V e r k ü n d u n g s b l a t t

der Universität Duisburg-Essen - Amtliche Mitteilungen

Jahrgang 13 Duisburg/Essen, den 12. Juni 2015 Seite 313 Nr. 72

Dritte Ordnung zur Änderung der Prüfungsordnung für den Masterstudiengang Water Science an der Universität Duisburg-Essen

Vom 03. Juni 2015

Aufgrund des § 2 Abs. 4 und des § 64 Abs. 1 des Gesetzes über die Hochschulen des Landes Nordrhein-Westfalen (Hochschulgesetz - HG) vom 16.09.2014 (GV. NRW. S. 547) hat die Universität Duisburg-Essen folgende Ordnung erlassen:

Artikel I

Die Prüfungsordnung für den Masterstudiengang Water Science an der Universität Duisburg-Essen vom 01. Juni 2012 (Verkündungsblatt Jg. 10, 2012 S. 377 / Nr. 55), zuletzt geändert durch zweite Änderungsordnung vom 10. Juni 2014 (VBl Jg. 12, 2014 S. 747 / Nr. 71), wird wie folgt geändert:

1. **§ 1 Abs. 4** wird wie folgt neu gefasst:

   „Es handelt sich um einen englischsprachigen Studiengang. Studierende müssen vor Aufnahme des Studiums englische Sprachkenntnisse entsprechend der abgeschlossenen Niveau-Stufe B2 des Gemeinsamen Europäischen Referenzrahmens für Sprachen (GER) nachweisen. Der Nachweis erfolgt in der Regel durch ein international anerkanntes Sprachzertifikat (z.B. TOEFL- Internet-based Test 100, IELTS Band 6.5) oder ein vergleichbares Zeugnis."

2. Die **Anlage 1: Studienplan** erhält die dieser Ordnung als Anlage 1 beigefügte Fassung.

3. Die **Anlage 2: Inhalte und Kompetenzziele der Module** erhält die dieser Ordnung als Anlage 2 beigefügte Fassung.

Artikel II

Diese Ordnung tritt am Tage nach ihrer Veröffentlichung im Verkündungsblatt der Universität Duisburg-Essen – Amtliche Mitteilungen in Kraft.

Ausgefertigt aufgrund des Beschlusses des Fakultätsrates der Fakultät für Chemie vom 23.04.2015 sowie des Eilentscheids des Dekans der Fakultät für Chemie vom 28.05.2015.

Duisburg und Essen, den 03. Juni 2015

Für den Rektor
der Universität Duisburg-Essen

Der Kanzler
In Vertretung

Frank Tuguntke

Anlage 1: Studienplan

Das Lehrangebot im Master-Studiengang Water Science erstreckt sich über zwei Jahre. Das Studium umfasst Lehrveranstaltungen aus dem Pflicht-, Wahlpflicht- und Wahlbereich, wie im nachfolgenden Regelstudienplan erklärt:

A) Required Modules:

Term	Module	Total Number of Credits for Modules	Course					Cr. per Course	Requirements	Exam
			Requirements	Course	HPW					
					L	S	P			
2	Applied Analytical Chemistry (ApplAnaC)	5	none	Applied Analytical Chemistry	2	1		5	none	Written Exam
2	Applied Microbiology (ApplMiBi)	6	none	Geomicrobiology Hygiene	2 2			3 3	none none	Written Exam for Module
3	Biofouling, Biocorrosion (Biof)	5	none	Biofouling, Biocorrosion	2	1		5	none	Written Exam
1	Chemometrics and Statistics (Chemo)	5	none	Chemometrics and Statistics	2	1		5	none	Written Exam
1 2	Environmental Microbiology (EnviMiBi)	12	none	Environmental Microbiology Practical Course Environmental Microbiology	2	1 1	 8	5 7	none	Written Exam for Module
3	Practical Analytical Chemistry (AnaC-P)	10	none	Practical Course Analytical Chemistry		1	14	10	none	
3	Research Practical (Res Pract)	10	AnaC-P, P EnviMiBi	Research Practical Course		1	14	10	none	Written Report
1	Water Chemistry (WatChem)	5	none	Water Chemistry	2	1		5	none	Written exam/ Presentation
4	Master Thesis	30	80 Cr. from the Master degree Programm	Master Thesis			0	30		Master Thesis

B) Optional Modules*:

Term	Module	Total Number of Credits for Modules	Course					Cr. per Course	Requirements	Exam
			Requirements	Course	HPW					
					L	S	P			
2	Advanced Mass Spectrometry (Adv MS)	3	none	Advanced Mass Spectrometry	1	1		3	none	Written or oral Exam
1 or 3	Electrochemistry and Electro-chemical Analysis (Electro)	5	none	Electrochemistry and Electrochemi-cal Analysis	2	1		5	none	Written Exam
1 or 3	Environmental Chemistry: Pollutants (EnviPoll)	5	none	Environmental Chemistry: Pollutants	2	1		5	none	Written or oral Exam
1 or 3	Environmental Chemistry: Soil/Waste (EnviSoil)	5	none	Environmental Chemistry: Soil/Waste	2	1		5	none	Written or oral Exam
1, 2 or 3	Excursions	1-5	none	Excursions	1-5			1-5	none	Written re-port (no grades)
2	Management (Manage)	6	none	Quality Manage-ment	1	1		3	none	Written Exam for Module
3				Project Manage-ment	2			3	none	
1 or 3	Membrane Tech-nologies (MemTech)	3	none	Membrane Tech-nologies	1	1		3	none	Written Exam
2	Metrology in Chemistry (Metrol)	2	none	Metrology in Chemistry	1			2	none	Written or oral Exam
2	Microbial Physiology (MicrobPhys)	3	none	Microbial Physio-logy	2			3	none	Written Exam
2	Oxidative Pro-cesses in Water Technology (OxProcess)	5	none	Oxidative Pro-cesses	2	1		5	none	Written or oral Exam and Presen-tation
2	Stable Isotope Analysis (SIA)	9	none	Stable Isotope Analysis	2	1		5	none	Written exam/ Presentation
				Practical Course			3	4	none	Written re-ports

2 3	Technical Engineering Water (TechEngWater)	9	none L Technical Engineering Water	Technical Engineering Water Practical Course	2	1	 3	5 4	none none	Written or oral Exam Written exam
1 or 3	Wastewater Treatment (WWT)	5	none	Wastewater Treatment	2	1		5	none	Written exam
1, 2 or 3	WaterPollution / Water Treatment (WatPoll)	5	none	Water Pollution / Water Treatment	2		1	5	none	Written or oral exam
1 oder 3	Nanopartikel und Kolloide (Nano)	5	none	Nanopartikel und Kolloide	2	1		5	none	Written or oral exam
1, 2 or 3	Polymers as Biomaterials (Biopolymer)	5	none	Polymers as Biomaterials	2	1		5	none	Written or oral exam
1, 2 or 3	Nano-Biophotonik (NABIP)	5	none	Nano-Biophotonik-Lecture Nano-Biophotonics - block internship and methods course	2		1	5	none	Written exam
2	Advanced Gas Chromatography (Adv GC)	3	none	Advanced Gas Chromatography	2			3	none	Written or oral exam
*		Additional to the list of optional courses students may choose any offered module from the M.Sc. Chemistry that is not already part of the Water Science curriculum. In the case of doubt the examination committee decides on the acceptance.								
Optional Courses MTW3		Out of the Master's Programme Management and Technology of Water and Wastewater (MTW3) students may choose any offered module that is not already part of the Water Science curriculum (Admission to modules needs to be arranged with the individual lecturers and may be limited to a certain number of students.)								
Optional Courses EnviTox		Out of the Master's Programme Environmental Toxicology (EnviTox) students may choose any offered module that is not already part of the Water Science curriculum (Admission to modules needs to be arranged with the individual lecturers and may be limited to a certain number of students.)								

Compulsory Courses	Applied Analytical Chemistry	25 Credits
	Biosciences	23 Credits
	Research Practical	10 Credits
Optional Modules		32 Credits
Master Thesis		30 Credits
Total		120 Credits

First Term	HPW	Cr	Exam
Chemometrics and Statistics	3	5	1
Environmental Microbiology	3	5	1
Water Chemistry	3	5	1
Optional Courses		**15**	**2-3**
Electrochemistry and Electrochemical Analysis	3	5	1
Environmental Chemistry: Soil/Waste	3	5	1
Environmental Chemistry: Poll			
Membrane Technologies	2	3	1
Wastewater Treatment	3	5	1
Water Pollution/ Water Pollution Monitoring	3	5	1
Nanopartikel und Kolloide	3	5	1
Polymers as Biomaterials	3	5	1
Nano-Biophotonik	3	5	1
Excursions	1-5	1-5	
Sum		30	5-6

Second Term	HPW	Cr	Exam
Applied AnaC	3	5	1
Env-MiBi-P	9	7	
Applied Microbiology	4	6	1
Optional Courses		**12**	**2-3**
Advanced Mass Spectrometry	2	3	1
Quality Management	2	3	
Metrology in Chemistry	1	2	1
Microbial Physiology	2	3	1
Oxidative Processes	3	5	1
Stable Isotope Analysis	6	9	1
Technical Engineering Water	3	5	1
Water Pollution/ Water Pollution Monitoring	3	5	1
Polymers as Biomaterials	3	5	1
Nano-Biophotonik	3	5	1
Advanced Gas Chromatography	1	2	1
Excursions	1-5	1-5	
Sum		30	4-5

Third Term	**HPW**	**Cr**	**Exam**
Biofouling, Biocorrosion	3	5	1
AnaC-P	15	10	
Research-P	15	10	
Optional Courses		**5**	**1**
Electrochemistry and Electrochemical Analysis	3	5	1
Environmental Chemistry: Pollutants	3	5	1
Environmental Chemistry: Soil/Waste	3	5	1
Project Management	2	3	1
Membrane Technologies	2	3	1
Technical Engineering Water-Practical Course	3	4	
Wastewater Treatment	3	5	1
Water Pollution/ Water Pollution Monitoring	3	5	1
Excursions	1-5	1-5	
Nanopartikel und Kolloide	3	5	1
Polymers as Biomaterials	3	5	1
Nano-Biophotonik	3	5	1
Sum		30	2
Fourth Term	**HPW**	**Cr**	**Exam**
Master-Arbeit	0	30	1
Sum		30	1
Total Sum		120	11-12

Anlage 2: Inhalte und Kompetenzziele der Module

Module	Contents	Authority Goals The students …
Applied Analytical Chemistry	Acquisition of basic theoretical and practical knowledge in applied analytical chemistry, in particular sampling, sample storage, sample preparation, X-ray analyses, qualitative and quantitative determination of main, trace and ultra-trace components as well as the ratio of stable and unstable isotopes	understand the opportunities and limitations of mmobilizatal analytical methods to obtain information on environmental systems.
Applied Microbiology	Fundamentals of Geomicrobiology, in particular formation and degradation of carbonates, mmobilitions with Si, P, N, As, Sb, Hg, Cr, geomicrobiology of Fe, Mn; An overview of the characteristics and epidemiology of water-related infectious diseases in particular transmission routes and reservoirs of water-related pathogens, hygienic aspects of water treatment, disinfection and water distribution	have knowledge how deeply microorganisms are involved in geochemical cycles. They are able to understand that microbial ecology, geochemistry and geology are closely connected. They obtain knowledge of the physiology and biochemistry of the microorganisms for the understanding of geochemical processes.
Biofouling, Biocorrosion	Fundamentals of Biofouling and Biocorrosion, in particular structure, function, growth, analysis of biofilms, biofouling in water systems and biocorrosion of mineral or metallic materials	learn about biofilms as the dominant form of microbial life on earth, the occurrence, the development, structure, function and analysis of biofilms.
Chemometrics and Statistics	A brief repetition of classical statistics and fundamentals of modern multivariate chemometric methods including factor analysis	are able to use these in modern chemometric data evaluation methods. They can solve problems within a programming environment.
Environmntal Microbiology	Fundamentals of Environmental Microbiology, in particular drinking water microbiology, microbiology of waste and waste water treatment, molecular ecology; The practical course contains microscopy of microorganisms, analysis of microbial communities through biomolecular methods (PCR methods), different cultivation methods for water and sediment microorganisms	understand the processes underlying drinking water and waste water purification by biological filtration. They will obtain knowledge about the basics of sediment mmobilology and bioremediation and get access to the basics of biotechnology.
Practical analytical Chemistry	In the Master practical course analytical chemistry students select topics suggested by all research groups involved in analytical chemistry training, covering topics from advanced spectrometry via hyphenation techniques to sophisticated mass spectrometry. Although only a limited and individually selected number of analytical techniques will thus be learned hands-on, this procedure contributes to the development of an individual study profile and due to the research orientation is much more motivating for the students than carrying out pre-selected experiments with known results.	can estimate and evaluate the advantages and disadvantages of different modern methods and special work techniques of analytical chemistry critically.
Research Practical	For a limited period a defined research project in one of the research groups. IT-supported literature searching, learning of typical experimental laboratory work, oral presentations, written reports	learn how to set-up a small-scale research project, to carry out the required experimental work independently in a limited period of time and to present their results in a written report and/or an oral presentation.

Water Chemistry	Fundamentals of water chemistry, in particular sorption processes and surfaces in aquatic systems, tools in aquatic chemistry, reaction kinetics and transformation	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.
Advanced Mass Spectrometry	Fundamentals of mass spectrometry, understanding of ionization, ion selection and detection, mass analyzers, fragmentation of ions in MS, compound characterization from spectra, understanding of hyphenated techniques, advantages and disadvantages of different analytical instruments, usability in regard to problem solving.	understand of the use of mass spectrometric methods, technical understanding of fundamental issues, learning to solve problems in analytical chemistry, technical understanding of fundamental issues.
Electrochemistry and Electrochemical Analysis	Fundamentals of electrochemistry, electrochemical methods and techniques, error of measurements, corrosion and corrosions protection, water treatment, detectors for liquid chromatography	can understand and to apply electrochemical methods and techniques in analytical chemistry, water treatment, corrosion and its protection.
Environmental Chemistry: Air	The composition of the atmosphere; in particular temperature profile and vertical structure; global circulation, Eddy-diffusion, long-range transport; atmospheric radiation, photochemistry of trace gases; atmospheric chemical cycles, radical chemistry; global CO_2 cycle; ozone depletion in the stratosphere	are to convey fundamental aspects of environmental chemistry in the air and water compartments.
Environmental Chemistry: Soil / Waste	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	have an insight into relevant environmental scenarios with regard to geogenic and anthropogenic impact.
Excursions	Excursion options may change according to willingness and ability of companies/operators to host student groups. Regular excursions are currently offered to an ultrafiltration plant for drinking water production in Roetgen, the Alfred-Wegener-Institute in Bremerhaven and the IRMM in Geel/Belgium.	get to know how large scale research facilities, advanced water works or wastewater treatment plants work.
Management	Quality assurance in analytics and production; Introduction into the terms Good Laboratory Practice, Accreditation, Certification and the corresponding guides like GLP, GMP, EN 45001 und ISO 9000 ff; Requirements concerning a quality management system, e.g. standard operating standard procedures (SOPs), manuals, test devices, validation of methods; Quality Control Charts; Metrology; Documentation and archiving of data; Software Applications; Fundament of project management, in particular project characteristics and success factor, project life cycle concept, role of project manager and work in project team	are able to establish and validate quality management and assurance systems.
Membrane Technologies	Fundamentals of membrane technologies, in particular types, materials and preparation, shape, membrane bioreactors	gain detailed insights into the fundamentals of membranes and membrane separations as well as the most important membrane technologies which are applied to water treatment and/or purification.
Metrology in Chemistry	Metrology and the analytical process, metrological traceability, measurement uncertainty, mmobilical quality assurance, ISO 17025, method validation, reference materials, international standardisation, European measurement infrastructure	understand the fundamental concepts of metrology and their application in chemical analysis.

Microbial Physiology	Fundamentals of metrology, in particular basic metabolism, anabolism, photosynthesis, fermentation of organic compound	get an overview of all relevant metabolic types of microorganisms: from the basic metabolic cycles to the metabolism of special bacteria effecting the cycling of elements on Earth.
Oxidative Processes in Water Technology	Oxidative species/processes of interest: Chlorine, Chlorine dioxide, Ozone, Fenton, UV, Permanganate, Hydroxyl radicals, Other radicals, Ferrate; Transformation reactions: electron transfer, H-abstraction, electrophilic addition; Kinetics of transformation reactions; Applications in water treatment (including disinfection); Applications in wastewater treatment; Disinfection/transformation by-products; (Eco)toxicological evaluation; economical considerations	obtain an overview of routine and state-of-the-art mmobtive processes used in water and wastewater treatment.
Stable Isotope Analysis	Isotope fundamentals, isotope fractionation, referencing and calibration; Instrumentation, principles of isotope analysis; Gas source isotope ratio mass spectrometry (C, H, N, and O), bulk techniques: dual inlet, continuous flow, compound specific isotope analysis, position-specific isotope analysis; Isotope analysis of heavy elements: multicollector-ICP-MS, thermal ionization MS (e.g., Fe, Ca, Sr, Pb); Applications of stable isotope analysis in environmental science (source apportionment, transformation (extent and pathways), food sciences (food adulteration, food origin), geosciences (tracing of geochemical pathways by stable isotopes), forensic sciences (doping analysis).	get to know the principles and instrumentation in modern stable isotope analysis with emphasis on light elements.
Technical Engineering Water	Basics knowledge and practical orientated knowledge for the following water treatment processes, in particular oxidation processes, ion exchange, gas exchange, flocculation, sludge treatment, membrane processes	learn the theoretical basics of different processes in drinking water treatment, and basic knowledge for the practical design.
Wastewater Treatment	Sources and composition of wastewater, basic biological processes, activated sludge plants, trickling filters, nitrification, denitrification, P-elimination, anaerobic processes, sludge treatment, mass balances; Pollution of surface waters with organic contaminants such as pesticides, detergents, plasticisers, and endocrine disruptors. Sources of pollution: Point sources like sewage treatment plants, diffuse sources like agriculture, air-water gas exchange (PAHs, PCBs) Fate of contaminants in surface waters: Hydrolysis, metabolisation, sediment interaction. Fate of contaminants in wastewater treatment, as well as drinking water. Effects: biomagnification, acute toxicity, chronic toxicity Differences in highly used and remote water bodies (urban waters, remote areas like Arctic Seas) Legal issues: Water Framework Directive. Complyment with target concentration. Sampling strategies: Why is sampling performed-diverse targets: pollution control, safeguard drinking water production, healthy ecosystems, fish production / bio-accumulating compounds Sampling techniques Analytical techniques: Internal standards, recovery rates, method validation. Extraction techniques: SPE, LLE, Clean-ups, Drafting and experimentally testing an own sampling strategy, performing the sampling and analysis of own field samples, interpretation of results	understand the fundamentals in the field of Urban Water Management. Are able to develop and assess sampling strategies under the diverse rationales. They are able to realistically assess field and monitoring data.
Nano	Grundlagen der Kolloidchemie; Spezielle Eigenschaften von Nanopartikeln; Synthese von Nanopartikeln; Anwendung von Nanopartikeln und -materialien; Charakterisierung von Nanopartikeln	anhand von Fallbeispielen aus der Nanotechnologie die Vermittlung von funktionellen Eigenschaften durch Nanopartikel erläutert.

Polymere as Biomaterials	Reactions at interfaces between polymers and an aquatic-biological environment, foreign-body reaction (tissue-implant-interaction); Biocompatibility, hemocompatibility (in vitro/in vivo characterization methods); Biocompatible polymers (permanent, biodegradable, resorbable); Bulkmodifications of polymers (immobilization n, polymerblends, chemical modifications); Surface engineering (coatings, structuring, plasma- and wet-chemical treatments), characterization methods (e.g. microscopy, contact angle, ATR-FTIR); Biofunctionalization (adsorption, layer-by-layer deposition, covalentimmobilization), characterization methods (e.g. SPR, quartz crystal microbalance); Drug delivery systems (diffusion-, degradation- and swelling-controlled systems, polymer-drug-conjugates), models and methods to examine drug release (HPLC, ELISA, proteinassays); Medical/Biological application of surface engineered polymers (e.g. vascular prostheses, suture materials, tissue engineering, etc.	will gain detailed insights into the fundamentals of reactions at interfaces between polymers and the aquatic-biological environment, polymer surface engineering processes to control such reactions and analytical methods for surface characterization and determination of biocompatibility. At the end of the course, students will be able to evaluate the applicability of polymers as biomaterial as well as to name suitable modification methods.
Nano-Biophotonik	Introduction to the exciting novel concepts of NanoBiophotonics, Nanobiomaterials, Characterization and Functionalization of nanobiomaterials, Biophotonic methods, strategies and case studies, Diagnostic methods of NanoBiophotonics, Therapeutic approaches of NanoBiophotonics. Methods to design and apply nanomaterials in life science using light. Practical couses include the following three branches: NANO: synthesis, (bio) functionalization, characterization, stabilization BIO: imaging, biomolecules, nanobiomaterials, assays PHOTO: spectroscopy, laser / optics, plasmonics	gain basic knowledge at the topical intersections of nanomaterials, biology and photonics. They will know modern methods of Nanobiophotonics, how biological and optical functions can be designed using nanomaterials and photonic tools useful in biology and medical diagnosis and therapy. In the case studies, students should be able to find a suitable nanomaterial as solution for a biological or biomedical exercise with the tool "Light". They are able to select synthesis routes, biofunctionalization and appropriate characterization methods for specific problems, these apply and estimate. The theoretical knowledge of these three areas "nano", "bio" and "photonics" will be experimentally proved in the small groups during the internship
Advanced Gas Chromatography	Hyphenation chromatographic techniques, interface techniques, large volume injections in GC, solvent effects, basics in capillary column technology, presentation and discussion of examples from various application fields.	understanding pros and cons of advanced chromatographic techniques and their technical implementation with a particular respect to hyphenated techniques and large volume injection methods in gas chromatography. Another key aspect will be the understanding of fundamental issues for the enantiodifferentiation of volatile chiral compounds, learning to optimize a separation and being able to choose appropriate conditions in enantioselective GC separations.