UNIVERSITY OF DUISBURG ESSEN

Open-Minded

University of Duisburg-Essen

Module Handbook

Master course

Environmental Toxicology

(EnviTox)

Year 2015/2016

Content

Introduction

The Module Handbook aims at providing a general overview on the Master Programme, its modules and courses. The document also provides additional information on registration and assessment procedures, such as guidelines, forms and recommendations. Since the content is subject to frequent changes in curricula and procedures, **please always check the relevant websites for actual information. This includes deviations from the course descriptions announced by individual teachers during the term.**

Aims of the Master Program Environmental Toxicology (EnviTox)

Environmental Toxicology (EnviTox) is an integrated interdisciplinary Master Degree Programme in the sector of European monitoring and assessment of Xenobiotics and other anthropogenic emitted elements offered by the University of Duisburg-Essen.

EnviTox focuses on Biology, Chemistry and environmental sciences, therefore students with a bachelor degree in Biology, Chemistry or Ecology and similar fields of study are welcome to apply for EnviTox.

The aims and learning targets of the study program are provided in the following table:

Study aims for the Master Program EnviTox

Superior Aims of the study program	Learning outcomes	Target oriented module
Ability of systematic representation of complex relations in the topics pollutant dispersal, uptake of pollutants by plants and animals and effects of pollutants on those organism	Graduated EnviTox students: - Use their knowlegde of biological and chemical processes to evaluate the behavior of harmful substances in different environmental matrices	Modules 2,3,4,6
	- Analyze the uptake and metabolism of harmful substances in cells and organism (plants and animals)	Modules 3,4,6
	- Have an overview about actual reseach topics in specific disciplines and can interpret results critically due to a scientific background knowledge	Modules 1,5,6,7,8
	- They can address and evaluate ethical questions relevant to society and give new impulses, especially to topics related to „diversity“, „sustainability” and “resource protection”.	Modules 4,7,8,9
Evaluation and Integration of research and test results in the context of european environmental legislation	Graduated EnviTox students: - Know the european legislation regarding topics relevant to ecotoxicology	Module 7
	- Use this knowledge to asses and integrate new	

	research and test results	
Address, evaluate and present classical and new problems in the field of environmental toxicology and put them into the given research context	Graduated EnviTox students: - Know different modern methods and techniques to quantify pollutants and xenobiotics in different environmental compartments and for the detection of effects in cells, organisms and ecosystems - can critically interpret the results of the above mentioned methods in context of the given research hypothesis - are able to autonomous handle those methods in the laboratory and field work - evaluate, interpret research results and put them into an ecotoxicological context - present results in oral and written form to different stakeholders	Modules 2,5,6,8,9 Modules 5,6,8,9 Modules 5,6,8,9 Modules 5,6,8,9 Modules 5,6,8,9
Ability to work in a leading position in the industry/gouvernmental agency/NGO and/or to accomplish a phd thesis	Graduated EnviTox students: - develope autonomous research questions and hypotheses - plan research projects under limitated time and resources - conduct research projects with suitable methods, work in research teams, evaluate results, interpret results critically, and put results into a ecotoxicological and ethical context - present results in oral and written presentations to different stakeholders - stellen Ergebnisse in mündlicher und schriftlicher Form adressatenbezogen vor	All modules, but especially Module 9

Study contents

The study course EnviTox consists of a more theoretical first study year and a more practical second study year.

The curriculum consists of a total of nine modules, one of which representing a 16-week internship and the final module being the six-month Master Thesis.

The nine modules are grouped into different focuses. In "**Fundamentals"** students are introduced into the field of EnviTox (Module "Aspects of environmental research"), they gain fundamental knowledge of the movement of elements in environmental compartments (Environmental chemistry), get an inside into important molecular biological sciences (biochemistry and bioinformatics) and learn how to monitor chemical substances in different matrices (Environmental analytics).

The focus **"Effects"** summarizes the effects of pollutants on different organisms. The module "biological interaction" covers the role of microbes in drinking water supply and waste water treatment, explains how pollutants are uptaken by plants and animals and

how we can use population structures of different keygroups to monitor the ecological state of ecosystems. The module “Effects on biological functions” directly deals with the effects of xenobiotics and other pollutants on cells, plants and animals. Additional competencies related to the presentation of information, teamwork, information technologies and strategies to solve problems will be integrated in the courses with an emphasis on multidisciplinarity.

During the practical year “**Applied Environmental Toxicology**” focuses on the European legislation regarding the use of Xenobiotics and the implementation of monitoring, assessment and risk managing by the Industry and other stakeholders. Furthermore, in a 16 week internship students are encouraged to get first working experiences in an industrial, administrational, advisory or scientific setting in Germany or abroad.

The Master Programme will close with the Master Thesis on current questions in Environmental Toxicology.

Curriculum Master EnviTox

First term		Lecturer	hpw	CP
Fundamentals	**Aspects of environmental research**			**1**
	Aspects of environmental research	various	1	1
	Environmental chemistry			**13**
	Biogeochemical cycles	Kuttler	2	3
	Geochemistry of soil and sediments	Schreiber, Berberich	3	5
	Water chemistry	Schmidt	3	5
	Biosciences			**8**
	Biochemistry: structure and function of biomolecules	Bayer	2	3
	Bioinformatics	Hoffmann	3	5
Effects	**Biological interactions**			**8**
	Ecotoxicology I: Uptake and metabolisms	Pfanz, Sures	2	3
	Environmental Microbiology	NN	3	5
Second term				
Fundamentals	**Environmental analytics**			**10**
	Applied Analytical Chemistry	Schmitz	3	5
	Environmental analytics	Schmid	7	5
Effects	**Biological interactions**			**5**
	Ecology and Protection of Freshwater Ecosystems and Aquatic Organisms	Hering	4	5
	Effects on biological functions			**15**
	Ecotoxicology II: Effects	Pfanz, Sures	3	4
	Cellular toxicity	Dopp, Johannes, Ruchter	4	5
	Applied methods in (eco-)toxicology	Pfanz, Sures	6	6
Third term				
Applied Environmental Toxicology	**European Environmental Legislation**			**8**
	Introduction to EU-environmental legislation	Franßen, Pottschmidt	2	3
	Assessment of Chemicals under REACH	NN	3	5
	Internship			**22**
Fourth term				
Master Projekt				**30**
Master Thesis				28
Master Colloqium				2
				Σ120

Module Descriptions

Module Name	Abbreviation Module
Aspects of environmental research	EnviTox-MA-1
Responsible for the Module	Faculty
N. Ruchter	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology	Master

Designated Semester	Duration of Module	Module Type (P/WP/W)	Credits
First term	One term	P	1

Prerequisites according to examination regulations	Recommended Prerequsites
none	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
1.1	Aspects of environmental research	Lecture	1	30 h
Sum (Compulsory and Supplementary Courses)			1	30 h

Learning targets of the Module
– Students get an inside about current relevant research topics in the field of Environmental Toxicology – They reflect the aim of their studies courses. – Students can interpret results critically due to their scientific background knowledge
Associated Key Qualifications
-

Module examinations to gain grades	
none	
Contribution of the Module Grade for the Final Grade	none

Module Name	Abbreviation Module	
Aspects of environmental research	EnviTox-MA-1	
Course Name	Abbreviation Course	
Aspects of environmental research	1.1	
Lecturer	Division	Module Type (C/S)
several	Biology and Chemistry	C

Designated Semester	Frequency	Language	no. Students/Course
First Term	WS	english	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
1	15 h	15 h	30 h

Education Methodology
Lecture
Learning targets
– Students get an inside about current relevant research topics in the field of Environmental Toxicology and reflect the aim of their studies. They are able to analyse results.
Contents
– Actual scientific questions, used methods and results of relevant field in Environmental Toxicology, regarding the distribution, uptake, metabolism and effects of xenobiotics.
Examination
-/-none
Literature
▪ Will be presented during the lecture
Further Information on the course (e.g. contact days, …..)
none

Module Name	Abbreviation Module
Environmental chemistry	EnviTox-MA-2
Responsible for the Module	Faculty
Prof. Dr. Schreiber	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology, Master Water Science	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
First Term	One term	C	13

Prerequisites according to examination regulations	Recommended Prerequsites
none	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
2.1	Biogeochemical Cycles	VO	2	90 h
2.2	Geochemistry of Soils and Sediments	VO/SE	3	150 h
2.3	Water chemistry	VO/SE	3	150 h
Sum (Compulsory and Supplementary Courses)			8	390 h

Learning targets of the Module
– Students have an understanding of chemical and biochemical processes in soil, air and water systems. – They have an overview about transformation and transport processes affecting the mobility and toxicological relevance of pollutants in soil and water systems. – Students are able to use their knowledge of biological and chemical processes to evaluate the behaviour of harmful substances in different environmental matrices. – They know different modern methods and techniques to quantify pollutants and xenobiotics in different environmental compartments.
Module examinations to gain grades
First part of the examination: Written exam for 2.1 and 2.2 (Duration of the exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min) *Second part of the examination:* written exam and presentation (duration 20 min) for 2.3 (Duration of the written exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min) For the module Grade: Grades of the examination parts are weighted accordingly to the credits of the respective lecture

Contribution of the Module Grade for the Final Grade	13/119

Module Name	Abbreviation Module	
Environmental chemistry	EnviTox-MA-2	
Course Name	Abbreviation Course	
Biogeochemical Cycles	2.1	
Lecturer	Division	Module Type (C/S)
W. Kuttler	Climatology	C

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	english	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
2	30 h	60 h	90 h

Education Methodology
Lecture (2 HPW)
Learning targets
Insights into the role of biogeochemical cycling: cross linking of biotic and abiotic processes in the geo- and hydrosphere.
Contents
To understand the movement of chemical elements around an ecosystem via physical and biological processes I. General Overview of Biogeochemical Cycles II. The Water Cycle III. The Carbon Cycle IV. The Nitrogen Cycle V. The Phosphorus Cycle VI. The Sulfur Cycle Biogeochemical Cycles in Urban Ecology
Examination
Written test together with course 2.2 (Duration of the written exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min)

Literature
• **Berner, E.K. and Berner, R.A. (1987):** The Global Water Cycle – Geochemistry and Environment. Prentice-Hall, Inc., 397 p. • **Bonan, G. (2008):** Ecological Climatology – Concepts and Applications. 2nd ed., Cambridge University Press, 550 p. • **Krebs, C.J. (2009):** Ecology - The Experimental Analysis of Distribution and Abundance. 6th ed., Pearson Education, 655 p. • **Molles, M.C. (1999):** Ecology - concepts and applications. WCB McGraw Hill, 509 p. • **Ricklefs, R.E. and Miller, G.L. (1999):** Ecology. 4th ed., W. H. Freeman and Company, 822 p. • **Holmén, K.** (2000): The global carbon cycle, In: Michael C. Jacobson, Robert J. Charlson, Henning Rodhe and Gordon H. Orians, (eds), International Geophysics, Academic Press, Volume 72, pp. 282-321 • **Butcher, S.S., Charlson, R.J. and Orians, G.H. (eds)**, Global Biogeochemical Cycles. London: Academic Press, 1992. • **IPCC, 2007**: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA
Further Information on the course (e.g. contact days, …..)
none

Module Name	Abbreviation Module	
Environmental chemistry	EnviTox-MA-2	
Course Name	Abbreviation Course	
Geochemistry of Soils and Sediments	2.2	
Lecturer	Division	Module Type (C/S)
U. Schreiber, G. Berberich	Geology	C

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	english	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	45 h	105 h	150 h

Education Methodology
Lecture (2 HPW) and Seminar (1 HPW)
Learning targets
Aquisition of basic knowledge of environmental chemistry of soils and sediments. Insight into relevant environmental scenarios with regard to geogenic and anthropogenic impact
Contents
Environmental chemistry Soil / Waste Overview of contamination of environmentally relevant solid samples. Explanation of transformation and transport processes affecting the mobility and toxicological relevance of pollutants - Soils and sediments (genesis, components, clay minerals, humic material, interaction, pollutant-chronology) - Pollutant mobility - waste (geochemical background contamination, stabilisation and storage, compilation and appraisal)
Examination
Written Test together with course 2.1 (Duration of the written exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min)
Literature
1)Mirsal, Ibrahim (2008): Soil Pollution, Springer - 2) Singer, M.J., Munns, D.N. (2006): Soils: An Introduction, Pearson – 3) Fetter, C.W. (2001): Applied Hydrogeology, Pearson – 4) Lutgens, F.K., Tarbuck, E.J. (2009): Essentials of Geology, Pearson
Further Information on the course (e.g. contact days, …..)
Every student has to present a topic for 20 min

Module Name	Abbreviation Module	
Environmental chemistry	EnviTox-MA-2	
Course Name	Abbreviation Course	
Water chemistry	2.3	
Lecturer	Division	Module Type (C/S)
T.C. Schmidt	Analytical chemistry	C

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	english	50

hours per week (SWS)	Presence	preparation, self tutoring, preparation for exam (h)	Workload
3	45 h	105 h	150 h

Education Methodology
Lecture (2 HPW) and Seminar (1 HPW)
Learning targets
Students should acquire an advanced understanding of chemical processes relevant in natural and technical aqueous systems, and of conceptual models and quantitative approaches to describe these. Controls of behavior and fate of organic and inorganic contaminants will be emphasized.
Contents
Recapture of thermodynamics, chemical equilibrium and thermodynamics **Useful tools:** Thermodynamic cycle, Mass balance equations, Single-parameter Linear Free Energy Relationships (LFERs), Poly-parameter LFERs **Sorption processes:** partitioning, adsorption, ion exchange, surface complexation; sorption coefficients, linear and nonlinear sorption, sorption isotherms, dual mode theory, role of colloids/DOM, role of inorganic surfaces, mass transfer limitations, experimental methods and predictive tools. **Reaction kinetics:** first-order, second-order and pseudo-first-order reactions, reaction rates and half life, kinetics and thermodynamics. **Transformations:** nucleophilic substitution including hydrolysis, elimination, redox reactions, introduction to photolysis.
Examination
Written exam and presentation of results of a case study (Duration of the exams will be announced at the beginning of the lecture. The written exam durates min. 45 and max. 180 min, the presentation between 15 and 45 min)
Literature
a) Schwarzenbach, R. P., Gschwend, P. M., Imboden, D. M. *Environmental Organic Chemistry*, 2nd ed., Wiley: Ney York, 2003. b) Jensen, J. N. *A Problem-Solving Approach to Aquatic Chemistry*, Wiley: New York, 2003. c) Brezonik, P. L., Arnold, W.A. *Water Chemistry*, Oxford University Press, Oxford, 2011

Module Name	Abbreviation Module
Biosciences	EnviTox-MA-3
Responsible for the Module	Faculty
Prof. Dr. P. Bayer	Biology

Relevance for following study programmes:	Module Level
Master EnviTox, Master Chemie, Master angewandte Informatik,	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
First Term	One term	C	8

Prerequisites according to examination Regulations	Recommended Prerequisites
None	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
3.1	Biochemistry: structure and function of biomolecules	VO	2	90 h
3.2	Bioinformatics	VO	3	150 h
Sum (Compulsory and Supplementary Courses)			5	240 h

Learning targets of the Module

- Students understand the importance of structure-function relationship for signal transduction pathways. They analyse the absorption and metabolic pathways of xenobiotics in cells.
- Students have knowledge of methods for computational processing, analysis, and modeling of biological data.
- They have an understanding of chemical and biochemical processes to evaluate the behaviour of pollutants in cells and organism.

Module examinations to gain grades

First part of the examination:

Written exam for 3.1

(Duration of the exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min)

Second part of the examination:

Written exam for 3.2

(Duration of the exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min)

For the module Grade:
Grades of the examination parts are weighted accordingly to the credits of the respective lecture

Contribution of the Module Grade for the Final Grade	8/119

Module Name	Abbreviation Module	
Biosciences	EnviTox-MA-3	
Course Name	Abbreviation Course	
Biochemistry: structure and function of biomolecules	3.1	
Lecturer	Division	Module Type (C/S)
P. Bayer	Biochemistry	C

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	english	50

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
2	30 h	60 h	90 h

Education Methodology
Lecture (2 HPW)
Learning targets
Students are able to apply and assess modern structure determination methods. They understand the processes of protein-protein interaction and relevance of conformational and structural rearrangements in proteins. They have an understanding of biophysical and biochemical processes to evaluate the behaviour of pollutants in the environment.
Contents
Methods: Crystallizing of proteins, structure determination by X-ray analysis, nmr of biomolecules (principles of nmr, spectra, assignment, labelling strategies), fluorescence spectroscopy (FRET, anisotropy), IR-spectroscopy, Structure and function of proteins: membrane receptors, GPCR and G-binding proteins, signal transduction cascades, second messengers
Examination
Written exam (Duration of the written exam will be announced at the beginning of the lecture. Duration min. 45 and max. 180 min)
Literature
- Biophysical Chemistry (Part II), Cantor and Schimmel, Freeman and Company 1980 - Physical Biochemistry, van Holde et al., Prentize Hall 1998 - Wirkstoffdesign, Böhm et al., Spektrum Verlag 2002 - Bioanalytik, Lottspeich, Spektrum Verlag 1998 - X-ray crystallography of biological macromolecules, A. Messerschmidt and R. Huber, Encyclopedia of Analytical Chemistry, R.A.Meyers (Ed) p 6061-6107, John Wiley & Sons Ltd. Chichester 2000
Further Information on the course (e.g. contact days, …..)
none

Module Name	Abbreviation Module	
Biosciences	EnviTox-MA-3	
Course Name	Abbreviation Course	
Bioinformatics	3.2	
Lecturer	Division	Module Type (C/S)
D. Hoffmann	Bioinformatics	C

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	english	30

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	45 h	105 h	150 h

Education Methodology
Lecture using beamer and whiteboard
Learning targets
– Knowledge of relevant biological basics – Knowledge of data intensive problems in current biology and bioinformatics solutions thereof – Knowledge of bioinformatics methods for the solution of such problems – Ability to apply such methods – Ability to choose method for solution of given problem and interpret outcome critically
Contents
Relevant biological basics (biological organisation and biomolecules); data intensive problems and methods in biology; analytical methods in biology and the data generated by these methods; biological databases; methods for processing and analysing biological data, and for prediction and modelling (sequence alignment, pattern search, phylogeny, hidden Markov models, structure prediction, biomolecular modelling, graph based methods, etc.)
Examination
Written exam (Duration of the written exam will be announced at the beginning of the lecture. It will take between 45 and 180 min)
Literature
Merkl, Rainer; Bioinformatik; 3. Auflage; 2015; WILEY-VCH Zvelebil, Marketa; Baum, Jeremy O.; Understanding Bioinformatics, 2008; Garland
Further Information on the course (e.g. contact days, …..)
none

Module Name	Abbreviation Module
Biological interactions	EnviTox-MA-4
Responsible for the Module	Faculty
Prof. Dr. Daniel Hering	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology, Master TWM	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
First and second term	One year	C	13

Prerequisites according to examination regulations	Recommended Prerequisites
None	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
4.1	Ecotoxicology I: Uptake and metabolisms	VO/SE	2	90 h
4.2	Environmental Microbiology	VO/SE	3	150 h
4.3	Ecology and Protection of Freshwater Ecosystems and Aquatic Organisms	VO/SE	4	150 h
Sum (Compulsory and Supplementary Courses)			9	390 h

Learning targets of the Module

- Students know metabolic pathways and effect mechanisms of xenobiotics and pollutants in cells, plants and animals as well as ecosystems.
- They know the processes of underlying drinking water and waste water purification by biological filtration.
- Students are able to use their knowledge of biological and chemical processes to evaluate the behavior of harmful substances in different environmental.
- They know different assessment methods for freshwater bodies and measures to renaturate freshwater ecosystems.
- They are able to participate in scientific discussions about current topics and to assess them critically.
- They can address and evaluate ethical questions relevant to society and give new impulses, especially to topics related to „diversity“, „sustainability” and “resource protection”.

Module examinations to gain grades	
First part of the examination: (Duration of the exam for 4.1 will be announced at the beginning of the lecture. The written exam durates min. 45 and max. 180 min, the oral exam is in between 10 and 30 min) *Second part of the examination:* Written exam for 4.2 (Duration of the exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min) *Third part of the examination:* Written exam and homework for 4.3 (Duration of the exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min) For the module Grade: Grades of the examination parts are weighted accordingly to the credits of the respective lecture	
Contribution of the Module Grade for the Final Grade	13/119

Module Name	Abbreviation Module	
Biological interactions	EnviTox-MA-4	
Course Name	Abbreviation Course	
Ecotoxicology I: Uptake and metabolisms	4.1	
Lecturer	Division	Module Type (C/S)
H. Pfanz, B. Sures, S. Zimmermann	Applied Botany, Aquatic Ecology	C

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	english	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
2	30 h	60 h	90 h

Education Methodology
Lecture combined with seminar
Learning targets
The students - gain insight in uptake processes, metabolic pathways and effects of xenobiotics and pollutants in living organisms - know how to find scientific literature by using different data bases - are able to present and discuss a topic in context using modern means of presentation
Contents
Uptake, bioaccumulation, biotransformation and elimination processes of organic compounds, metals and air pollutants, mechanisms of toxicity at (sub)cellular, organismic and higher organizational levels, phase I reactions, phase II reactions, cytochrome P450 family, Ah receptor, metal binding proteins, bioactivation of xenobiotics
Examination
Duration of the exam will be announced at the beginning of the lecture. The written exam durates min. 45 and max. 180 min, the oral presentation is in between 10 and 30 min.
Literature
Large number of journal articles and grey literature Klaassen C.D. (2008) Casarett and Doull's Toxicology -The Basic Science of Poisons, 7th edition, The McGraw-Hill Companies, Inc.
Further Information on the course (e.g. contact days, …..)
Compulsory attendance The presence of the student in the seminar is obligatory.

Module Name	Abbreviation Module
Biological interactions	EnviTox-MA-4
Course Name	Abbreviation Course

Environmental Microbiology	4.2	
Lecturer	Division	Module Type (C/S)
Prof. Dr. H.C. Flemming	Aquatic Microbiology	C

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	english	100

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	45 h	105 h	150 h

Education Methodology
Lecture (2 HPW) and Seminar (1 HPW)
Learning targets
The students understand the processes underlying drinking water and waste water purification by biological filtration. They obtain knowledge about the basics of sediment microbiology and bioremediation and get access to the basics of biotechnology.
Contents
- Drinking water microbiology: bank filtration, groundwater - Microbiology of drinking water treatment - Microbiology of waste and waste water treatment - Sediment – microbiology - Bioremediation - Introduction to biotechnology
Examination
Written exam (Duration of the exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min)
Literature
Brock: Biology of Microorganisms 10 th Edition 2002. Prentice Hall, ISBN 0-13-081922-0 Doods, W.K.: Freshwater Ecology. Academic Press, San Diego, 2002, ISBN 0-12-219135-8 Maier, Pepper, Gerba: Environmental Microbiology, Academic Press, 2000, ISBN 0-12-49750-4
Further Information on the course (e.g. contact days, …..)
None

Module Name	Abbreviation Module	
Biological interactions	EnviTox-MA-4	
Course Name	Abbreviation Course	
Ecology and Protection of Freshwater Ecosystems and Aquatic Organisms	4.3	
Lecturer	Division	Module Type (C/S)
Prof. Dr. D. Hering	Hydrobiology	C

Designated Semester	Frequency	Language	no. Students/Course
Second term	SS	english	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
4	56 h	94 h	150 h

Education Methodology
Combination of lecture and exercise: general lectures introduce to the topic, the student partly prepares a topic based on background materials; presentations of students and discussions.
Learning targets
The student: - Gains knowledge of different freshwater ecosystem and classifications - Gains knowledge of related environmental impacts and stressors - Gains knowledge of and practice with freshwater ecological assessment and monitoring - Gains a basic understanding of applied water management - Gains knowledge of basic multivariate tools to analyse ecological data - Is able to transfer freshwater ecology into actual policies (e.g. the Water Framework Directive) - Is able to gain and filter information to understand and explain water-related problems - Is able to derive measures to protect freshwater ecosystems They are able to participate in scientific discussions about current topics and to assess them critically.
Contents
A-priori and *a-posteriori* typology of freshwater ecosystems, impacts of different perturbations (pollution, eutrophication, acidification, pesticides, hydromorphological alteration, waterpower) on aquatic ecosystems, river and lake assessment according to national and international regulations, the organism groups addressed by the Water Framework Directive and how to use them in biomonitoring, transferring monitoring results into restoration measures, lake and river restoration, impact of global climate change
Examination
Written exam (45-180 minutes), homework
Literature
Rosenberg, D.M. & V.H. Resh (ed.) (1992): Freshwater Biomonitoring and Benthic Macroinvertebrates. Springer, Chapman & Hall, New-York, 504pp. Davis, W.S. & T.P. Simon (1995): Biological Assessment and Criteria. Boca Raton, Lewis Publishers. Cooke, D., E.B. Welch, S.A. Peterson & S.A. Nichols (2005): Restoration and Management of Lakes and Reservoirs. 3rd edition. CRC Press, Boca Raton. Naiman, R.J., R.E. Bilby (ed.) (2001): River Ecology and Management. New-York, Springer. Firth, P. & S.G. Fisher (1992): Global Climate Change and Freshwater Ecosystems. New-York, Springer.
Further Information on the course (e.g. contact days, …..)

Willing students can do an optional presentation Numerous literature (pdf files) will be available on the internet; also course materials will be made available prior to the courses on ILIAS

Education Methodology (**M2.1b: determination**)
Introductory overview of the specific organism groups, systematic information on the groups, practical exercises in identification and application of determination keys, ecological background information, application of bioindicators, practical exercise in river assessment using different organism groups.
Learning targets
The students - get an overview on organism groups inhabiting fresh and marine waters - are capable to use determination keys - know about morphological and autecological characteristics of organism groups - understand the pros and cons with regard to the usage of bioindicators for aquatic monitoring.
Contents
Algae, Protozoa, Bivalvia, Gastropoda, Annelida, Entomostraca, Malacostraca, insect larvae, insect adults, insect special groups, fish, amphibians, birds; extension to macrophytes possible
Examinations
Written examination, Duration 45-180 min: Examination consists of a theoretical part (50%) and a determination exercise (50 %) (theory and practice)
Literature
Will be newly compiled for the purpose of the course and introduced during the classes. Overview of useful determination keys is subject to frequent updates and will be provided during the course.
Further Information on the course (e.g. contact days, …..)
None

Module Name	Abbreviation Module
Environmental analytics	EnviTox-MA-5
Responsible for the Module	Faculty
Prof. Dr. T. C. Schmidt	Chemistry

Relevance for following study programmes:	Module Level
Master Environmental Toxicology, Master Water Science	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
Second term	One term	C	10

Prerequisites according to examination regulations	Recommended Prerequisites
None	Basic knowledge in analytical chemistry

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
5.1	Applied Analytical Chemistry	VO/SE	3	150 h
5.2	Environmental analytics	PR/SE	7	150 h
Sum (Compulsory and Supplementary Courses)			10	300 h

Learning targets of the Module

- Students know modern methods of quantitative captures of xenobiotics and of detection of effects and are able to autonomous handle those methods in the laboratory and field work.
- Students understand the opportunities and limitations of instrumental analytical methods to obtain information on environmental systems.
- Students can critically interpret the results of the above mentioned methods in context of the given research hypothesis and the ecotoxicological context.
- They are able to use their knowledge to asses and integrate new research and test results
- They present results in oral and written form to different stakeholders.

Module examinations to gain grades	
First part of the examination: Written exam for 5.1. (Duration of the exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min) *Second part of the examination:* Reports on experimental work and method fundamentals plus Colloquium (Duration of the colloquium will be announced at the beginning of the lecture. It durates min. 15 and max. 45 min) For the module Grade: Grades of the examination parts are weighted accordingly to the credits of the respective lecture	
Contribution of the Module Grade for the Final Grade	10/119

Module Name	Abbreviation Module	
Environmental analytics	EnviTox-MA-5	
Course Name	Abbreviation Course	
Applied Analytical Chemistry	5.1	
Lecturer	Division	Module Type (C/S)
O. J. Schmitz	Analytical Chemistry	C

Designated Semester	Frequency	Language	no. Students/Course
Second term	SS	English	100

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	42 h	108 h	150 h

Education Methodology
Lecture (2 HPW) and Seminar (1 HPW)
Learning targets
Acquisition of basic theoretical and practical knowledge in applied analytical chemistry. The handling and preparation of samples and the reduction of matrix effects through application of appropriate analytical methods will be addressed. Students understand the opportunities and limitations of instrumental analytical methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They able to present their results in an oral and written way. Target analytical niveau: Eurocurriculum
Contents
Concrete knowledge transfer with regard to the chemical and analytical preparation of samples (material and environmental samples, biological samples): Handling of samples and analytical methodology with respect to the most important instrumental techniques of chromatography and mass spectrometry. Exemplary topics are: • Sampling and sample preparation. • Use of CE, GC, GCxGC, HPLC and LCxLC with various detectors such as mass analyzers or fluorescence detector for the development of analytical applications • Qualitative and quantitative determination of main, trace and ultratrace components
Examination
Written exam (Duration of the exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min)
Literature
Holler,Skoog, Crouch: Principles of Instrumental Analysis, International Student Edition (2007)
Further Information on the course (e.g. contact days, …..)
None

Module Name	Abbreviation Module	
Environmental analytics	EnviTox-MA-5	
Course Name	Abbreviation Course	
Environmental analytics	5.2	
Lecturer	Division	Module Type (C/S)
T.C. Schmidt	Analytical Chemistry	C

Designated Semester	Frequency	Language	no. Students/Course
Second term	SS	English	15

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
7	105 h	45 h	150 h

Education Methodology
Lab Course (6 HPW) and seminar (1 HPW)
Learning targets
Acquisition of practical knowledge in environmental analytical chemistry and an understanding of how to select and use appropriate analytical techniques to address environmentally relevant problems. By own measurements the students shall also realize that any analytical result comes with some uncertainty. This will help them in a critical appraisal of analytical data they encounter in other courses or their later career. Students know modern methods of quantitative captures of xenobiotics and of detection of effects. Students get an inside about current relevant research topics in special branches. They are able to analyse results.
Contents
Performance of environmental analytical methods with modern instrumental techniques covering the whole analytical process consisting of sample retrieval and preparation, measurement (qualitative and quantitative), and data evaluation. Error and uncertainty analysis will be an integral part of the evaluation step. Instrumental methods covered may include separation techniques (HPLC, GC), spectroscopic techniques, electroanalytical techniques and hyphenated methods applied to environmentally relevant problems.
Examination
Reports on experimental work and method fundamentals plus Colloquium (Duration of the colloquium will be announced at the beginning of the lecture. It durates min. 15 and max. 45 min)
Literature
e.g., Holler, Skoog, Crouch: Principles of Instrumental Analysis, 6th ed., Thomson, 2007
Further Information on the course (e.g. contact days, …..)
None

Module Name	Abbreviation Module
Effects on biological functions	EnviTox-MA-6
Responsible for the Module	Faculty
Prof. Dr. B. Sures	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
Second term	One term	C	15

Prerequisites according to examination Regulations	Recommended Prerequsites
None	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
6.1	Ecotoxicology II: Effects	VO/SE	3	120 h
6.2	Applied methods in (eco-)toxicology	SE/PR	6	180 h
6.3	Cellular toxicity	SE/PR	4	150 h
Sum (Compulsory and Supplementary Courses)			13	450 h

Learning targets of the Module
– Students know modern methods of quantitative captures of xenobiotics and of detection of effects in cells, plants and animals and are able to autonomous handle those methods in the laboratory and field work. – Students understand the opportunities and limitations of analytical methods to obtain information on effects on cells and organism. – Students can critically interpret the results of the above mentioned methods in context of the given research hypothesis and the ecotoxicological context. – They use their knowledge to asses and integrate new research and test results – They present results in oral and written form to different stakeholders.
Associated Key Qualifications
Basics in environmental toxicology; methods competence; promotion of problem-solving strategies; students know to develop a specific topic using recent literature and how to depict and clarify the topic in a written report and an oral talk.

Module examinations to gain grades	
First part of the examination: Oral and written exam for 6.1 and 6.2 (Duration of the exam will be announced at the beginning of the lecture. The written exam durates min. 45 and max. 180 min, the oral exam is in between 15 and 45 min) *Second part of the examination:* Written exam and protocol for 6.3 (Duration of the exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min) For the module Grade: Grades of the examination parts are weighted accordingly to the credits of the respective lecture	
Contribution of the Module Grade for the Final Grade	15/119

Module Name	Abbreviation Module	
Effects on biological functions	EnviTox-MA-6	
Course Name	Abbreviation Course	
Ecotoxicology II: Effects	6.1	
Lecturer	Division	Module Type (C/S)
B. Sures, H. Pfanz, S. Zimmermann	Applied Botany, Aquatic Ecology	C

Designated Semester	Frequency	Language	no. Students/Course
Second term	SS	english	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	42 h	78 h	120 h

Education Methodology
Seminar combined with lecture
Learning targets
The students gain insight into the multidisciplinarity and complexicity of ecotoxicology and get an overview of different toxicity tests as well as bioindication and biomonitoring methods. Students know modern methods of quantitative captures of xenobiotics and of detection of effects under laboratory and field conditions. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. They get an inside on current relevant research topics with local and global importance. They are able to analyse results.
Contents
Effects of selected toxic and/or environmentally relevant substances (e.g. metals, polychlorinated biphenyls, dioxins, halogenated hydrocarbons, endocrine disruptors, particles) at all levels of biological organization from cell to ecosystem. Biomarker, single and multi-species tests, acute and long-term tests, life-cycle tests, lab-to-field dilemma of toxicity tests, biological indication and monitoring,
Examination
Oral and written exam together with 6.2 (Duration of the exam will be announced at the beginning of the lecture. The written exam durates min. 45 and max. 180 min, the oral exam is in between 15 and 45 min)
Literature

Agrios GN (2004): Plant Pathology, 4 ed., Academic Press

Connell D.W., Lam P., Richardson B., Wu R. (1999) Introduction to Ecotoxicology, Wiley-Blackwell

Walker C.H., Hopkin S.P., Sibly R.M., Peakall D.B. (2006) Principles of Ecotoxicology, 3rd edition, CRC Press Taylor & Francis Group

Wright D.A., Welbourn P. (2002) Environmental Toxicology, 1st edition, Cambridge University Press

Fent K. (2007) Ökotoxikologie, 3. Auflage, Georg Thieme Verlag

Landis W.G., Yu M.-H. (2003) Introduction to environmental toxicology: impacts of chemicals upon ecological systems, 3rd edition, CRC Press;

Markert B.A., Breure A.M., Zechmeister H.G. (eds): Bioindicators and biomonitors. Elsevier Science B.V.

Schüürmann G., Markert B.A.: Ecotoxicology, John Wiley & Sons

large number of journal articles.

Further information
Compulsory attendance The presence of the student in the seminar is obligatory. If a student arrives later than 15 minutes after the start of a course, the lecturer will list this student in the attendance list as “absent” for this date. If the student misses more than twice the whole course is failed and has to be repeated in total the next summer semester.

Module Name	Abbreviation Module	
Effects on biological functions	EnviTox-MA-6	
Course Name	Abbreviation Course	
Applied methods in (eco-)toxicology	6.2	
Lecturer	Division	Module Type (C/S)
B. Sures, H. Pfanz, C. Wittmann, S. Zimmermann	Applied Botany, Aquatic Ecology	C

Designated Semester	Frequency	Language	no. Students/Course
Second term	SS	english	15

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
6	84 h	96 h	180 h

Education Methodology
Practical course (5 HPW) combined with seminar (1 HPW)
Learning targets
The students - get an overview of toxicological methods at all levels of biological organisation from the molecular level to whole communities and ecosystems - learn to plan, perform and evaluate toxicological tests and to use the appropriate equipment - gain information on biological effects of pollutants Students know modern methods of quantitative captures of xenobiotics and of detection of effects. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. They get an inside on current relevant research topics with local and global importance. They are able to analyse results.

Contents
- fundamentals on acute and chronic toxicity tests - biomarkers - biological monitoring of ecosystems in theory and praxis - bioaccumulation and bioavailability of xenobiotics in aquatic systems - toxicological tests using aquatic and terrestrial organisms
Examination
Oral presentation and written exam together with 6.1 (Duration of the exam will be announced at the beginning of the lecture. The written exam durates min. 45 and max. 180 min, the oral exam is in between 15 and 45 min)
Literature
• Connell D.W., Lam P., Richardson B., Wu R. (1999) Introduction to Ecotoxicology, Wiley-Blackwell • Walker C.H., Hopkin S.P., Sibly R.M., Peakall D.B. (2006) Principles of Ecotoxicology, 3rd edition, CRC Press Taylor & Francis Group • Wright D.A., Welbourn P. (2002) Environmental Toxicology, 1st edition, Cambridge University Press • Fent K. (2007) Ökotoxikologie, 3. Auflage, Georg Thieme Verlag • Landis W.G., Yu M.-H. (2003) Introduction to environmental toxicology: impacts of chemicals upon ecological systems, 3rd edition, CRC Press; • Markert B.A., Breure A.M., Zechmeister H.G. (eds): Bioindicators and biomonitors. Elsevier Science B.V. • Schüürmann G., Markert B.A.: Ecotoxicology, John Wiley & Sons • Merian E., Anke M., Ihnat M., Stoeppler, M. (eds): Elements and their Compounds in the Environment. Wiley-VCH, Weinheim
Further information
Compulsory attendance The attendance in the lecture “Safety instructions” is absolutely obligatory before starting with the practical work. The presence of the student in this practical course is obligatory. If a student arrives later than 15 minutes after the start of a course, the lecturer/supervisor will list this student in the attendance list as “absent” for this date. If the student misses more than twice the whole course is failed and has to be repeated in total the next summer semester.

Module Name	Abbreviation Module	
Effects on biological functions	EnviTox-MA-6	
Course Name	Abbreviation Course	
Cellular toxicity	6.3	
Lecturer	Division	Module Type (C/S)
E. Dopp, C. Johannes, N. Ruchter	Biology	C

Designated Semester	Frequency	Language	no. Students/Course
Second term	SS	english	15

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
4	56 h	94 h	150 h

Education Methodology
Practical course and seminar
Learning targets
The students - understand the influence of toxic agents on cellular functions and genomic damage - have an overview of toxicological cell culture methods and learn to handle cell cultures - know how to perform toxicological experiments - gain information on toxicological effects of pollutants Students know modern methods of quantitative captures of xenobiotics and of detection of effects. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. They get an inside about current relevant research topics in special branches. They are able to analyse results.
Contents
- fundamentals on toxicity tests in vitro - cell biology, cellular toxicity - Micronucleus test - Sister Chromatid Exchange - Algae Test - Neutral Red Retention Test
Examination
-/-Oral exam (15-45 minutes) and protocol
Literature
▪ Marquardt H., Schäfer S.G. (eds): Lehrbuch der Toxikologie. Spektrum, Heidelberg ▪ Lindl T (ed): Zell- und Gewebekultur. Spektrum, Heidelberg ▪ Greim H., Deml E. (eds.): Toxikologie. Wiley-VCH, Weinheim ▪ Lodish H., Berk A., Zipursky S.L., Matsudaira P., Baltimore D., Darnell J. (eds.): Molecular cell biology. Media Connected, England ▪ Actual OECD guidelines for standardized ecotoxicological testprotocolls

Further Information on the course (e.g. contact days, …..)
none

Module Name	Abbreviation Module
European environmental legislation	EnviTox-MA-7
Responsible for the Module	Faculty
Prof. Dr. Reinhard Zellner	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
Third term	One Term	C	8

Prerequisites according to examination regulations	Recommended Prerequsites
none	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
7.1	Introduction to EU-environmental legislation	VO	2	90 h
7.2	Assessment of Chemicals under REACH	VO/SE	3	150 h
Sum (Compulsory and Supplementary Courses)			5	240 h

Learning targets of the Module
- Students possess basic knowledge of the environmental legislation of the European Union relevant to environmental toxicology. - They use their skills to assess and interpretation of new research results. - They can address and evaluate ethical questions relevant to society and give new impulses, especially to topics related to „diversity“, „sustainability” and “resource protection”.

Module examinations to gain grades	
Written exam together for 7.1 and 7.2. (Duration of the exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min)	
Contribution of the Module Grade for the Final Grade	8/119

Module Name	Abbreviation Module	
European environmental legislation	EnviTox-MA-7	
Course Name	Abbreviation Course	
Introduction to EU-environmental legislation	7.1	
Lecturer	Division	Module Type (C/S)
Franßen, Pottschmidt	External lecturer	C

Designated Semester	Frequency	Language	no. Students/Course
Third term	WS	english	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
2	30 h	60 h	90 h

Education Methodology
Lectures; papers and presentations of students
Learning targets
The students possess basic knowledge of the environmental legislation of the European Union relevant to environmental toxicology. They use their skills to assess and file research results.
Contents
– water protection: directive 2000/60/EC establishing a framework for Community action in the field of water policy; directive 98/83/EC on the quality of water intended for human consumption; directive 91/271/EEC concerning urban waste water treatment; directive 2006/118/EC on the protection of groundwater against pollution and deterioration – - quality of ambient air: directive 96/62/EC on ambient air quality assessment and management; directive 2008/1/EC concerning integrated pollution prevention and control; related legislative acts – - waste management: directive 2008/98/EC on waste; directive 1999/31/EC on the landfill of waste; directive 2000/76/EC on the incineration of waste – - tackling climate change: directive 2009/31/EC on the geological storage of carbon dioxide – - chemical products: regulation 1907/2006/EC concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) – - environmental liability: directive 2004/35/EC on environmental liability with regard to the prevention and the remedying of environmental damaging
Examination
-/-written exam together with 7.2 (45-180 minutes)
Literature
▪ Will be announced during the course and will be available on Ilias
Further Information on the course (e.g. contact days, …..)
Course will be taught in a block with 7.2, beginning in the first week of the term

Module Name	Abbreviation Module	
European environmental legislation	EnviTox-MA-7	
Course Name	Abbreviation Course	
Assessment of Chemicals under REACH	7.2	
Lecturer	Division	Module Type (C/S)
R. Zellner, T. Schmiegelt	Chemistry, External lecturer	C

Designated Semester	Frequency	Language	no. Students/Course
Third term	WS	english	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	45 h	105 h	150 h

Education Methodology
Lectures, lecture notes and official REACH material
Learning targets
The students know methods and results of the assessment of chemicals including their exposure and behaviour in environmental compartments. Students get an inside about current relevant research topics in special branches. They are able to analyse results. They are able to participate in scientific discussions about current topics and to assess them critically.
Contents
– The need for a joint European assessment strategy of industrial chemicals – The derivation and assessment of physical chemical data of existing chemicals – The use of SAR techniques in the derivation of PC data of chemicals – The environmental behaviour of chemicals based on their physical chemical properties – The assessment of the exposure to industrial chemicals of humans and ecosystems – The comparison of modeled and measured exposure data - Ecotoxicological endpoints in chemical assessments within REACH
Examination
-/-Written exam together with 7.1 (45-180 minutes)
Literature
▪ Available text books, hand-out from lectures
Further Information on the course (e.g. contact days, …..)
Course will be taught in a block with 7.1, beginning in the first week of the term

Module Name	Abbreviation Module
Internship	EnviTox-MA-8
Responsible for the Module	Faculty
The supervisor of the Internship (Lecturer of the EnviTox program)	Biology and Chemistry

Relevance for following study programmes:	Module Level
Master Environmantel Toxicology	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
Third term	16 weeks	C	22

Prerequisites according to examination regulations	Recommended Prerequsites
None	Module 1-8

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
8.1	Internship	PR		660 h
Sum (Compulsory and Supplementary Courses)				660 h

Learning targets of the Module
- Students have the ability to effectively apply theoretical/practical knowledge and competencies to real-world problems in environmental toxicology. - They develop autonomous research questions and hypotheses. - They plan (research) projects under time and resources restrictions. - Students apply (research) projects with suitable methods. - They work in a multidisciplinary (and bi-/multinational) setting. - Students evaluate results, interpret them critically and bring them into an ecotoxicological context. - They communicate and cooperate with industrial managers, stakeholders, NGOs, and the general public and present results in a written and oral form to different stakeholders.

Module examinations to gain grades	
protocol	
Contribution of the Module Grade for the Final Grade	22/119

Module Name	Abbreviation Module	
Internship	EnviTox-MA-8	
Course Name	Abbreviation Course	
Internship	8.1	
Lecturer	Division	Module Type (C/S)
The supervisor of the Internship (Lecturer of the EnviTox program)		C

Designated Semester	Frequency	Language	no. Students/Course
Third term	WS	English (exceptions possible depending on the country)	

Duration	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
16 weeks			660 h

Education Methodology
Practical work in an institution/organisation in the field of Environmental Toxicology.
Learning targets
• The students have work and practical experience in environmental toxicology; • Have knowledge about current problems and apply theoretical/practical knowledge and competencies in practice; • Get insight into projects and activities; • Know how to act in multidisciplinary (and bi-/multinational) groups (communication skills). Students know modern methods of quantitative captures of xenobiotics and of detection of effects. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. The students have an inside about current relevant research topics in special branches. They are able to analyse results. They are able to participate in scientific discussions about current topics and to assess them critically.
Contents
– a) Elaboration of a small self-contained *project*, or b) carrying out *research* related to a project/activity in the field of Environmental Toxicology. The student's project/research is embedded in a larger project/activity carried out by the host institution/organisation.
Examination
-/-Protocoll
Literature
▪ Depending on the project or research topic

Module Name	Abbreviation Module
Master project	EnviTox-MA-9
Responsible for the Module	Faculty
The supervisor of the Master project (Lecturer of the EnviTox program)	Biology or Chemistry

Relevance for following study programmes:	Module Level
Master Environmental Toxicology	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
Fourth term	One term	C	30

Prerequisites according to examination regulations	Recommended Prerequsites
90 Credits	

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
9.1	Master Thesis			840
9:2	Master Colloquium			60
Sum (Compulsory and Supplementary Courses)				900 h

Learning targets of the Module
- Students have the ability to effectively apply theoretical/practical knowledge and competencies to real-world problems in environmental toxicology. - They develop autonomous research questions and hypotheses. - They plan (research) projects under time and resources restrictions. - Students apply (research) projects with suitable methods. - They work in a multidisciplinary (and bi-/multinational) setting. - Students evaluate results, interpret them critically and bring them into an ecotoxicological context. - They communicate and cooperate with industrial managers, stakeholders, NGOs, and the general public and present results in a written and oral form to different stakeholders.

Module examinations to gain grades	
Master Thesis (2/3), Colloquium (1/3)	
Contribution of the Module Grade for the Final Grade	30/119

Module Name	Abbreviation Module	
Master Project	EnviTox-MA-9	
Course Name	Abbreviation Course	
Master Thesis	9.1	
Lecturer	Division	Module Type (C/S)
The supervisor of the Master project (Lecturer of the EnviTox program)		C

Designated Semester	Frequency	Language	no. Students/Course
Fourth term	WS	Depending on thesis	

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
			840 h

Education Methodology
Experimental and theoretical work and evaluation and written documentation
Learning targets
– The Master Thesis is an experimental or theoretical work presented in written form showing that the students can perform and evaluate a scientific topic within 6 months time. The students will gain experiences with modern scientific methods. The students have the ability to effectively apply theoretical/practical knowledge and competencies to real-world problems in environmental toxicology. They are able to work in a multidisciplinary (and bi-/multinational) setting and to analyse and present complex matters. They have the ability to communicate and cooperate with industrial managers, stakeholders, NGOs, and the general public. The Students know modern methods of quantitative captures of xenobiotics and of detection of effects. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. The students have an inside about current relevant research topics in special branches. They are able to analyse results. They are able to participate in scientific discussions about current topics and to assess them critically.
Contents
– The projects will be provided by the lecturers. The students are free to choose the supervisor by themselves.
Examination
-/- Master thesis
Literature
▪ Depending on the topic of the master thesis
Further Information on the course (e.g. contact days, …..)
none

Module Name	Abbreviation Module	
Master Project	EnviTox-MA-9	
Course Name	Abbreviation Course	
Master colloquium	9.2	
Lecturer	Division	Module Type (C/S)
The supervisor of the Internship (Lecturer of the EnviTox program)		C

Designated Semester	Frequency	Language	no. Students/Course
Fourth term	WS	english	

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
2			60 h

Education Methodology
Presentation of the most important results of the thesis and discussion
Learning targets
– Student is able to reflect the results of the master thesis and to present it to a broad public with experts and non experts in his topic. He knows the background of his work and is able to set it into a wider context. The students have the ability to effectively apply theoretical/practical knowledge and competencies to real-world problems in environmental toxicology. They are able to work in a multidisciplinary (and bi-/multinational) setting and to analyse and present complex matters. They have the ability to communicate and cooperate with industrial managers, stakeholders, NGOs, and the general public. The Students know modern methods of quantitative captures of xenobiotics and of detection of effects. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. The students have an inside about current relevant research topics in special branches. They are able to analyse results. They are able to participate in scientific discussions about current topics and to assess them critically.
Contents
– Depending on the chosen field
Examination
-/- Presentation and discussion Duration of the complete exam: 60 min
Literature
▪ Depending on the masters thesis
Further Information on the course (e.g. contact days, …..)
none

Impressum

University of Duisburg-Essen

Faculty of Biology and Geography

Nadine Ruchter

Phone: 0201/183-3103

E-mail: envitox@uni-due.de

http://www.uni-due.de/envitox