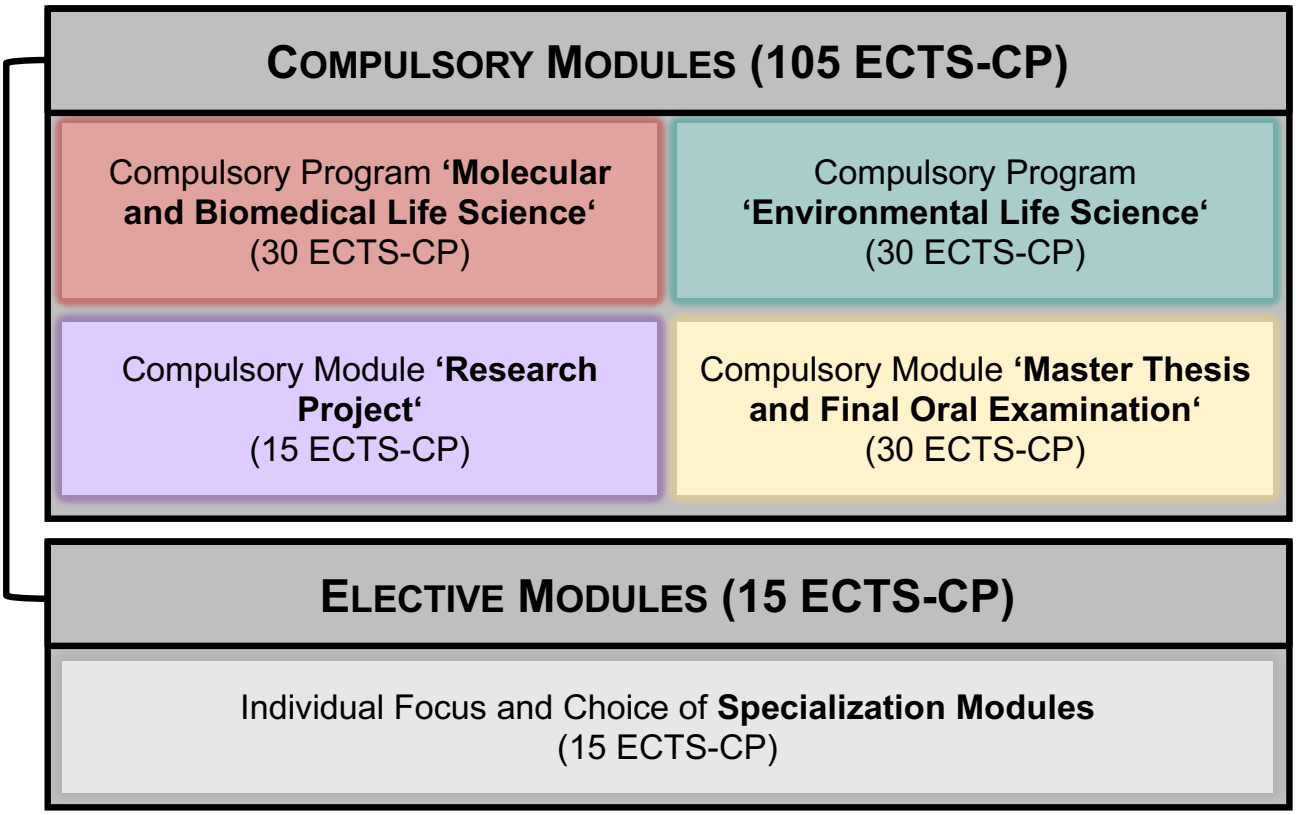

Fig. 1. Overview of the study programme's compulsory and elective building blocks.

The Master degree programme (120 ECTS credits in total) consists of two compulsory modules 'Molecular and Biomedical Life Science' and 'Environmental Life Science', each with 30 ECTS-CP, whereby the first compulsory module focuses on (bio)chemical and biotechnological skills, while the second compulsory module essentially conveys environmental science and ecological content.

Within the elective modules of 15 ECTS-CP, there are both in German and English, as the international orientation of the degree programme also requires students to be qualified for the domestic labour market. Knowledge of the German language (and culture) is an important

competence in this context. In the module handbook, the module descriptions of the German-language modules are consistently written in German, while the English-language modules are consistently written in English.

A study counselling session with the person responsible for the degree programme is recommended after the first semester.

3. Study programme plan

The following study plan makes it possible to adhere to the standard period of study (4 semester), as the compulsory modules planned for each semester are coordinated by the examination board without overlapping. The dates of the compulsory elective modules are variable. The degree programme can be studied starting in the summer or winter semester changing the sequence of modules.

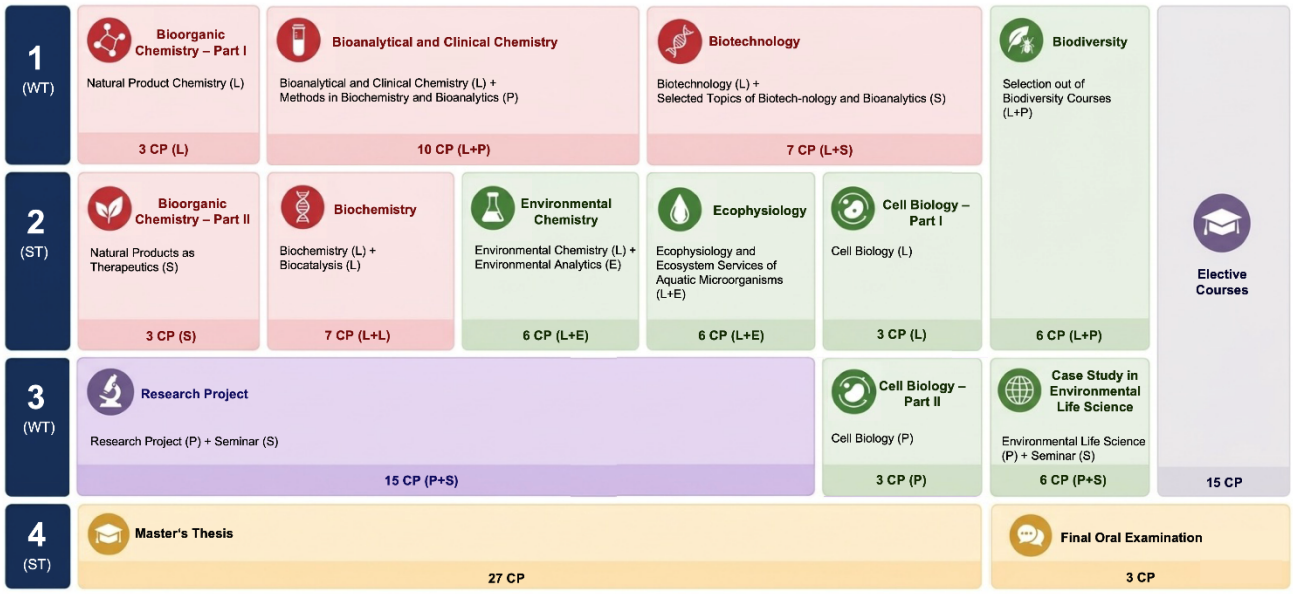

Fig.2. Study plan for the start in a winter semester.

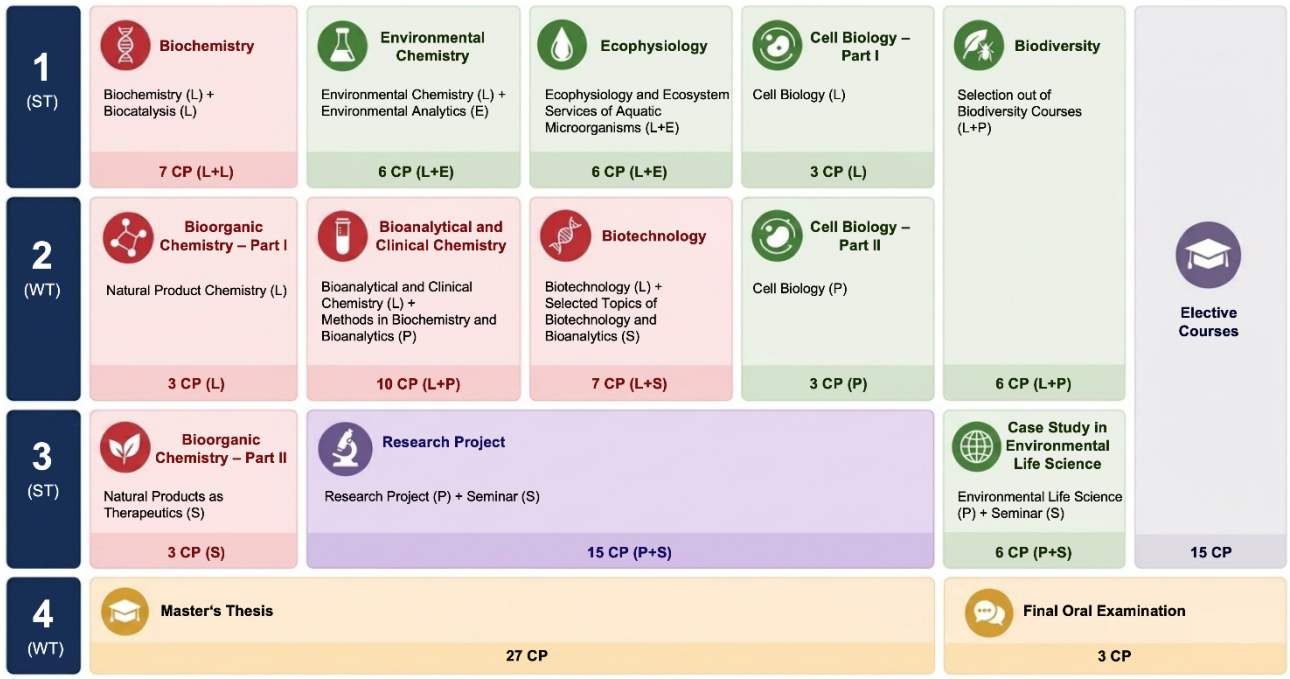

Fig.3. Study plan for the start in a summer semester.

There is no entitlement to the offer of a particular module or to participation in a particular module outside the underlying examination regulations.

4. General information on the Master degree programme

Contact persons for the Master programme: Prof. Dr. W. Imhof / Prof. Dr. M.-T. Hopp

On the following pages you will find a list of all components, modules and their courses together with the credit points (ECTS-CP) of the respective module for the Master degree programme.

The credit points per module include the time for contact time and self-study (referred to as workload in total) according to the formula 1 CP = 30 hours. As the students' workload in terms of preparation and follow-up work varies greatly between the individual types of course, average values are used in the calculation. The average workload in hours is calculated from the sum of contact time and independent study time according to the following formula: Workload = 30 times ECTS-CP or credit points (CP); whereby the specified contact times in hours result from the estimation of 1 SWS = 15 h.

5. Courses and examinations

Examinations for the individual modules can be completed in the form of ungraded coursework (Studienleistung), examination-relevant coursework (graded) (prüfungsrelevante Studienleistung), module examinations (Modulprüfung) or partial module examinations (Modulteilprüfung) in the form of written, oral or practical work (for details see the framework examination regulations of the University of Koblenz ("Rahmenprüfungsordnung der Universität Koblenz") §§ 14, 15 and 16). The form of the examinations as well as the duration and number of pages are specified in this module handbook. The examination date will be announced at the beginning of the first course of the module. Students are required to register for the module examination in the semester in which the last course belonging to the module was attended or in which the required coursework was completed (cf. Section 19 of the "Rahmenprüfungsordnung der Universität Koblenz"). An examination that has not been graded as sufficient can be repeated twice. If the second repetition is also not graded at least 'sufficient' (4.0), the examination is deemed to have been definitively failed; a new repetition of the same examination is excluded. If this happens with a compulsory module, the degree can no longer be achieved (cf. Section 27 of the Framework Examination Regulations of the University of Koblenz). There is no entitlement to be offered a particular module or to participate in a particular module outside of the underlying examination regulations.

The headers of the following module descriptions contain information on the type (compulsory or elective module) and title of the module, the credit points to be acquired (ECTS-CP), the number of semester hours per week (SWS) and the self-study time, the workload in hours (h) and the course cycle. The courses are differentiated according to lectures (V), laboratory courses (LÜ), exercises (Ü), practical courses (P), seminars (S) and final thesis (A). Section 2 describes the expected learning outcomes and the specialist skills that students should acquire by the end of the degree programme and to the acquisition of which each module contributes in a specific way. Section 3 'Contents' contains a brief description of the main subjects of the courses. This is followed by further information on frequency, participation requirements, forms of examination, the teaching language, literature, the institutes/departments involved and the module coordinators.

6. Module descriptions

6.1 Compulsory section

The compulsory section consists of the two practical modules, 'Research Project' (15 CP) and 'Master's Thesis' (30 CP), as well as the compulsory programmes in 'Molecular and Biomedical Life Science' (30 CP) and 'Environmental Life Science' (30 CP) (105 CP in total).

6.1.1 Compulsory programme 'Molecular and Biomedical Life Science' (30 CP)

The compulsory programme 'Molecular and Biomedical Life Science' (compulsory modules, 30 CP) consists of modules from the Chemistry and Biology departments of the Institute for Integrated Natural Sciences. Recommendations concerning the semester in which the respective modules should be studied refer to a start of the master programme in a winter semester. Nevertheless, there is an alternative study schedule for a start of the master programme in a summer semester (cf. page 7)

<table>
<tr><td colspan="10">Module 01 – Bioorganic Chemistry

03CH2701

6 Credit points (CP)
Compulsory module</td></tr>
<tr><td colspan="3">Work load

180 h</td><td colspan="5">Study semester

3324082 - 1st semester (recommended)
3327012 – 2nd semester (recommended)</td><td colspan="2">Duration

2 semesters</td></tr>
<tr><td>1</td><td colspan="3">Courses</td><td></td><td>Compulsory/ elective</td><td>Contact time</td><td>Self-study</td><td>Planned group size</td><td>CP</td></tr>
<tr><td></td><td>1.1</td><td>V</td><td>Natural Product Chemistry</td><td>3324082</td><td>compulsory</td><td>2 SWS
30 h</td><td>60 h</td><td>30</td><td>3</td></tr>
<tr><td></td><td>1.2</td><td>S</td><td>Natural Products as Therapeutics</td><td>3327012</td><td>compulsory</td><td>2 SWS
30 h</td><td>60 h</td><td>30</td><td>3</td></tr>
<tr><td>2</td><td colspan="9">Learning outcomes / competences

3324082 – Natural Product Chemistry (V)
The students
• know the most important natural product classes and can present their occurrence and their physiological effects;
• know essential concepts for synthesis planning of complex molecules like, for example, retro-synthetic methods;
• use their chemical basic knowledge from modules from bachelor courses to develop synthetic strategies for simple example molecules.
3327012 – Natural Products as Therapeutics (S)</td></tr>
</table>

	The students • have a general understanding about the recent developments in the field of peptide science, encompassing synthesis techniques, biology of peptides and the application of peptides and conjugates thereof; • acquired skills to tackle the synthesis and usage of peptides and peptide libraries
3	**Contents** **3324082 – Natural Product Chemistry (V)** • terpenes and steroids; • biogenic amines and alkaloids; • amino acids, peptides and proteins; • carbohydrates; • lipids; • nucleosides, nucleotides and nucleic acids; • antibiotics and chemotherapeutics. **3327012 – Natural Products as Therapeutics (S)** • synthesis of peptides and proteins (e.g., solid phase peptide synthesis, native chemical ligation, etc.) • peptide modifications (e.g., labelling strategies, cyclization, etc.) • peptide libraries and arrays • peptides with bioactivities, cell-penetrating peptides, peptide conjugates • application of peptides in biotechnology and pharmaceutical industry • peptides as pharmaceuticals, cosmeceuticals etc. (focus on peptide therapeutics)
4	**Frequency of the course** **3324082 – Natural Product Chemistry (V)** only winter semester **3327012– Natural Products as Therapeutics (S)** only summer semester
5	**Teaching language** **3324082 – Natural Product Chemistry (V)** English **3327012– Natural Products as Therapeutics (S)** English
6	**Requirements for participation** none

7	**Types of examination** **3324082 – Natural Product Chemistry (V)** Module examination (Modulprüfung): written exam (Klausur) (90 min) **3327012– Natural Products as Therapeutics (S)** Coursework (Studienleistung): Presentation (20 min) and scientific discussion in the seminar
8	**Requirements for the awarding of credit points** passing the written exam and the seminar coursework
9	**Importance for the final grade** 6/120
10	**Module coordinator** Prof. Dr. Marie-T. Hopp
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3324082 – Natural Product Chemistry (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3327012– Natural Products as Therapeutics (S)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department
12	**Literature** **3324082 – Natural Product Chemistry (V)** • Hanessian, S. (Ed.): Natural Products in Medicinal Chemistry. Wiley-VCH. • Sicher, D., Zeller, K.-P-, Siehl, H.U., Berger, S. (Eds.): Natural Products: Isolation, Structure Elucidation, History. Wiley-VCH • Habermehl, G., Hammann, P.E., Krebs, H.C., Ternes, W. (Eds.): Naturstoffchemie. Springer-Verlag. • Nuhn, P. (Ed.): Naturstoffchemie: Mikrobielle, pflanzliche und tierische Naturstoffe. S. Hirzel Verlag Stuttgart. **3327012– Natural Products as Therapeutics (S)** • Sewald, N., Jakubke, H.-D. (Ed.): Peptides: Chemistry and Biology. Wiley-VCH. • Wang, L., Wang, N., Zhang, W., Cheng, X., Yan, Z., Shao, G., Wang, X., Wang, R., Fu, C. (2022): Therapeutic peptides: Current applications and future directions. Sig. Transduct. Target Ther. 7, 48. Doi: 10.1038/s41392-022-00904-4.

	• Groner, B. (Ed.): Peptides as Drugs. Wiley-VCH. Further literature will be announced in the respective course.
13	**Use of the module or related courses (in other study programmes)** M.Sc. Life Science (XXXXX)
14	**Other information** -

Module 02 – Bioanalytical and Clinical Chemistry

10 Credit points (CP)
Compulsory module

03CH2702

Work load	**Study semester**	**Duration**
300 h	1st semester (recommended)	1 semester

1	**Courses**				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	2.1	V	Bioanalytical and Clinical Chemistry	3327021	compulsory	2 SWS 30 h	60 h	30	3
	2.2	LÜ	Methods in Biochemistry and Bioanalytics	3327022	compulsory	4 SWS 60 h	150 h	25	7

2 **Learning outcomes / competences**

3327021– Bioanalytical and Clinical Chemistry (V)

The students

- learned about modern techniques in biochemistry and bioanalytics;
- gained knowledge about structure-based drug design (including bioinformatic approaches);
- are able to select theoretically suitable separation and analysis methods for biomolecules in order to characterise compounds from complex matrices.
- know about laboratory and diagnostic techniques for the detection and measurement of biochemical changes in diseases and learn opportunities and limitations associated with these laboratory techniques
- are able to interpret clinical chemistry laboratory tests.

3327022 – Methods in Biochemistry and Bioanalytics (LÜ)

The students

- understand the basics of biochemical and bioanalytical methods
- are able to apply, evaluate and interpret modern biochemical and bioanalytical techniques and the results thereof
- have knowledge about the use of biological databases, in particular in planning, analysing and interpreting experiments.

3 **Contents**

3327021– Bioanalytical and Clinical Chemistry (V)

- main strategies and methods of analytical biochemistry and clinical chemistry as, for example, sequencing of DNA and proteins, peptide and protein analytics, structural analysis of proteins, qualitative and quantitative description of protein-protein/ligand interactions and the use of data bases will be addressed;
- focus in clinical chemistry will be laid on hematology and respective application areas
- modern techniques such as biosensing and imaging as well as concepts of „omics“ technologies will be addressed as well

	• the basics of clinical chemistry and laboratory testing • the pathobiochemical and pathophysical alterations present in exemplary diseases and the selection of biomarkers **3327022 – Methods in Biochemistry and Bioanalytics (LÜ)** The practical will train, for example, the following with a strong focus proteins and peptides as well as interactions thereof: • chromatographic and electrophoretic methods; • characterization of natural products by spectroscopic methods • sequencing of peptides by tandem mass spectrometry; • bioactivity assays and enzymatic assays (enzyme kinetics); • immuno-based techniques (e.g., ELISA); • characterization of protein/peptide-ligand interactions; • quantification of biomolecules; • molecular docking and molecular dynamics simulation.
4	**Frequency of the course** only winter semester **3327021– Bioanalytical and Clinical Chemistry (V)** only winter semester **3327022 – Methods in Biochemistry and Bioanalytics (LÜ)** only winter semester
5	**Teaching language** **3327021– Bioanalytical and Clinical Chemistry (V)** English **3327022 – Methods in Biochemistry and Bioanalytics (LÜ)** English
6	**Requirements for participation** none
7	**Types of examination** **3327021– Bioanalytical and Clinical Chemistry (V)** module examination (Modulprüfung): written exam (Klausur) (90 min) **3327022 – Methods in Biochemistry and Bioanalytics (LÜ)** Examination-relevant coursework (prüfungsrelevante Studienleistung): report/documentation (Dokumentation/Bericht) combined with practical examination (praktische Prüfung, Einzelprüfung) in form of preparation, execution and evaluation of all experiments (written and practical – duration: 1 semester). The number of pages of the report/documentation depends on the chosen task and will be determined in discussion with the responsible examiner.
8	**Requirements for the awarding of credit points**

	passing the written exam **3327022 – Methods in Biochemistry and Bioanalytics (LÜ)** passing the examination-relevant coursework
9	**Importance for the final grade** 10/120
10	**Module coordinator** Prof. Dr. Marie-T. Hopp
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3327021– Bioanalytical and Clinical Chemistry (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3327022 – Methods in Biochemistry and Bioanalytics (LÜ)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department
12	**Literature** • Lottspeich, F., Engels, J. W. (Ed.): Bioanalytics: Analytical Methods and Concepts in Biochemistry and Molecular Biology, Wiley-VCH. • Hallbach, J. (Ed.): Klinische Chemie und Hämatologie. Thieme Verlag. • Gey, M.H. (Ed.): Instrumentelle Analytik und Bioanalytik. Springer Verlag. Further literature will be announced in the respective course.
13	**Use of the module or related courses (in other study programmes)** M.Ed. Gymnasium Chemie (20133) M.Sc. Chemie und Physik funktionaler Materialien (20145) M.Sc. BioGeoWissenschaften (20187) M.Sc. Life Science (XXXXX)
14	**Other information** A practical course script (and possibly other electronic media) will be provided for this course describing the experiments. In addition, before the start of the course there will be an obligatory safety instruction.

Module 03 – Biotechnology

03XX2703

7 Credit points (CP)
Compulsory module

Work load	**Study semester**	**Duration**
210 h	1st semester (recommended)	1 semester

	Courses				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	3.1	V	Biotechnology	32212311	compulsory	2 SWS 30 h	60 h	30	3
	3.2	S	Selected Topics of Biotechnology and Bioanalytics	3427032	compulsory	2 SWS 30 h	90 h	30	4

2 **Learning outcomes / competences**

32212311 – Biotechnology (V)

The students

- can explain and apply the basic and advanced procedures and applications of biotechnology and understand the interrelationships within biotechnological methods

3427032– Selected Topics of Biotechnology and Bioanalytics (S)

The students

- can collect, understand, assess and present information extracted from current publications on isotope biotechnology and its applications;
- are capable of participating in scientific discussions on isotope biotechnology and application.

3 **Contents**

32212311 – Biotechnology (V)

- basics of biotechnology (biochemical basis, cultivation of microorganisms, recombinant techniques, etc.)
- different fields of biotechnology with topics such as:
  - contribution of biology, biochemistry, bioprocess engineering, microbiology and cell biology to biotechnology with examples of up-to-date applications;
  - biotechnology for the production of food (food industry)
  - white biotechnology (e.g., for the production of organic acids)
  - substrates in biotechnology
  - biotechnological process engineering
  - biotechnological production of amino acids, peptides and proteins/enzymes, immobilization of enzymes and the usage thereof (e.g., biosensors, process engineering)
  - biotechnological preparation of vitamins
  - biopolymers and steroids in biotechnology
  - biotransformation processes

	- green biotechnology - red biotechnology/pharmaceutical and medical biotechnology **3427032– Selected Topics of Biotechnology and Bioanalytics (S)** Isotopes are widely applied in life sciences and have gained key importance in many methodological approaches. The seminar gives an overview on the analytics of radioactive and stable isotopes and their applications in different research fields, e.g. biogeochemistry, tracing chemical fate in the environment (in situ and REACH registration), microbial metabolism and degradation ('omics' techniques: fluxomics, metabolomics, proteomics, genomics, transcriptomics), clinical drug development, medical treatment, and forensics (reconstructing the past, crime investigation).
4	**Frequency of the course** **32212311 – Biotechnology (V)** only winter semester **3427032– Selected Topics of Biotechnology and Bioanalytics (S)** only winter semester
5	**Teaching language** **32212311 – Biotechnology (V)** English **3427032– Selected Topics of Biotechnology and Bioanalytics (S)** English
6	**Requirements for participation** none
7	**Types of examination** **32212311 – Biotechnology (V)** module examination (Modulprüfung): written exam (Klausur) (45 min) **3427032– Selected Topics of Biotechnology and Bioanalytics (S)** coursework (Studienleistung): Presentation (Vortrag) (30 min)
8	**Requirements for the awarding of credit points** **32212311 – Biotechnology (V)** passing the written exam **3427032– Selected Topics of Biotechnology and Bioanalytics (S)** passing the coursework
9	**Importance for the final grade** 7/120

10	**Module coordinator** Prof. Dr. Karolina Nowak
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Geography Department **32212311 – Biotechnology (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3427032– Selected Topics of Biotechnology and Bioanalytics (S)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Geography Department
12	**Literature** will be announced in the respective course.
13	**Use of the module or related courses (in other study programmes)** M.Ed. Gym Biologie (20103) B.Sc. BioGeoWissenschaften (20187) M.Sc. BioGeoWissenschaften (20187) M.Sc. Gewässerkunde und Wasserwirtschaft (20233) M.Sc. Life Science (XXXXX)
14	**Other information** -

Module 04 – Biochemistry

7 Credit points (CP)
Compulsory module

03CH2704

Work load	**Study semester**	**Duration**
210 h	2nd semester (recommended)	1 semester

1	**Courses**				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	4.1	V	Biochemistry	3327041	compulsory	2 SWS 30 h	90 h	30	4
	4.2	V	Biocatalysis	3327042	compulsory	2 SWS 30 h	60 h	30	3

2 **Learning outcomes / competences**

3327041– Biochemistry (V)

The students

- are able to understand and reproduce biochemical questions on a molecular basis;
- learned the basic structures and pathways in biochemistry and the key organic reactions and reaction mechanisms of relevance for understanding how some biochemical processes work on a chemical basis;
- have a deepened understanding on regulatory processes and mechanisms of hormonal communication and signal transduction.

3327042– Biocatalysis (V)

The students

- are able to mechanistically interpret catalytical reactions and understand the respective modes of action on a molecular level;
- understand thermodynamic and kinetic implications of the use of catalysts;
- understand the basic principles and differences of organocatalysis, biocatalysis and enzyme catalysis;
- are able to discuss selected examples of enzymes as target structures with respect to strategies and possibilities of intervention if biochemical processes are misdirected (therapeutical potential);
- learned how to implement biocatalysis into organic synthetic and biotechnological applications

3 **Contents**

3327041 – Biochemistry (V)

- The lecture will include knowledge about biosynthesis as well as degradation pathways of biomolecules in the human organism (metabolism), and the molecular basics of intra- and intercellular signalling;
- The lecture will present regulatory mechanisms of signalling and signal processing in terms of hormones, hormone receptors, hormonal regulation, signal transduction, membrane receptors,

	kinase cascades, intracellular linkage of signal pathways (crosstalk), transcription regulation, covalent modification of signal proteins and transcription factors; • Selected present scientific problems and research trends in biochemistry, especially with respect to the research on pathophysiological conditions (development of diseases) will be addressed. **3327042– Biocatalysis (V)** • The lecture will present topics related to catalytic chemistry in the area of basic principles of catalysis, organocatalysis, biocatalysis and enzymology (enzyme properties and structure, classification, mechanisms, chemistry of enzyme cofactors); • The role of catalytic reactions in connection with a more sustainable chemistry will be presented; • The application of enzymes in organic synthesis, biotechnology, and synthetic biology will be highlighted (including engineering of desired enzyme functions).
4	**Frequency of the course** only summer semester **3327041– Biochemistry (V)** only summer semester **3327042– Biocatalysis (V)** only summer semester
5	**Teaching language** **3327041– Biochemistry (V)** English **3327042– Biocatalysis (V)** English
6	**Requirements for participation** none
7	**Types of examination** Module examination (Modulprüfung): written exam (Klausur) (90 min)
8	**Requirements for the awarding of credit points** passing the written exam

9	**Importance for the final grade** 7/120
10	**Module coordinator** Prof. Dr. Wolfgang Imhof
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3327041– Biochemistry (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3327042– Biocatalysis (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department
12	**Literature** • Berg, J.M., Tymoczko, J.L., Stryer, L. (Ed.): Biochemistry. W.H.Freeman & Co Ltd. • Nelson, D.L., Cox, M. (Ed.): Lehninger, Principles of Biochemistry. Macmillan Learning. Further literature will be announced in the respective course.
13	**Use of the module or related courses (in other study programmes)** M.Ed. RS+ Chemie B.Sc. BioGeoWissenschaften (20125) M.Sc. Life Science (XXXXX)
14	**Other information** -

6.1.2 Compulsory programme 'Environmental Life Science' (30 CP)

The compulsory programme 'Environmental Life Science' (compulsory modules, 30 CP) consists of modules from the Chemistry and Biology departments of the Institute for Integrated Natural Sciences. Recommendations concerning the semester in which the respective modules should be studied refer to a start of the master programme in a winter semester. Nevertheless, there is an alternative study schedule for a start of the master programme in a summer semester (cf. page 7)

<table>
<tr><td colspan="10">Module 05 – Cell Biology

03BI1408

6 Credit points (CP)
Compulsory module</td></tr>
<tr><td colspan="2">Workload

180 h</td><td colspan="6">Study semester

3214081 - 2nd semester (recommended)
3214082 - 3rd semester (recommended)</td><td colspan="2">Duration

2 semester</td></tr>
<tr><td>1</td><td colspan="4">Courses</td><td>Compulsory/ Elective</td><td>Contact time</td><td>Self-study</td><td>Planned Group Size</td><td>CP</td></tr>
<tr><td></td><td>17.1</td><td>V</td><td>Cell Biology</td><td>3214081</td><td>Pflicht</td><td>2 SWS
30 h</td><td>60 Std.</td><td>20</td><td>3</td></tr>
<tr><td></td><td>17.2</td><td>LÜ</td><td>Cell Biology</td><td>3214082</td><td>Pflicht</td><td>2 SWS
30 h</td><td>60 Std.</td><td>20</td><td>3</td></tr>
<tr><td>2</td><td colspan="9">Learning outcomes / competences

3214081 – Cell Biology (V)
The students
• are able to define appropriate subject-specific objectives for new application- or research-oriented tasks in the field of cell biology, source further information and translate this into practical knowledge.

3214082 – Cell Biology (LÜ)
The students
• are able to identify eukaryotic and prokaryotic cells and their components.</td></tr>
<tr><td>3</td><td colspan="9">Contents

3214081 – Cell Biology (V)
• Introduction to the Cell
• Basic structure: similarities and differences between eukaryotic and prokaryotic cells
• Cell cycle, division and reproduction</td></tr>
</table>

	• Membrane transport • Intracellular compartments and transport • Cell communication • Cytoskeleton • Tissues, stem cells • Methods in cell biology • Tissue engineering **3214082 – Cell Biology (LÜ)** • Guided practical exercises on the identification of eukaryotic and prokaryotic cells and their components.
4	**Frequency of the course** **3214081 – Cell Biology (V)** only summer semester **3214082 – Cell Biology (LÜ)** only winter semester
5	**Teaching language** **3214081 – Cell Biology (V)** English **3214082 – Cell Biology (LÜ)** English
6	**Requirements for participation** none
7	**Types of examination** **3214081 – Cell Biology (V)** module examination (Modulprüfung): written exam (Klausur) (90 min) **3214082 – Cell Biology (LÜ)** Examination-relevant coursework (prüfungsrelevante Studienleistung): Preparation, conduct and evaluation of all experiments (written and practical – 1 semester); the scope of the written evaluation depends on the chosen assignment and will be determined in consultation with the examiner. A laboratory manual (and, where applicable, additional digital resources) will be provided for this course, in which the experiments are described. In addition, there will be a compulsory safety briefing before the course begins.
8	**Requirements for the awarding of credit points** passing the written exam

	3214082 – Cell Biology (LÜ) passing the examination-relevant coursework
9	**Importance for the final grade** 6/180
10	**Module coordinator** Prof. Dr. Werner Manz
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **3214081 – Cell Biology (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **3214082 – Cell Biology (LÜ)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department
12	**Literature** will be announced in the respective course
13	**Use of the module or related courses (in other study programmes)** B.Sc. Angewandte Naturwissenschaften (20241) B.Sc. Angewandte Naturwissenschaften (20181) M.Sc. Life Science (XXXXX)
14	**Sonstige Informationen** -

Module 06 – Case Study in Environmental Life Science — 6 Credit points (CP), Compulsory module

03XX2706

Work load	**Study semester**	**Duration**
180 h	3rd semester (recommended)	1 semester

1	**Courses**				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	6.1	P	Environmental Life Science	3327061	compulsory	0 SWS 0 h	120 h	10	4
	6.2	S	Environmental Life Science	3327062	compulsory	1 SWS 15 h	45 h	10	2

2 **Learning outcomes / competences**

3327061 – Environmental Life Science (P)

The students

- gain advanced knowledge in hypothesis testing, experimental design, and carrying out a scientific project in the context of environmental life science research;
- gain advanced knowledge in data management and analysis and the presentation of scientific data;
- gain advanced knowledge in scientific writing and in summarizing key findings within a scientific presentation.

3327062 – Environmental Life Science (S)

The students

- gain in-depth knowledge on literature review and evaluation of up-to-date scientific topics in environmental life science;
- feature advanced knowledge on producing, processing and presenting scientific results.

3 **Contents**

3327061 – Environmental Life Science (P)

- planning and carrying out a scientific project in the context of environmental life science research;
- analysis of own data;
- writing a project report in the style of a scientific publication.

3327062 – Environmental Life Science (S)

- discussing and critically reflecting scientific topics in environmental life science research
- processing and presenting scientific results (talk).

4	**Frequency of the course** every semester **3327061 – Environmental Life Science (P)** every semester **3327062 – Environmental Life Science (S)** every semester
5	**Teaching language** **3327061 – Environmental Life Science (P)** English **3327062 – Environmental Life Science (S)** English
6	**Requirements for participation** none
7	**Types of examination** **3327061 – Environmental Life Science (P)** Module examination (Modulprüfung): written term paper (Hausarbeit), duration: four weeks. The number of pages of the term paper depends on the chosen task and will be determined in discussion with the responsible examiner. **3327062 – Environmental Life Science (S)** Coursework (Studienleistung): presentation (Vortrag) (20 min)
8	**Requirements for the awarding of credit points** passing the module examination and the coursework
9	**Importance for the final grade** 7/120
10	**Module coordinator** Prof. Dr. Marie-T. Hopp
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department

	3327061 – Case Study in Environmental Life Science (P) Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3327062 – Case Study in Environmental Life Science (S)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department
12	**Literature** Literature will be provided by the respective research group in which the case study is performed.
13	**Use of the module or related courses (in other study programmes)** M.Sc. Life Science (XXXXX)
14	**Other information** The module is offered by various authorized examiners involved in the degree programme.

Module 07 – Environmental Chemistry

6 Credit points (CP)
Compulsory module

03CH2707

Work load	**Study semester**	**Duration**
180 h	2nd semester (recommended)	1 semester

1	**Courses**				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	7.1	V	Applied Environmental Chemistry	3311082	compulsory	2 SWS 30 h	60 h	30	3
	7.2	V	Environmental Analytics	3311083	compulsory	2 SWS 30 h	60 h	30	3

2 **Learning outcomes / competences**

3311082 – Applied Environmental Chemistry (V)

The students

- are able to recognize and discuss chemical processes in daily life and in the environment qualitatively and quantitatively;
- are able to establish links to other scientific disciplines.

3311083 – Environmental Analytics (V)

The students

- have gained knowledge and understanding of the most important chemical processes in the environment and environmental analytical techniques as well as the respective physicochemical basis;
- are able to critically discuss results of analytical measurements;
- know the basic principles and applications of selected analytical methods in the structural characterization of organic compounds.

3 **Contents**

3311082 – Applied Environmental Chemistry (V)

- environmental compartments, their development, composition, chemical function and their respective pollution by substances;
- effect and toxicity of environmentally relevant groups of substances, chemodynamic processes in the environment;
- distribution between phases, deposition, sedimentation, bioaccumulation, transformation and degradation.

3311083 – Environmental Analytics (V)

- qualitative and quantitative analysis of organic pollutants;
- methods for sampling of environmental matrices;

	• sample preparation techniques; • chromatographic analytical techniques; • quality management in analytical chemistry; • statistical evaluation of analytical results; • basics of modern spectroscopic methods; • application of modern spectroscopic methods on selected groups of organic substances; • elucidation of structure-properties-relationships; • structural information and structural models.
4	**Frequency of the course** only summer semester **3311082 – Applied Environmental Chemistry (V)** only summer semester **3311083 – Environmental Analytics (V)** only summer semester
5	**Teaching language** **3311082 – Applied Environmental Chemistry (V)** English **3311083 – Environmental Analytics (V)** English
6	**Requirements for participation** none
7	**Types of examination** Module examination (Modulprüfung): written exam (Klausur) (90 min)
8	**Requirements for the awarding of credit points** passing the written exam
9	**Importance for the final grade** 6/120
10	**Module coordinator** Prof. Dr. Wolfgang Imhof / apl. Prof. Dr. Thomas Ternes (BfG)
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department, Federal Institute for Hydrology **3311082 – Applied Environmental Chemistry (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry

	Department, Federal Institute for Hydrology **3311083 – Environmental Analytics (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department, Federal Institute for Hydrology
12	**Literature** **3311082 – Applied Environmental Chemistry (V)** • René P. Schwarzenbach, Philip M. Gschwend, Dieter M. Imboden, Environmental Organic Chemistry von (ISBN 978-1-118-76719-1) **3311083 – Environmental Analytics (V)** • Ritgen, U.: Analytische Chemie I. 1. Aufl., Springer Spektrum: 2020 • Ritgen, U.; Oligschleger, C.: Analytische Chemie II. 1. Aufl., Springer Spektrum: 2020 • Skoog, D.A.; Holler, F.J.; Crouch, S.R.: Instrumentelle Analytik: Grundlagen - Geräte – Anwendungen. 2. Aufl., Springr Spektrum: 2013 • Cammann, K. (Hrsg.): Instrumentelle Analytische Chemie: Verfahren, Anwendungen, Qualitätssicherung. Spektrum Akademischer Verlag: 2010 • Gross, J.H.: Massenspektrometrie: Spektroskopiekurs kompakt. 1. Aufl., Spinger Spektrum: 2019. • Budzikiewicz, H.; Schäfer, M.; Massenspektrometrie: Eine Einführung. 6. Aufl., Wiley-VCH: 2012 • Otto, M.: Analytische Chemie. 5. Aufl., Wiley-VCH: 2019. • Hein, H.; Kunze, W.: Umweltanalytik mit Spektroskopie und Chromatographie: Von der Laborgestaltung bis zur Dateninterpretation. 3. Aufl., Wiley-VCH: 2004.
13	**Use of the module or related courses (in other study programmes)** B.Ed. Chemie KO (20111) B.Sc. Angewandte Naturwissenschaften (20181) B.Sc. BioGeoWissenschaften (20187) M.Sc. Life Science (XXXXX)
14	**Other information** -

Module 08 – Biodiversity

6 Credit points (CP)
Compulsory module

03BI2708

elective courses:
Two of the following elective courses have to be chosen. Either the two courses 3223371 and 3223372 or the two courses 3223291 and 3223292.

Work load	**Study semester**	**Duration**
180 h	2nd semester (recommended)	1 semester

1	**Courses**				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	8.1	V	Insect Diversity Assessment	3223371	elective	2 SWS 30 h	60 h	25	3
	8.2	LÜ	Insect Diversity Assessment	3223372	elective	2 SWS 30 h	60 h	25	3
	8.3	V	Angiosperm Diversity Assessment	3223291	elective	2 SWS 30 h	60 h	30	3
	8.4	LÜ	Angiosperm Diversity Assessment	3223292	elective	2 SWS 30 h	60 h	30	3

2 **Learning outcomes / competences**

3223371 – Insect Diversity Assessment (V)
The students
- gain an overview on diversity and phylogeny of insects.

3223372 – Insect Diversity Assessment (LÜ)
The students
- know morphology and phylogeny of insects;
- can allocate insects to taxa;
- can determine insects with keys;
- know and can use insects assessment methods.

3223291 – Diversity of Angiosperms (V)
The students
- get in-depth knowledge on phylogeny and diversity of angiosperms.

3223292 – Diversity of Angiosperms (LÜ)
The students
- are able to critically reflect the phylogeny of angiosperms and to identify groups that are sensitive bioindicators and suitable for a rapid biodiversity assessment.

3	**Contents** **3223371 – Insect Diversity Assessment (V)** • introduction to insect diversity with overview on major taxa; • morphology and phylogeny of insects; • introduction on methods of insect assessment. **3223372 – Insect Diversity Assessment (LÜ)** • practical course in insect morphology; • training of insect identification; • assessment of insects in the field. **3223291 – Diversity of Angiosperms (V)** • introduction into phylogenetic methods • autapomorphic characters of angiosperms • molecular systematics of angiosperms and their importance for the phylogenetic systematics • pollination as driver of angiosperm evolution • basal angiosperms (Magnoliidae) • Magnolianae (basal "dicotyledoneae") • Lillianae ("Monocotyledoneae") • Rosidae (higher evolved "dicotyledoneae") **3223292 – Diversity of Angiosperms (LÜ)** • practical examination of living plants • overview of the angiosperms • reflection of autapomorphic and synampomorphic characters • identification of plant families • identification of plant groups suitable for rapid biodiversity assessment • examination of different pollination syndromes
4	**Frequency of the course** only summer semester **3223371 – Insect Diversity Assessment (V)** only summer semester **3223372 – Insect Diversity Assessment (LÜ)** only summer semester **3223291 – Diversity of Angiosperms (V)** only summer semester **3223292 – Diversity of Angiosperms (LÜ)** only summer semester

5	**Teaching language** **3223371 – Insect Diversity Assessment (V)** English **3223372 – Insect Diversity Assessment (P)** English **3223291 – Diversity of Angiosperms (V)** English **3223292 – Diversity of Angiosperms (LÜ)** English
6	**Requirements for participation** none
7	**Types of examination** Module examination (Modulprüfung): written term paper (Hausarbeit), duration: 2 weeks. The number of pages of the term paper depends on the chosen task and will be determined in discussion with the responsible examiner.
8	**Requirements for the awarding of credit points** passing the module examination
9	**Importance for the final grade** 6/120
10	**Module coordinator** apl. Prof. Dr. Thomas Wagner / Prof. Dr. Eberhard Fischer
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **3223371 – Insect Diversity Assessment (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **3223372 – Insect Diversity Assessment (LÜ)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department

	3223291 – Diversity of Angiosperms (V) Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **3223292 – Diversity of Angiosperms (LÜ)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department
12	**Literature** **3223371 – Insect Diversity Assessment (V)** • McGavin, G. C. 2001. Essential Entomology. Pp. 323. Oxford University Press. • Schoonhoven, L. M., v. Loon, J. J. A. & Dicke, M. 2008. Insect-Plant Biology, 2nd. ed. Pp. 421. Oxford University Press. • Daly, H. V., Doyen, J. T. & Purcell, A. H. 2014. Introduction to insect Biology and Diversity. Oxford University Press. **3223372 – Insect Diversity Assessment (LÜ)** • McGavin, G. C. 2001. Essential Entomology. Pp. 323. Oxford University Press. • Schoonhoven, L. M., v. Loon, J. J. A. & Dicke, M. 2008. Insect-Plant Biology, 2nd. ed. Pp. 421. Oxford University Press. • Daly, H. V., Doyen, J. T. & Purcell, A. H. 2014. Introduction to insect Biology and Diversity. Oxford University Press. **3223291 – Diversity of Angiosperms (V)** will be announced in the respective course. **3223292 – Diversity of Angiosperms (LÜ)** will be announced in the respective course.
13	**Use of the module or related courses (in other study programmes)** B.Ed. Biologie B.Sc. BioGeoWissenschaften (20187) M.Ed. BBS Biologie (20106) M.Ed. Gym Biologie KO (20103) M.Sc. BioGeoWissenschaften Koblenz (20187) M.Sc. Life Science (XXXXX)
14	**Other information** Other courses in the field of biodiversity may be recognised, provided they consist of a lecture and a practical component with the same number of ECTS credits. Prior consultation with the module coordinator is essential.

Module 09 – Ecophysiology and ecosystem services of aquatic microorganisms

6 Credit points (CP)
Compulsory module

03BI2344

Work load	**Study semester**	**Duration**
180 h	2nd semester (recommended)	1 semester

1	**Courses**				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	9.1	V	Ecophysiology and ecosystem services of aquatic microorganisms	3223441	compulsory	2 SWS 30 h	60 h	30	3
	9.2	Ü	Ecophysiology and ecosystem services of aquatic microorganisms	3223442	compulsory	2 SWS 30 h	60 h	30	3

2 **Learning outcomes / competences**

3223441 – Ecophysiology and ecosystem services of aquatic microorganisms (V)

The students

- have profound knowledge on the ecophysiological traits of aquatic microorganisms;
- are able to explain the role microorganisms play in ecosystem functioning and the provision of ecosystem services in aquatic systems;
- are in the position to consider ecophysiological potentials and metabolic power of microorganisms with respect to applied problem solving;
- are able to grasp the significance of microbial activity in scope of governmental activities and the definition of guideline values and quality targets.

3223442 – Ecophysiology and ecosystem services of aquatic microorganisms (Ü)

The students

- have the skill to present orally and in writing the results of scientific studies (including analysis and prognoses);
- are capable to discuss in a factual and professional manner and to express constructive criticism;
- are able to evaluate and to revise their own work by means of discussion and by considering comments and recommendations made by peers and instructors.

3 **Contents**

3223441 – Ecophysiology and ecosystem services of aquatic microorganisms (V)

Ecophysiological traits of microorganisms and the provided ecosystem services result from the adaption to specific environmental conditions. This course imparts extended and in-depth knowledge concerning these phenomena. The relationship between ecophysiology and metabolic performance and its impact on the environment and ecosystem services are demonstrated using

	selected examples such as: • microorganisms of the nitrogen cycle and the transformation of nitrogen compounds in aquatic ecosystems and waste water treatment plants; • the role of bacteria for the production and treatment of drinking water; • microbial degradation of natural biopolymers and organic (micro)pollutants; • extracellular electron transport and its importance for metabolic turnover and element cycling; • horizontal gene transfer and the spread of (resistance) genes. **3223442 – Ecophysiology and ecosystem services of aquatic microorganisms (Ü)** The students are instructed to work on a specific problem within the field of ecophysiology and ecosystem services in a scientifically sound and valid manner, to prepare a presentation and to revise it in a process similar to peer reviewing of scientific publications. The course includes: • the independent elaboration of a specific topic based on a scientific publication (in small groups); • the preparation of a presentation and acquisition of knowledge relevant for the discussion of the selected topic (in small groups); • presentation and discussion of the works within the whole group; • a revision based on comments expressed in discussions and a subsequent final presentation.
4	**Frequency of the course** only summer semester **3223441 – Ecophysiology and ecosystem services of aquatic microorganisms (V** only summer semester **3223442 – Ecophysiology and ecosystem services of aquatic microorganisms (Ü)** only summer semester
5	**Teaching language** **3223441 – Ecophysiology and ecosystem services of aquatic microorganisms (V)** English **3223442 – Ecophysiology and ecosystem services of aquatic microorganisms (Ü)** English
6	**Requirements for participation** none
7	**Types of examination** **3223441 – Ecophysiology and ecosystem services of aquatic microorganisms (V)** Partial module examination (Modulteilprüfung): written examination (Klausur) (45 Minuten) **3223442 – Ecophysiology and ecosystem services of aquatic microorganisms (Ü)** Partial module examination (Modulteilprüfung): oral examination (mündliche Prüfung) (30 Minuten)
8	**Requirements for the awarding of credit points**

	passing the partial module examinations
9	**Importance for the final grade** 6/120
10	**Module coordinator** Prof. Dr. Werner Manz
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **3223441 – Ecophysiology and ecosystem services of aquatic microorganisms (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **3223442 – Ecophysiology and ecosystem services of aquatic microorganisms (Ü)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department
12	**Literature** **3223441 – Ecophysiology and ecosystem services of aquatic microorganisms (V)** • Allan, Castillo (2007) Stream Ecology. Springer, Dordrecht • Fuchs (Hrsg.) (2017) Allgemeine Mikrobiologie. Thieme, Stuttgart • Madigan, Martinko, Stahl, Clark (2013) Brock Mikrobiologie. Pearson Studium, München • Maier, Pepper, Gerba (2009) Environmental Microbiology. Academic Press Elsevier, London Further literature will be provided at the beginning of each course. **3223442 – Ecophysiology and ecosystem services of aquatic microorganisms (Ü)** • Allan, Castillo (2007) Stream Ecology. Springer, Dordrecht • Fuchs (Hrsg.) (2017) Allgemeine Mikrobiologie. Thieme, Stuttgart • Madigan, Martinko, Stahl, Clark (2013) Brock Mikrobiologie. Pearson Studium, München • Maier, Pepper, Gerba (2009) Environmental Microbiology. Academic Press Elsevier, London Further literature will be provided at the beginning of each course.
13	**Use of the module or related courses (in other study programmes)** M.Sc. BioGeoWissenschaften (20187) M.Sc. Gewässerkunde und Wasserwirtschaft (20223) M.Sc. Life Science (XXXXX)
14	**Other information** -

6.1.3 Compulsory Module 'Research Project' (15 CP)

Module 10 – Research Project **03XX2710**								15 Credit points (CP) Compulsory module
Work load 450 h	**Study semester** 3rd semester (recommended)					**Duration** 1 semester		
1	**Courses**			**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	10.1	P	Research Project	3327101	compulsory	0 SWS 0 h	420 h	1	14
	10.2	S	Seminar	3327102	compulsory	1 SWS 15 h	15 h	5	1
2	**Learning outcomes / competences** **3327101 – Research Project (P)** The students • have the ability to work herself/himself into a scientific field in a given time under professional guidance; • they are able to reflect and classify the results into the status of knowledge and can document the results in English; • are able to achieve, adapt and apply scientific results; • improve their communication abilities and other social competences by means of teamwork, group discussions and presentations. **3327102 – Seminar (S)** The students • have the ability to work herself/himself into a scientific field in a given time under professional guidance. • are able to reflect and classify the results into the status of knowledge and can document the results in English.								
3	**Contents** **3327101 – Research Project (P)** • knowing about scientific methods for acquiring, assessing and presenting knowledge • the project seminar offers insight into scientific work • awareness of relevant questions of the subject • awareness of relevant publications of the subject								

	3327102 – Seminar (S) • Knowing about scientific methods for acquiring, assessing and presenting knowledge • The project seminar offers insight into scientific work • Awareness of relevant questions of the subject • Awareness of relevant publications of the subject
4	**Frequency of the course** Every semester **3327101 – Research Project (P)** every semester **3327102 – Seminar (S)** every semester
5	**Teaching language** **3327101 – Research Project (P)** English **3327102 – Seminar (S)** English
6	**Requirements for participation** none
7	**Types of examination** **3327101 – Research Project (P)** Module examination (Modulprüfung): written term paper (Hausarbeit), duration: four weeks. The term paper (Hausarbeit) addresses the project work, including the results and their classification in scientific discourse. The number of pages of the term paper depends on the chosen task and will be determined in discussion with the responsible examiner. **3327102 – Seminar (S)** Coursework (Studienleistung): presentation (Vortrag) (20 min)
8	**Requirements for the awarding of credit points** passing the exam (written term paper and presentation)
9	**Importance for the final grade** 15/120
10	**Module coordinator** Prof. Dr. Marie-T. Hopp
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology

	Department Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3327101 – Research Project (P)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3327102 – Seminar (S)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department
12	**Literature** Will be announced in the respective courses
13	**Use of the module or related courses (in other study programmes)** M.Sc. Life Science (XXXXX)
14	**Other information** The project work can be carried out in all areas of "Environmental Life Science" or “Molecular and Biomedical Life Science”, but also in industry or external research institutes, as long as a supervisor of the University Koblenz takes over the supervision.

6.1.4 Compulsory Module 'Master Thesis' (30 CP)

Module 11 – Master Thesis **03XX2711**								30 Credit points (CP) Compulsory module
Work load 900 h	**Study semester** 4th semester (recommended)					**Duration** 1 semester		
1	**Courses**			**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	11.1	A	Master Thesis	3327111	compulsory	0 SWS 0 h	810 h	1	27
	11.2	A	Final Oral Examination	3327112	compulsory	0 SWS 0 h	90 h	1	3
2	**Learning outcomes / competences** **3327111 – Master Thesis (A)** The students • can independently handle a scientific question under expert guidance • master the principles of scientific working and publishing • can write a paper about the results obtained. **3327112 – Final Oral Examination (A)** The students • present the knowledge gained in a form appropriate to the subject • defend the master thesis in a discussion • master the principles of scientific work and presentation								
3	**Contents** **3327111 – Master Thesis (A)** The aim of the master's thesis is to show that candidates are able to work on a defined biological or chemical problem related to Life Sciences by scientific methods within a set deadline. Here the means of the solution as well as the solution itself are to be presented and interpreted in an understandable and correct way. The master thesis can only be issued when the project work has been completed successfully. The Examining Board may allow exceptions in special cases. The candidate must complete a subject-related topic within a set time frame. Candidates are expected to have the ability to largely independently deliver scientific results, to identify and solve any problems that arise, to critically evaluate and classify them according to their								

	level of knowledge and in an appropriate manner appropriate to the subject form to document and present the results in writing. **3327112 – Final Oral Examination (A)** The oral final examination completes the master programme. The candidate must present and discuss the results of the master thesis in the oral final examination in an appropriate manner.
4	**Frequency of the course** Every semester **3327111 – Master Thesis (A)** every semester **3327112 – Final Oral Examination (A)** every semester
5	**Teaching language** **3327111 – Master Thesis (A)** English **3327112 – Final Oral Examination (A)** English
6	**Requirements for participation** **3327111 – Master Thesis (A)** Admission to the Master thesis is granted to those who • have acquired at least 80 LP and • have agreed the provisional topic for a Master's thesis with a supervisor. **3327112 – Final Oral Examination (A)** Passing the Master thesis (03XX2490) according to § 24 of the "Rahmenprüfungsordnung der Universität Koblenz"
7	**Types of examination** **3327111 – Master Thesis (A)** In accordance with § 24 of the "Rahmenprüfungsordnung der Universität Koblenz" and the appendix "Life Science" to the uk-Master-Prüfungsordnung "Life Science" (written thesis/Masterarbeit, duration: 20 weeks). The number of pages of the thesis depends on the chosen task and will be determined in discussion with the responsible examiner. **3327112 – Final Oral Examination (A)** Presentation and scientific discussion of the results of the Master thesis according to the appendix "Life Science" of the uk-Master-Prüfungsordnung "Life Science" (oral presentation and scientific discussion, 30 min.)

8	**Requirements for the awarding of credit points** **3327111 – Master Thesis (A)** Submission of the Master thesis to a reasonable extent in German or English after a processing period of 20 weeks **3327112 – Final Oral Examination (A)** Passing the final oral examination
9	**Importance for the final grade** 30/120
10	**Module coordinator** Prof. Dr. Wolfgang Imhof
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3327111 – Master Thesis (A)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3327112 – Final Oral Examination (A)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department
12	**Literature** Will be announced in the respective courses
13	**Use of the module or related courses (in other study programmes)** M.Sc. Life Science (XXXXX)

14	**Other information** **3327111 – Master Thesis (A)** The Master thesis can be carried out in all areas of compulsory or elective modules, as well as in industry or external research institutes in Germany and abroad, as far as a supervisor of the University Koblenz takes over the supervision.

6.2 Elective section

6.2.1 Compulsory elective module 'Advances in Life Science' (15 CP)

The compulsory elective module 'Advances in Life Science' (15 CP) consists of modules from the departments of the Institute for Integrated Natural Sciences, the Mathematical Institute and the Institute of Sports Science. In the elective modules, it is possible to choose both modules in English or German in order to enable a pathway in English only through the Master degree programme and to support the acquisition of German language skills for a qualification in the German labour market.

<table>
<tr><td colspan="9">Module 12 – Parasitology

03BI2712

6 Credit points (CP)
Elective module</td></tr>
<tr><td colspan="3">Work load

180 h</td><td colspan="4">Study semester

2nd/3rd Semester (recommended)</td><td colspan="2">Duration

2 semesters</td></tr>
<tr><td>1</td><td colspan="3">Courses</td><td>Compulsory/ elective</td><td>Contact time</td><td>Self-study</td><td>Planned group size</td><td>CP</td></tr>
<tr><td></td><td>12.1</td><td>VÜ</td><td>Human Parasitology & Infection Biology</td><td>32110832</td><td>compulsory</td><td>2 SWS
30 h</td><td>60 h</td><td>30</td><td>3</td></tr>
<tr><td></td><td>12.2</td><td>VÜ</td><td>Ecological Parasitology</td><td>33110832</td><td>compulsory</td><td>2 SWS
30 h</td><td>60 h</td><td>30</td><td>3</td></tr>
<tr><td>2</td><td colspan="8">Learning outcomes / competences

32110832 – Human Parasitology & Infection Biology (VÜ)
The students will be familiarized with the most important infectious agents of humans and their companion animals. The focus is on parasites. Using selected microorganisms relevant to humans, students will gain a solid overview of human parasitology and infection biology in order to develop an understanding of morphology, the route of infection (chain of infection), and the prevention of infectious agents in the context of clinical relevance and diagnostic procedures (again focus on parasites). From this, host-parasite relationships will be derived. In particular, host-pathogen interactions and the morphology of the pathogens are of utmost importance.

33110832 – Ecological Parasitology (VÜ)
The students will be familiarized with the most important infectious agents of humans and their companion animals. The focus is on parasites. Using selected microorganisms, students will gain a solid overview of ecoparasitology in order to develop an understanding of the ecological significance, morphology and route of infection (chain of infection), again with focus on parasites in their natural environment). Particular emphasis will be provided on host-parasite-</td></tr>
</table>

	environment relationships, including the influence of environmental changes.
3	**Contents** **32110832 – Human Parasitology & Infection Biology (VÜ)** • introduction in "parasitology and infection biology" • domestic animals as a source of human parasites (zoonoses) • malaria parasites and other blood parasites • intestinal parasites (helminths and protozoa) • manipulation by parasites • water – associated infectious diseases (climate/water management) • free-living amoebae as pathogens and vectors of pathogens • parasite-host interactions • lice – truth and myth • ticks, insects, and rodents as vectors and reservoirs • and/or other relevant topics **33110832 – Ecological Parasitology (VÜ)** • introduction in "ecological parasitology" • water and health: Biodiversity in free-living amoebae • water and health: Fish parasites and aquaculture • water and health: Water-associated parasites and other infectious pathogens • water and health: Schistosomes • why simple when you can make it complex? Diverse life cycles of parasites • bark beetles as plant pests • parasitism, a recipe for success in nature • and/or other relevant topics
4	**Frequency of the course** summer and winter semester **32110832 – Human Parasitology & Infection Biology (VÜ)** only summer semester **33110832 – Ecological Parasitology (VÜ)** only winter semester
5	**Teaching language** **32110832 – Human Parasitology & Infection Biology (VÜ)** English **33110832 – Ecological Parasitology (VÜ)** English
6	**Requirements of participation** none

7	**Types of examination** **32110832 – Human Parasitology & Infection Biology (VÜ)** Partial module examination (Modulteilprüfung): written exam (Klausur) (60 min) **33110832 – Ecological Parasitology (VÜ)** Partial module examination (Modulteilprüfung): written exam (Klausur) (60 min)
8	**Requirements for the awarding of credit points** Passing the written exams.
9	**Importance for the final grade** 6/120
10	**Module coordinator** apl. Prof. Dr. Patrick Scheid
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **32110832 – Human Parasitology & Infection Biology (VÜ)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **33110832 – Ecological Parasitology (VÜ)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department
12	**Literature** Will be announced in the respective course.
13	**Use of the module or related courses (in other study programmes)** M.Sc. Life Science (XXXXX) B.Ed. Biologie KO (20111) M.Ed. Gym Biologie KO (20103) B.Sc. BioGeoWissenschaften Koblenz (20125) B.Sc. BioGeoWissenschaften Koblenz (20187) M.Sc. BioGeoWissenschaften Koblenz (20125) M.Sc. BioGeoWissenschaften Koblenz (20187)

14	**Other information** The lectures will provide an overview in Parasitology. They may be optionally supplemented and combined with **microscopic analyses** (practical part) of various endo- and ectoparasites from a collection. It includes parasites of humans and animals. **Short presentations**, given by the **participants,** are also optional and may complement the event (topics will be announced before the event or at the first lecture (introductionary lecture)

Module 13 – Conservation Biology

6 Credit points (CP)
Elective module

03BI2328

Work load	**Study semester**	**Duration**
180 h	2nd semester (recommended)	1 semester

1	**Courses**				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	13.1	V	Conservation Biology	3223281	compulsory	2 SWS 30 h	60 h	30	3
	13.2	S	Conservation Biology	3223282	compulsory	2 SWS 30 h	60 h	30	3

2 **Learning outcomes / Competences**

3223281 – Conservation Biology (L)

The students

- gain in-depth knowledge in the field of conservation biology and associated challenges

3223282 – Conservation Biology (S)

The students

- are able to critically reflect primary scientific literature in the context of conservation biology and to summarize the key findings within a scientific presentation.

3 **Contents**

3223281 – Conservation Biology (L)

- introduction to conservation biology
- threats to biodiversity
- habitat degradation, loss, and fragmentation
- habitat fragmentation
- overexploitation
- invasive species
- biological impacts of climate change
- conservation genetics
- species and landscape approaches to conservation
- goals, limitations, and design of protected areas
- corridors in conservation biology

3223282 – Conservation Biology (S)

- reading and discussing primary scientific literature in the context of conservation biology
- giving a scientific presentation on selected topics within the field of conservation biology

4	**Frequency of the course** only summer semester **3223281 – Conservation Biology (L)** only summer semester **3223282 – Conservation Biology (S)** only summer semester
5	**Teaching language** **3223281 – Conservation Biology (L)** English **3223282 – Conservation Biology (S)** English
6	**Requirements for participation** none
7	**Types of examination** Module examination (Modulprüfung): written exam (Klausur) (60 min)
8	**Requirements for the awarding of credit points** passing the exam
9	**Importance for the final grade** 6/120
10	**Module coordinator** Prof. Dr. Klaus Fischer
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **3223281 – Conservation Biology (L)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **3223282 – Conservation Biology (S)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department

12	**Literature** • Groom, Meffe, Carroll: Principles of Conservation Biology, Sinauer Associates Inc. • Pullin: Conservation Biology. Cambridge • Primack: Essentials in Conservation Biology. Sinauer Associates Inc.
13	**Use of the module or related courses (in other study programmes)** M.Sc. BioGeoWissenschaften Koblenz (20125) M.Sc. BioGeoWissenschaften Koblenz (20187) M.Sc. Life Science (XXXXX)
14	**Other information** -

Module 14 – Global Change Ecology 3 Credit points (CP)
Elective module

03BI2713

Work load	**Study semester**	**Duration**
90 h	3rd semester (recommended)	1 semester

	Courses				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	14.1	S	Global Change Ecology	3223382	compulsory	2 SWS 30 h	60 h	30	3

2 **Learning outcomes / Competences**

3223382 – Global Change Ecology (S)

The students

- are familiar with the field of global change ecology, its theory, and methodology
- can explain how global change affects various ecological systems
- think critically about scientific research in the field of global change

3 **Contents**

3223382 – Global Change Ecology (S)

- effects of global change (e.g., climate change, urbanization, deforestation, etc.) on organisms, ecosystems, ecological processes and communities

4 **Frequency of the course**

only winter semester

3223382 – Global Change Ecology (S)

only winter semester

5 **Teaching language**

3223382 – Global Change Ecology (S)

English

6 **Requirements for participation**

none

7 **Types of examination**

3223382 – Global Change Ecology (S)

Module examination (Modulprüfung): oral exam (mündliche Prüfung) in the form of a presentation (Vortrag) (20 min)

8	**Requirements for the awarding of credit points** successful oral presentation
9	**Importance for the final grade** 3/120
10	**Module coordinator** Prof. Dr. Klaus Fischer
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **3223382 – Global Change Ecology (S)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department
12	**Literature** Will be announced in the respective course.
13	**Use of the module or related courses (in other study programmes)** M.Sc. Life Science (XXXXX)
14	**Other information** Consultation on the work with the supervisor before the presentation is compulsory.

Module 15 – Freshwater Ecology 6 Credit points (CP)
Elective module

03BI2348

Work load	**Study semester**	**Duration**
180 h	2nd semester (recommended)	1 semester

1	**Courses**				**Compulsory/ elective**	**Contact time**	**Self study**	**Planned group size**	**CP**
	15.1	V	Concepts of Stream Ecology	3223431	compulsory	2 SWS 30 h	60 h	30	3
	15.2	S	Literature Seminar	3223433	compulsory	2 SWS 30 h	60 h	30	3

2 **Learning outcomes / Competences**

3323431 – Concepts of Stream Ecology (V)

The students

- understand the structure and function of freshwater ecosystems
- possess in-depth biological and ecological knowledge
- are able to apply biological and ecological knowledge to stream ecosystems
- understand the interaction of environmental factors and organisms in stream ecosystems
- understand nutrient cycles in stream ecosystems
- are able to identify and assess the impact of anthropogenic altered environmental factors on aquatic ecosystems

3323433 – Literature Seminar (S)

The students

- are capable to search and select relevant scientific literature regarding specific topics
- have the skill to understand and critically assess the results in scientific papers
- are capable to present complex scientific contents clearly, logically, and comprehensible
- are able to critically discuss the presented contents based on their own and their peer's lectures

3 **Contents**

3323431 – Concepts of Stream Ecology (V)

- structure and function of stream ecosystems
- concepts of ecological processes and interactions
- specific methods in stream ecology
- anthropogenic impacts and their remediation

3323433 – Literature Seminar (S)

- structure and function of stream ecosystems

	• concepts of ecological processes and interactions • specific methods in stream ecology • anthropogenic impacts and their remediation
4	**Frequency of the course** only summer semester **3323431 – Concepts of Stream Ecology (V)** only summer semester **3323433 – Literature Seminar (S)** only summer semester
5	**Teaching language** **3323431 – Concepts of Stream Ecology (V)** English **3323433 – Literature Seminar (S)** English
6	**Requirements for participation** none
7	**Types of examination** **3323431 – Concepts of Stream Ecology (V)** Coursework (Studienleistung): written exam (Klausur), 45 min. **3323433 – Literature Seminar (S)** Module examination: written term paper (Hausarbeit), duration: 2 weeks. The number of pages of the term paper depends on the chosen task and will be determined in discussion with the responsible examiner.
8	**Requirements for the awarding of credit points** **3323431 – Concepts of Stream Ecology (V)** passing the written exam **3323433 – Literature Seminar (S)** passing the written term paper
9	**Importance for the final grade** 6/120
10	**Module coordinator** Prof. Dr. Kenneth Dumack

11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **3323431 – Concepts of Stream Ecology (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department **3323433 – Literature Seminar (S)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Biology Department
12	**Literature** **3323431 – Concepts of Stream Ecology (V)** • Lampert & Sommer 2007 Limnoecology: The Ecology of Lakes and Streams, 2. Auflage, Oxford University Press • Moss (2010) Ecology of Fresh Waters: A View for the Twenty-First Century, 4th Edition, Wiley-Blackwell **3323433 – Literature Seminar (S)** Further literature will be provided within the seminar.
13	**Use of the module or related courses (in other study programmes)** M.Sc. Life Science (XXXXX) M.Sc. BioGeoWissenschaften Koblenz (20125) M.Sc. BioGeoWissenschaften Koblenz (20187) M.Sc. Gewässerkunde und Wasserwirtschaft (20233)
14	**Other information** -

Module 16 – Sustainable Functional Materials 6 Credit points (CP)
Elective module

03CH2404

Work load	**Study semester**	**Duration**
180 h	1st/2nd semester (recommended)	2 semesters

1	**Courses**				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	16.1	V	Sustainable Synthesis and Processing of Materials	3324041	compulsory	2 SWS 30 h	60 h	30	3
	16.2	V	Materials for Energy Storage and Conversion	3324042	compulsory	2 SWS 30 h	60 h	30	3

2 **Learning outcomes / Competences**

3324041 – Sustainable Synthesis and Processing of Materials (V)

The students

- know basic ideas, fundamental principles and methods of solid state chemistry
- understand material production strategies and technologies on the basis of green chemistry descriptors
- are able to recognise, describe and elaborate sustainability aspects in different material fabrication procedures
- become familiar with the language of condensed matter and key theories and concepts.

3324042 – Materials for Energy Storage and Conversion (V)

The students

- know basic ideas, fundamental principles and methods of defect chemistry and electrochemistry
- are able to recognise and describe structural and functional properties of materials and indicate their role in respective energy-related applications
- understand energy storage and conversion technologies and their underlying working principles
- become familiar with the language of electrochemistry and key theories and concepts.

3 **Contents**

3324041 – Sustainable Synthesis and Processing of Materials (V)

- green chemistry synthesis methods of functional materials (e.g. hydrothermal synthesis)
- sintering and green sintering procedures
- raw materials
- recycling strategies
- net zero strategies in the chemical industry (e.g. CO_2 footprint reduction)

	3324042 – Materials for Energy Storage and Conversion (V) • concepts of solid state electrochemistry (defect chemistry, ionic and electronic transport in solids) • Li- and post Li-ion batteries • hydrogen storage materials • fuel cells and power-to-X devices • solar to fuel devices
4	**Frequency of the course** **3324041 – Sustainable Synthesis and Processing of Materials (V)** only winter semester **3324042 – Materials for Energy Storage and Conversion (V)** only summer semester
5	**Teaching language** **3324041 – Sustainable Synthesis and Processing of Materials (V)** English **3324042 – Materials for Energy Storage and Conversion (V)** English
6	**Requirements for participation** none
7	**Types of examination** **3324041 – Sustainable Synthesis and Processing of Materials (V)** Partial module examination (Modulteilprüfung): written exam (Klausur) (45 min) **3324042 – Materials for Energy Storage and Conversion (V)** Partial module examination (Modulteilprüfung): oral exam (mündliche Prüfung) (20 min)
8	**Requirements for the awarding of credit points** **3324041 – Sustainable Synthesis and Processing of Materials (V)** passing the partial module examination **3324042 – Materials for Energy Storage and Conversion (V)** passing the partial module examination
9	**Importance for the final grade** 6/120

10	**Module coordinator** Prof. Dr. Simone Mascotto
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3324041 – Sustainable Synthesis and Processing of Materials (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department **3324042 – Materials for Energy Storage and Conversion (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Chemistry Department
12	**Literature** Will be announced in the respective course.
13	**Use of the module or related courses (in other study programmes)** M.Sc. Material Science (20242) M.Sc. Life Science (XXXXX)
14	**Other information** -

Modul 17 – Ökologische Gewässerbewertung

6 Leistungspunkte (LP)
Wahlpflichtmodul

03BI2341

Workload	**Studiensemester**	**Dauer**
180 h	1./2. Semester (empfohlen)	2 Semester

1	**Lehrveranstaltungen**				**Pflicht/Wahl-pflicht**	**Kontaktzeit**	**Selbststudium**	**geplante Gruppengröße**	**LP**
	17.1	Ü	Bestimmungsübungen	3223411	Pflicht	2 SWS 30 h	60 h	30	3
	17.2	FÜ	Gewässerbewertung	3223412	Pflicht	2 SWS 30 h	60 h	30	3

2 **Lernergebnisse / Kompetenzen**

3223411 – Bestimmungsübungen (Ü)

Die Studierenden

- erlangen vertiefte taxonomische und ökologische Kenntnisse aquatischer Tiergruppen sowie praktische Fähigkeiten auf dem Gebiet der Bestimmung.

3223412 – Gewässerbewertung (FÜ)

Die Studierenden

- sind in der Lage die ökologische Qualität von Fließgewässern entsprechend der Vorgaben der Wasserrahmenrichtlinie zu erfassen und die Ergebnisse zu interpretieren.

3 **Inhalte**

3223411 – Bestimmungsübungen (Ü)

- Bestimmung invertebrater Wasserorganismen (Makrozoobenthos), Autökologische Charakterisierung behandelter Tiergruppen.

3223412 – Gewässerbewertung (FÜ)

- Durchführung von Strukturgütekartierung, Auswertung der Kartierungsergebnisse
- Durchführung der Gewässerbewertung der Qualitätskomponente Makrozoobenthos, Auswertung und Interpretation der Ergebnisse

4 **Häufigkeit des Angebots**

ab Wintersemester

3223411 – Bestimmungsübungen (Ü)

nur im Wintersemester

	3223412 – Gewässerbewertung (FÜ) nur im Sommersemester
5	**Lehrsprache** **3223411 – Bestimmungsübungen (Ü)** Deutsch **3223412 – Gewässerbewertung (FÜ)** Deutsch
6	**Teilnahmevoraussetzungen** keine
7	**Prüfungsformen** **3223411 – Bestimmungsübungen (Ü)** Modulprüfung: Ökologische Gewässerbewertung als Gruppenprüfung (praktisch - 90 Min.) **3223412 – Gewässerbewertung (FÜ)** Prüfungsrelevante Studienleistung: Dokumentation/Bericht mit praktischer Prüfung (Einzelprüfung) (Kombination) in Form einer Versuchsvorbereitung, -durchführung und -auswertung aller Versuche (schriftlich und praktisch – Dauer: 2 Wochen). Der Umfang der schriftlichen Auswertung ist abhängig von der gewählten Aufgabenstellung und wird im Gespräch mit der begutachtenden Person festgelegt.
8	**Voraussetzungen für die Vergabe von Leistungspunkten** **3223411 – Bestimmungsübungen (Ü)** Bestehen der Modulprüfung **3223412 – Gewässerbewertung (FÜ)** Bestehen der prüfungsrelevanten Studienleistung
9	**Stellenwert für die Endnote** 6/120
10	**Modulbeauftragte*r** PD Dr. Carola Winkelmann (Bundesanstalt für Gewässerkunde - BfG)
11	**Verantwortliche Einrichtung** FB 3: Mathematik / Naturwissenschaften, Institut für Integrierte Naturwissenschaften, Abteilung Biologie, Bundesanstalt für Gewässerkunde – BfG **3223411 – Bestimmungsübungen (Ü)** FB 3: Mathematik / Naturwissenschaften, Institut für Integrierte Naturwissenschaften, Abteilung Biologie, Bundesanstalt für Gewässerkunde - BfG

	3223412 – Gewässerbewertung (FÜ) FB 3: Mathematik / Naturwissenschaften, Institut für Integrierte Naturwissenschaften, Abteilung Biologie, Bundesanstalt für Gewässerkunde - BfG
12	**Literatur** wird in der Veranstaltung bekannt gegeben.
13	**Verwendung des Moduls oder dazugehöriger Lehrveranstaltungen (in anderen Studiengängen)** M.Sc. BioGeoWissenschaften Koblenz (20125) M.Sc. BioGeoWissenschaften Koblenz (20187) B.Sc. Gewässerkunde und Wasserwirtschaft (20233) M.Sc. Life Science (XXXXX)
14	**Sonstige Informationen** **3223412 - Gewässerbewertung (FÜ)** Blockveranstaltung im Sommersemester

Modul 18 – Ökotoxikologie 5 Leistungspunkte (CP)
Wahlpflichtmodul

03XX2602

Workload	**Studiensemester**	**Duration**
150 h	1. Semester (empfohlen)	1 Semester

1	**Lehrveranstaltungen**				**Pflicht/ Wahlpflicht**	**Kontaktzeit**	**Selbststudium**	**Geplante Gruppengröße**	**CP**
	5.1	V	Ökotoxikologie	3213211	Pflicht	2 SWS 30 h	60 h	30	3
	5.2	S	Ökotoxikologie	3926022	Pflicht	1 SWS 15 h	45 h	30	2

2 **Lernergebnisse / Kompetenzen**

3213211 – Ökotoxikologie (V)

Die Studierenden

- sind in der Lage, für neue anwendungs- oder forschungsorientierte Aufgabenstellungen im Bereich der Ökotoxikologie geeignete fachbezogene Ziele unter Berücksichtigung gesellschaftlicher, wirtschaftlicher und kultureller Auswirkungen zu definieren;
- können geeignete Methoden zur ökotoxikologischen Risikobewertung selbständig auswählen und fachspezifische Informationen analysieren;
- sind in der Lage, ökotoxikologisches Wissen anzuwenden und in neue Methoden und Modelle zu überführen;
- verfügen über vertiefte Kenntnisse über direkte und indirekte Effekte anthropogener Umweltschadstoffe auf allen biologischen Ebenen eines Ökosystems und deren regulatorischer Bewertung;
- können biologische Wirkungen von Umweltschadstoffen und der Pfade ihrer Verbreitung in Ökosystemen einordnen;
- können komplexe Zusammenhänge in der Ökotoxikologie vom molekularen Wirkmechanismus zur Wirkung auf Organismen und Populationen erfassen;
- lernen biologische und ökotoxikologische Untersuchungsmethoden und Standardprüfverfahren kennen und verstehen;
- verstehen die Terminologie der Ökotoxikologie und sind in der Lage, diese professionell anzuwenden;
- verstehen die Prinzipien der ökotoxikologischen Risikobewertung und der regulatorischen Risikobewertung.

3926022 – Ökotoxikologie (S)

Die Studierenden

- können mit Hilfe von Beispielstudien aus der Literatur und anhand von realen Analyseergebnissen ökotoxikologische Daten auswerten, darstellen und interpretieren;

	• können die komplexen Zusammenhänge zwischen molekularen Wirkmechanismen von Schadstoffen und den ökotoxikologisch relevanten Effekten auf der Populations- und Lebensgemeinschaftsebene bestimmen; • können die Darstellung von ökotoxikologischen Forschungsergebnissen im Rahmen eines Vortrags einem Fachpublikum präsentieren; • sind in der Lage, ökotoxikologische Forschungsergebnisse gesellschaftlich und regulatorisch einzuordnen.
3	**Inhalte** **3213211 – Ökotoxikologie (V)** • Umweltschadstoffe, die Pfade ihrer Verbreitung und die durch sie vermittelten ökotoxikologischen Auswirkungen auf verschiedene Ebenen von Ökosystemen; • Darstellung komplexer Zusammenhänge in der Ökotoxikologie von molekularen Wirkmechanismen bis zur Wirkung auf Organismen und Populationen. **3926022 – Ökotoxikologie (S)** • Literatur- und Datenbankrecherche zu Umweltschadstoffen und deren ökotoxikologischen Wirkungen; • Auswertung, Darstellung und Interpretation von fiktiven oder realen experimentellen Daten aus klassischen und spezifischen, einschließlich molekularen, Prüfmethoden.
4	**Häufigkeit des Angebots** nur im Wintersemester **3213211 – Ökotoxikologie (V)** nur im Wintersemester **3926022 – Ökotoxikologie (S)** nur im Wintersemester
5	**Lehrsprache** **3213211 – Ökotoxikologie (V)** Deutsch **3926022 – Ökotoxikologie (S)** Deutsch
6	**Teilnahmevoraussetzungen** keine
7	**Prüfungsformen** **3213211 – Ökotoxikologie (V)** Modulprüfung: schriftliche Klausur (90 min) **3926022 – Ökotoxikologie (S)** Studienleistung: Seminarvortrag (10-15 min)

8	**Voraussetzung für die Vergabe von Leistungspunkten** **3213211 – Ökotoxikologie (V)** Bestehen der Modulprüfung **3926022 – Ökotoxikologie (S)** Bestehen der Studienleistung
9	**Stellenwert der Note für die Endnote** 5/120
10	**Modulbeauftragte*r** Dr. Martina Fenske (Bundesanstalt für Gewässerkunde - BfG)
11	**Verantwortliche Einrichtung** Fachbereich 3: Mathematik / Naturwissenschaften, Institut für Integrierte Naturwissenschaften, Abteilung Biologie, Bundesanstalt für Gewässerkunde - BfG **3213211 – Ökotoxikologie (V)** Fachbereich 3: Mathematik / Naturwissenschaften, Institut für Integrierte Naturwissenschaften, Abteilung Biologie, Bundesanstalt für Gewässerkunde - BfG **3926022 – Ökotoxikologie (S)** Fachbereich 3: Mathematik / Naturwissenschaften, Institut für Integrierte Naturwissenschaften, Abteilung Biologie, Bundesanstalt für Gewässerkunde - BfG
12	**Literatur** • Campbell PGC, Hodson PV, Welbourn PM & Wright DA (eds.) (2022). Ecotoxicology. Cambridge: Cambridge University Press. • C.A.M. Van Gestel, F.G.A.J. Van Belleghem, N.W. Van den Brink, S.T.J. Droge, T. Hamers, J.L.M. Hermens, M.H.S. Kraak, A.J. Löhr, J.R. Parsons, A.M.J. Ragas, N.M. Van Straalen, M.G. Vijver (Eds.) 2019: Environmental toxicology, an open online textbook. https://maken.wikiwijs.nl/147644/Environmental_Toxicology__an_open_online_textbook • Hauser-Davis, R.A., & Parente, T.E. (Eds.). (2018). Ecotoxicology: Perspectives on Key Issues (1st ed.). CRC Press. https://doi.org/10.1201/b21896 • Fent, K. 2013 Ökotoxikologie. Thieme, Stuttgart, 4. Aufl. • C.H. Walker, R.M. Sibly, S.P. Hopkin, D.B. Peakall, 2012. Principles of Ecotoxicology. 4th Edition, CRC Press. • B. Streit, 1994. Lexikon der Ökotoxikologie. 2. Auflage, Wiley-VCH. Weitere Literatur wird in den betreffenden Veranstaltungen bekannt gegeben.
13	**Verwendung des Moduls oder dazugehöriger Lehrveranstaltungen (in anderen Studiengängen)** B.Sc. Angewandte Naturwissenschaften (20181) B.Sc. BioGeoWissenschaften (20187) M.Ed. Gym Biologie (20103)

	M.Sc. Gewässerkunde und Wasserwirtschaft (20221) M.Sc. Life Science (XXXXX)
14	**Sonstige Informationen** Das Seminar findet in der Bundesanstalt für Gewässerkunde (BfG) statt.

Modul 19 – Chemie der Heterocyclen

3 Leistungspunkte (LP)
Wahlpflichtmodul

03CH2719

Eine Belegung ist nur möglich, falls das Modul nicht bereits im Bachelorstudiengang „Angewandte Naturwissenschaften" abgeschlossen wurde.

Workload	**Studiensemester**	**Dauer**
90 h	3. Semester (empfohlen)	1 Semester

1	**Lehrveranstaltungen**				**Pflicht/Wahlpflicht**	**Kontaktzeit**	**Selbststudium**	**geplante Gruppengröße**	**LP**
	19.1	V	Chemie der Heterocyclen	3321114	Pflicht	2 SWS 30 h	60 h	30	3

2 **Lernergebnisse / Kompetenzen**

3321114 – Chemie der Heterocyclen (V)

Die Studierenden

- können die wichtigsten Klassen heterocyclischer Verbindungen an Hand ihrer Molekülstrukturerkennen und die Nomenklatur der Heterocyclen korrekt anwenden
- sind in der Lage, synthetische Verfahren zur Generierung von Heterocyclen zu erläutern und können von der Molekülstruktur abgeleitet Aussagen zur Reaktivität der Verbindungen machen

3 **Inhalte**

3321114 – Chemie der Heterocyclen (V)

- Kenntnisse über die Struktur und Reaktivität der wichtigsten Klassen von heterocyclischen Verbindungen
- Einfluss der Heteroatome auf die Reaktivität der Verbindungen im Vergleich zu rein carbocyclischen Substanzen
- typische Synthesewege zu den verschiedenen Heterocyclen
- Einsatz von heterocyclischen Verbindungen in technischen und pharmazeutischen Anwendungen

4 **Häufigkeit des Angebots**

nur im Wintersemester

3321114 – Chemie der Heterocyclen (V)

nur im Wintersemester

5 **Lehrsprache**

3321114 – Chemie der Heterocyclen (V)

Deutsch

6	**Teilnahmevoraussetzungen** keine
7	**Prüfungsformen** **3321114 – Chemie der Heterocyclen (V)** Modulprüfung: Klausur (45 Minuten)
8	**Voraussetzungen für die Vergabe von Leistungspunkten** **3321114 – Chemie der Heterocyclen (V)** Bestehen der Modulprüfung
9	**Stellenwert für die Endnote** 3/120
10	**Modulbeauftragte*r** Prof. Dr. Wolfgang Imhof
11	**Verantwortliche Einrichtung** FB 3: Mathematik / Naturwissenschaften, Institut für Integrierte Naturwissenschaften, Abteilung Chemie **3321114 – Chemie der Heterocyclen (V)** FB 3: Mathematik / Naturwissenschaften, Institut für Integrierte Naturwissenschaften, Abteilung Chemie
12	**Literatur** Wird in der Veranstaltung bekannt gegeben
13	**Verwendung des Moduls oder dazugehöriger Lehrveranstaltungen (in anderen Studiengängen)** M.Ed. Gymnasium Chemie (20103) M.Sc. Life Science (XXXXX)
14	**Sonstige Informationen** -

Modul 20 – Mikrobielle Ökologie

3 Leistungspunkte (LP)
Wahlpflichtmodul

03BI2720

Workload	**Studiensemester**	**Dauer**
90 h	3. Semester (empfohlen)	1 Semester

1	**Lehrveranstaltungen**				**Pflicht/Wahl-pflicht**	**Kontaktzeit**	**Selbststudium**	**geplante Gruppengröße**	**LP**
	20.1	V	Mikrobielle Ökologie	3213221	Pflicht	2 SWS 30 h	60 h	30	3

2 **Lernergebnisse / Kompetenzen**

3213221 – Mikrobielle Ökologie (V)

Die Studierenden

- sind in der Lage, neue Informationen aus der mikrobiellen Ökologie für sich verfügbar zu machen und dieses in zielführendes Wissen zu überführen;
- besitzen vertiefte Kenntnisse über ökologische Eigenschaften von Mikroorganismen und Besonderheiten mikrobieller Habitate
- sind in der Lage, die spezifischen Leistungen von Mikroorganismen in ökologischen Beziehungsgefügen zu bewerten

3 **Inhalte**

3213221 – Mikrobielle Ökologie (V)

- Grundlagen der Autökologie von Bakterien wie Bewegung und Taxien, der Kommunikation bei Bakterien, der Struktur und Funktion mikrobieller Lebensgemeinschaften mit Schwerpunkt auf der Betrachtung aquatischer Biozönosen, der Biofilme als natürlicher Lebensform mikrobiellen Lebens und der Interaktionen von Bakterien mit höheren Organismen sowie der Bedeutung spezieller mikrobieller Prozesse (z.B. der Methanogenese) im Stoffhaushalt von Ökosystemen.

4 **Häufigkeit des Angebots**

nur im Wintersemester

3213221 – Mikrobielle Ökologie (V)

nur im Wintersemester

5 **Lehrsprache**

3213221 – Mikrobielle Ökologie (V)

Deutsch

6 **Teilnahmevoraussetzungen**

keine

7	**Prüfungsformen** **3213221 – Mikrobielle Ökologie (V)** Modulprüfung: Klausur (45 Minuten)
8	**Voraussetzungen für die Vergabe von Leistungspunkten** **3213221 – Mikrobielle Ökologie (V)** Bestehen der Modulprüfung
9	**Stellenwert für die Endnote** 3/120
10	**Modulbeauftragte*r** Prof. Dr. Werner Manz
11	**Verantwortliche Einrichtung** FB 3: Mathematik / Naturwissenschaften, Institut für Integrierte Naturwissenschaften, Abteilung Biologie **3213221 – Mikrobielle Ökologie (V)** FB 3: Mathematik / Naturwissenschaften, Institut für Integrierte Naturwissenschaften, Abteilung Biologie
12	**Literatur** • Fuchs (Hrsg.) (2017) Allgemeine Mikrobiologie. Thieme, Stuttgart • Konhauser (2007) Geomicrobiology. Blackwell Publishing, Oxford • Madigan, Martinko, Stahl, Clark (2013) Brock Mikrobiologie. Pearson Studium, München • Maier, Pepper, Gerba (2009) Environmental Microbiology. Academic Press Elsevier, London Weitere Literatur wird in der Veranstaltung bekanntgegeben.
13	**Verwendung des Moduls oder dazugehöriger Lehrveranstaltungen (in anderen Studiengängen)** Angewandte Naturwissenschaften (20181) M.Sc. BioGeoWissenschaften (20187) M.Ed. Gym Biologie (20103) B.Sc. BioGeoWissenschaften (20187) M.Sc. Gewässerkunde und Wasserwirtschaft (20233) M.Sc. Life Science (XXXXX)
14	**Sonstige Informationen** -

Module 21 – Special Topics of Mathematics 9 Credit points (CP)
Elective module

03MA2508

Work load	**Study semester**	**Duration**
270 h	2nd or 3rd semester (recommended)	1 semester

1	**Courses**				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	21.1	V	Special Topics of Mathematics	3625081	compulsory	4 SWS 60 h	120 h	30	6
	21.2	Ü	Special Topics of Mathematics	3625082	elective	2 SWS 30 h	60 h	30	3
	21.3	S	Special Topics of Mathematics	3625083	elective	2 SWS 30 h	60 h	30	3

2 **Learning outcomes / Competences**

3625081 – Special Topics of Mathematics (V)

The students

- know the basic concepts and results of the respective field of mathematics.
- have an understanding of the definitions, theorems and methods presented in the lecture.
- are able to acquire, adapt and apply current research results.

3625082 – Special Topics of Mathematics (Ü)

The students

- know the basic concepts and results of the respective field of mathematics.
- have learned in the tutorials a precise, solid and autonomous handling of the definitions, theorems and methods presented in the lecture.
- broaden their analytical skills in one special topic of mathematics. They are able to acquire, adapt and apply current research results.

3625083 – Special Topics of Mathematics (S)

The students

- know the basic concepts and results of the respective field of mathematics.
- have learned in the tutorials a precise, solid and autonomous handling of the definitions, theorems and methods presented in the lecture.
- broaden their analytical skills in one special topic of mathematics. They are able to acquire, adapt and apply current research results.

3	**Contents** **3625081 – Special Topics of Mathematics (V)** One field of modern mathematics related to applications, e.g. • applied algebra and computer algebra • differential geometry • functional analysis and inverse problems • number theory and its relevance for cryptography • data analytics • machine learning • neural networks **3625082 – Special Topics of Mathematics (Ü)** • applied algebra and computer algebra • differential geometry • functional analysis and inverse problems • number theory and its relevance for cryptography • data analytics • machine learning • neural networks **3625083 – Special Topics of Mathematics (S)** • applied algebra and computer algebra • differential geometry • functional analysis and inverse problems • number theory and its relevance for cryptography • data analytics • machine learning • neural networks
4	**Frequency of the course** every semester **3625081 – Special Topics of Mathematics (V)** every semester **3625082 – Special Topics of Mathematics (Ü)** every semester **3625083 – Special Topics of Mathematics (S)** every semester
5	**Teaching language** **3625081 – Special Topics of Mathematics (V)** English

	3625082 – Special Topics of Mathematics (Ü) English **3625083 – Special Topics of Mathematics (S)** English
6	**Requirements for participation** none
7	**Types of examination** **3625081 – Special Topics of Mathematics (V)** Module examination (Modulprüfung): written examination (Klausur) (90 min) OR oral examination (mündliche Prüfung) (30 min) (only after consultation with the module coordinator; a binding determination and communication will be made at the latest at the beginning of the respective course)
8	**Requirements for the awarding of credit points** **3625081 – Special Topics of Mathematics (V)** passing the exam
9	**Importance for the final grade** 9/120
10	**Module coordinator** Prof. Dr. Thomas Götz
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Mathematical Institute **3625081 – Special Topics of Mathematics (V)** Faculty 3: Mathematics / Natural Sciences, Mathematical Institute **3625082 – Special Topics of Mathematics (Ü)** Faculty 3: Mathematics / Natural Sciences, Mathematical Institute **3625083 – Special Topics of Mathematics (S)** Faculty 3: Mathematics / Natural Sciences, Mathematical Institute
12	**Literature** will be announced in the respective course.
13	**Use of the module or related courses (in other study programmes)** M.Sc. Mathematical Modeling of Complex Systems (20142)

	M.Sc. Life Science (XXXXX)
14	**Other information** Only courses with relevance for life science (e.g., Mathematical Biology) can be chosen.

Modul 22 – Bewegungswissenschaft

4 Leistungspunkte (LP)
Wahlpflichtmodul

03SP2722

Eine der folgenden Veranstaltungen muss gewählt werden, entweder Veranstaltung 3721102 oder die Veranstaltung 3721103.

Workload	**Studiensemester**	**Dauer**
120 h	2. oder 3. Semester (empfohlen)	1 Semester

1	**Lehrveranstaltungen**				**Pflicht/Wahl-pflicht**	**Kontaktzeit**	**Selbststudium**	**geplante Gruppengröße**	**LP**
	22.1	S	Bewegungswissenschaft	3721102	Wahlpflicht	2 SWS 30 h	90 h	35	4
	22.2	S	Trainingswissenschaft	3721103	Wahlpflicht	2 SWS 30 h	90 h	35	4

2 **Lernergebnisse / Kompetenzen**

3721102 – Bewegungswissenschaft (S)

Die Studierenden

- können gängige sportwissenschaftliche Publikationen hinsichtlich ihrer methodischen Angemessenheit und Richtigkeit kritisch beurteilen,
- besitzen vertiefte fachwissenschaftliche Kenntnisse zu ausgewählten Themen der Bewegungswissenschaft, vorzugsweise mit Bezug zum Schulsport, und können solche Bereiche selbständig unter Anwendung adäquater sportwissenschaftlicher Forschungsmethoden analysieren
- sind fähig, sich kritisch mit Theorien auseinanderzusetzen und ihre Tragweiten für die sportliche und unterrichtliche Praxis zu erkennen und zu bewerten
- verfügen über die Schlüsselqualifikationen Medienkompetenz, Kommunikations-/Kooperationskompetenz durch Gruppenreferate und Diskussionen

3721103 – Trainingswissenschaft (S)

- können gängige sportwissenschaftliche Publikationen hinsichtlich ihrer methodischen Angemessenheit und Richtigkeit kritisch beurteilen,
- besitzen vertiefte fachwissenschaftliche Kenntnisse zu ausgewählten Themen der Bewegungswissenschaft, vorzugsweise mit Bezug zum Schulsport, und können solche Bereiche selbständig unter Anwendung adäquater sportwissenschaftlicher Forschungsmethoden analysieren
- sind fähig, sich kritisch mit Theorien auseinanderzusetzen und ihre Tragweiten für die sportliche und unterrichtliche Praxis zu erkennen und zu bewerten
- verfügen über die Schlüsselqualifikationen Medienkompetenz, Kommunikations-/Kooperationskompetenz durch Gruppenreferate und Diskussionen

3	**Inhalte** **3721102 – Bewegungswissenschaft** • Ausgewählte Themengebiete der Bewegungswissenschaft aus sportwissenschaftlicher Perspektive **3721103 – Trainingswissenschaft (S)** • Ausgewählte Themengebiete der Bewegungswissenschaft aus sportwissenschaftlicher Perspektive
4	**Häufigkeit des Angebots** Jedes zweite Semester **3721102 – Bewegungswissenschaft (S)** Jedes zweite Semester **3721103 – Trainingswissenschaft (S)** Jedes zweite Semester
5	**Lehrsprache** **3721102 – Bewegungswissenschaft (S)** Deutsch **3721103 – Trainingswissenschaft (S)** Deutsch
6	**Teilnahmevoraussetzungen** keine
7	**Prüfungsformen** **3721102 – Bewegungswissenschaft (S)** Modulprüfung: Mündliche Prüfung (20 Minuten) oder **3721103 – Trainingswissenschaft (S)** Modulprüfung: Mündliche Prüfung (20 Minuten)
8	**Voraussetzungen für die Vergabe von Leistungspunkten** **3721102 – Bewegungswissenschaft (S)** Bestehen der Modulprüfung oder **3721103 – Trainingswissenschaft (S)**

	Bestehen der Modulprüfung
9	**Stellenwert für die Endnote** 4/120
10	**Modulbeauftragte*r** Prof. Dr. Kiros Karamanides
11	**Verantwortliche Einrichtung** FB 3: Mathematik / Naturwissenschaften, Institut für Sportwissenschaft **3721102 – Bewegungswissenschaft (S)** FB 3: Mathematik / Naturwissenschaften, Institut für Sportwissenschaft **3721103 – Trainingswissenschaft (S)** FB 3: Mathematik / Naturwissenschaften, Institut für Sportwissenschaft
12	**Literatur** **3721102: Bewegungswissenschaft (S)** • Schewe, H. (2000) Biomechanik – wie geht das? Stuttgart: Thieme. • Hüter-Becker, A. & Dölken, M. (Hrsg.) (2005). Biomechanik, Bewegungslehre, Leistungsphysiologie, Trainingslehre. Stuttgart: Thieme.Wick, D. (2013). Biomechanik im Sport. Balingen: Spitta. **3721103: Trainingswissenschaft (S)** • Weineck, J. (2019). Optimales Training. Leistungsphysiologische Trainingslehre unter besonderer Berücksichtigung des Kinder- und Jugendtrainings (17., neu überarbeitete Auflage). Balingen: Spitta GmbH. • Martin, D., Carl, K. & Lehnertz, K. (1993). Handbuch Trainingslehre. Schorndorf: Hofmann.
13	**Verwendung des Moduls oder dazugehöriger Lehrveranstaltungen (in anderen Studiengängen)** M.Ed. Gymnasium Sport (20103) Zertifikat Sport (20118) M.Sc. Life Science (XXXXX)
14	**Sonstige Informationen** -

Modul 23 – Lebensmittellehre/-chemie sowie Prozesstechnik

3 Leistungspunkte (LP)
Wahlpflichtmodul

03SP2723

Workload	**Studiensemester**	**Dauer**
90 h	2. Semester (empfohlen)	1 Semester

	Lehrveranstaltungen				**Pflicht/Wahl-pflicht**	**Kontaktzeit**	**Selbststudium**	**geplante Gruppengröße**	**LP**
	23.1	V	Lebensmittellehre/-chemie sowie Prozesstechnik	3811072	Pflicht	2 SWS 30 h	60 h	60	3

2 **Lernergebnisse / Kompetenzen**

Die Studierenden

- besitzen Grundkenntnisse über Inhaltsstoffe, Qualitätsmerkmale und Qualitätsanforderungen wichtiger Lebensmittelrohstoffe
- kennen die Grundlagen der Prozesstechnik
- können verschiedene Nachhaltigkeitsstrategien und Kenngrößen in der Lebensmittel-produktion beurteilen
- verfügen über Grundlagen der Lebensmittelsensorik

3 **Inhalte**

- Ermittlung des Energiehaushalts, des Nährstoffbedarf Vorkommen und Verfügbarkeit von Nährstoffen in Lebensmitteln
- Bedeutung, Verbrauch und Aufkommen (weltweit) an Lebensmittelrohstoffen und Produkten
- Herkunft, Inhaltsstoffe und Technologie von Lebensmitteln
- Nachhaltigkeit in der Lebensmittelproduktion
- Reinigungstechnik, Kältetechnik, Warmwasserbereitung, Verbrennungstechnik
- sensorische Prüfung von Lebensmitteln

4 **Häufigkeit des Angebots**

nur im Sommersemester

5 **Lehrsprache**

Deutsch

6 **Teilnahmevoraussetzungen**

keine

7	**Prüfungsformen** Modulprüfung: Klausur (schriftlich – 45 min)
8	**Voraussetzungen für die Vergabe von Leistungspunkten** erfolgreicher Abschluss der Modulprüfung
9	**Stellenwert für die Endnote** 3/120
10	**Modulbeauftragte*r** apl. Prof. Dr. Michaela Schlich
11	**Verantwortliche Einrichtung** FB 3: Mathematik / Naturwissenschaften, Institut für Sportwissenschaft
12	**Literatur** Wird in der Veranstaltung bekanntgegeben
13	**Verwendung des Moduls oder dazugehöriger Lehrveranstaltungen (in anderen Studiengängen)** B.Ed. BBS Wirtschaft, Technik und Ernährung (20111) (zuvor: Wirtschaft und Arbeit) M.Sc. Life Science (XXXXX)
14	**Sonstige Informationen**

Module 24 – Surface Science

6 Credit points (CP)
Elective module

03PH2503

Work load	**Study semester**	**Duration**
180 h	1st or 3rd semester (recommended)	1 semester

	Courses				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	24.1	V	Fundamentals of Surface Science	3525031	compulsory	2 SWS 30 h	60 h	30	3
	24.2	V	Applications and Analytical Methods of Surface Science	3525032	compulsory	2 SWS 30 h	60 h	30	3

2 **Learning outcomes / Competences**

3525031 – Fundamentals of Surface Science (V)

The students

- can explain the particular characteristics of surfaces and discuss related problems,
- know the basics of reaction kinetics and other phenomena on surfaces,
- are aware of the interactions with different states of matter and the importance of clean surfaces,
- are able to transfer their knowledge to experiments for specific tasks and develop their own experimental schemes.

3525032 – Applications and Analytical Methods of Surface Science (V)

The students

- can explain the basic concepts and ideas of vacuum,
- develop an understanding of the countervailing effects relevant to the realisation of vacuum systems and are able to evaluate technical possibilities,
- are able to explain applications and trends in surface processing and can evaluate existing experimental setups,
- are able to describe and analyse independently typical detection techniques in surface science and evaluate their limitations.

3 **Contents**

3525031 – Fundamentals of Surface Science (V)

- surface structure
- interactions of surfaces with matter
- gas adsorption on surfaces
- preparation of clean surfaces

	3525032 – Applications and Analytical Methods of Surface Science (V) • physics behind vacuum technology • design of vacuum systems • deposition techniques and thin film growth • diffraction on surfaces and scattering methods • microscopy on surfaces • chemical surface analysis
4	**Frequency of the course** only winter semester **3525031 – Fundamentals of Surface Science (V)** only winter semester **3525032 – Applications and Analytical Methods of Surface Science (V)** only winter semester
5	**Teaching language** **3525031 – Fundamentals of Surface Science (V)** English **3525032 – Applications and Analytical Methods of Surface Science (V)** English
6	**Requirements for participation** None for students who have successfully completed the study programme “Angewandte Naturwissenschaften” (B.Sc.). Otherwise competences which are comparable to contents of module 03PH1304 “Physik für BioGeoWissenschaftler” (see module handbook “Angewandte Naturwissenschaften, B.Sc.”).
7	**Types of examination** Module examination (Modulprüfung): written exam (Klausur) (90 min)
8	**Requirements for the awarding of credit points** passing the exam
9	**Importance for the final grade** 6/120
10	**Module coordinator** Prof. Dr. Silke Rathgeber
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Physics Department

	3525031 – Fundamentals of Surface Science (V) Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Physics Department **3525032 – Applications and Analytical Methods of Surface Science (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Physics Department
12	**Literature** will be announced in the respective course.
13	**Use of the module or related courses (in other study programmes)** M.Sc. Material Science (20242) M.Sc. Mathematical Modelling of Complex Systems (20142) M.Sc. Chemie und Physik funktionaler Materialien / Chemistry and Physics of functional Materials (20145) M.Eng. Applied Physics (91) M.Sc. Mathematical Modelling of Complex Systems (20184) M.Sc. Chemie und Physik funktionaler Materialien / Chemistry and Physics of functional Materials (20183) M.Sc. Mathematical Modeling, Simulation and Optimisation (20194) M.Sc. Applied Natural Sciences (20193) M.Sc. Life Science (XXXXX)
14	**Other information** -

Module 25 – Polymer Science

6 Credit points (CP)
Elective module

03PH2505

Work load	**Study semester**	**Duration**
180 h	2nd and 3rd semester (recommended)	2 semester

	Courses				**Compulsory/ elective**	**Contact time**	**Self-study**	**Planned group size**	**CP**
	25.1	V	Polymer Physics	3525051	compulsory	2 SWS 30 h	60 h	30	3
	25.2	V	Characterization and Application of Polymer Materials	3525052	compulsory	2 SWS 30 h	60 h	30	3

2 **Learning outcomes / Competences**

3525051 – Polymer Physics (V)

The students

- can independently explain basic models describing the properties of different types of polymers and in different states
- are able to understand how the peculiarities of the polymer structure such as connectivity affects their physical properties.
- develop on the basis of the covered basic concepts their own solving schemes
- are able to transfer the discussed basic concepts to actual, scientific topics in polymer science.

3525052 – Characterization and Application of Polymer Materials (V)

The students

- can independently explain the characterisation and processing methodologies covered in this course
- can identify for the most important physical properties of polymer materials (3525051 Polymer Physics) the correct characterisation methods and are aware of their technical realisation
- they can give an overview over representative results for typical polymer systems and understand of which relevance these are for the processing and application of polymer materials
- are able to understand the environmental impact of polymeric materials and strategies for increasing sustainability of polymeric materials
- are able to transfer the discussed basic concepts to actual, scientific topics in polymer science

3	**Contents** **3525051 – Polymer Physics (V)** • Synthesis & molecular weight distributions • Chain models • Polymer solutions, polymer blends, block copolymers • Semi-crystalline state • Polymer dynamics & viscoelasticity • Mechanical properties of polymers **3525052 – Characterization and Application of Polymer Materials (V)** • Determination of molecular weights • Thermal characterisation • Mechanical testing • Scattering methods • Polymer processing • Environmental impact of polymers • Sustainability of polymeric materials, e.g. recycling, biopolymers etc.
4	**Frequency of the course** every semester **3525051 – Polymer Physics (V)** only summer semester **3525052 – Characterization and Application of Polymer Materials (V)** only winter semester
5	**Teaching language** **3525051 – Polymer Physics (V)** English **3525052 – Characterization and Application of Polymer Materials (V)** English
6	**Requirements for participation** **3525051 – Polymer Physics (V)** None for students who have successfully completed the study programme “Angewandte Naturwissenschaften” (B.Sc.). Otherwise competences which are comparable to contents of module 03PH1304 “Physik für BioGeoWissenschaftler” (see module handbook “Angewandte Naturwissenschaften, B.Sc.” for competences of module 03PH1304). **3525052 – Characterization and Application of Polymer Materials (V)** Knowledge from 3525051 “Polymer Physics”

7	**Types of examination** **3525051 - Polymer Physics (V)** partial module examination (Modulteilprüfung): written exam (Klausur) (45 min) **3524032 - Characterisation and Application of Polymer Materials (V)** partial module examination (Modulteilprüfung): written exam (Klausur) (45 min)
8	**Requirements for the awarding of credit points** Passing the partial module examinations **3525051 - Polymer Physics (V)** Passing the partial module examination **3524032 - Characterisation and Application of Polymer Materials (V)** Passing the partial module examination
9	**Importance for the final grade** 6/120
10	**Module coordinator** Prof. Dr. Silke Rathgeber
11	**Responsible institution** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Physics Department **3525051 – Polymer Physics (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Physics Department **3525052 – Characterization and Application of Polymer Materials (V)** Faculty 3: Mathematics / Natural Sciences, Institute for Integrated Natural Sciences, Physics Department
12	**Literature** will be announced in the respective course.
13	**Use of the module or related courses (in other study programmes)** M.Sc. Material Science (20242) M.Sc. Mathematical Modelling of Complex Systems (20142) M.Sc. Chemie und Physik funktionaler Materialien / Chemistry and Physics of functional Materials (20145) M.Sc. Mathematical Modelling of Complex Systems (20142) M.Eng. Applied Physics (91) M.Sc. Mathematical Modelling of Complex Systems (20184)

	M.Sc. Chemie und Physik funktionaler Materialien / Chemistry and Physics of functional Materials (20183) M.Sc. Mathematical Modeling, Simulation and Optimisation (20194) M.Sc. Applied Natural Sciences (20193) M.Sc. Life Science (XXXXX)
14	**Other information** -