- UNOFFICIAL VERSION -

Departmental Examination Regulations (FPO-M) for the

Master's Degree in

Engineering of Hydro-Environmental Extremes (HDE)

at the
University of Siegen

Dated 3 July 2024

These regulations are based on the wording of:

- The *Fachprüfungsordnung (FPO-M) für das Fach Engineering of Hydro-Environmental Extremes (HDE) im Masterstudium an der Universität Siegen* dated 3 July 2024 (*Amtliche Mitteilung* 45/2024).

Note: This English translation is provided solely for convenience; only the German version as formally published in an *Amtliche Mitteilung* from the University of Siegen is legally binding. In case of discrepancies, the German text shall prevail.

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Article 1
Scope

(1) These Departmental Examination Regulations, together with the General Examination Regulations for the Master's Degree (RPO-M) at the University of Siegen dated 28 February 2019 (*Amtliche Mitteilung* 5/2019), as amended, govern studies in the subject of Engineering of Hydro-Environmental Extremes (HDE).

(2) Article 2 contains regulations for studies in the subject of engineering of hydro-environmental extremes as a single subject degree program.

Article 2
Regulations for the Single Subject Degree Program Engineering of Hydro-Environmental Extremes

§ 1
Degree Program Model

Engineering of Hydro-Environmental Extremes is structured as a single subject degree program.

§ 2
Objectives for the Degree Program

The master's degree program in Engineering of Hydro-Environmental Extremes at the University of Siegen leads to an academic qualification that prepares graduates for professional roles in scientific consulting in the field of Engineering of Hydro-Environmental Extremes and provides them with the competencies required for independent research leading to a doctorate in one of the related subdisciplines of civil engineering, environmental sciences, geosciences, mechanical engineering, or computer science. Alongside the academic qualification, the degree program also seeks to produce highly qualified project engineers for industry, business, and government agencies.

Based on a first-cycle degree, the master's degree program leads to the acquisition of skills in analysis, argumentation, problem solving, and methodology in the field of hydro-environmental extremes engineering. This includes not only proficient usage of many modern modeling tools, but also quantification of the risk and resilience of flood and drought extremes, integrated river basin management and water quality management as well as reliability analysis for building design for climate resilience and under extreme conditions.

Graduates of the degree program acquire in-depth insights and skills in the most important areas of construction and environmental engineering and computer science, with a clear focus on the newly emerging field of hydro-environmental extremes. This puts them in a position to work in the interdisciplinary field of hydro-environmental extremes and to master crucial global topics such as the risk of environmental extremes and climate change, which must be addressed to improve civil security and the resilience of our infrastructure and, with it, our society. Due to the interdisciplinary character of the degree program, graduates are in a position to research in relevant fields at the intersection between civil and environmental engineering on the one hand and computer science and mechanical engineering on the other. The graduates acquire both fundamental insights and modern methodologies in several up-and-coming areas of modern engineering, including artificial intelligence, scientific visualization, and advanced numerical methods, allowing them, among other things, to work at leading industrial and service companies. Graduates of the program are also qualified for fundamental science research at the university level. Last but not least, students acquire the ability to work in teams and engage in successful social/intercultural interactions.

§ 3
Master's Degree

After successful completion of the degree program, the university awards the academic degree of "Master of Science" (M.Sc.).

§ 4
Special Admission Requirements

(1) In addition to § 4 RPO-M, the following proof is required for admission:

1. A bachelor's degree (including as part of a cooperative degree program [*duales Studium*]) in the fields of civil engineering, mechanical engineering, or computer science at the University of Siegen, or
2. A bachelor's degree of at least three years (including as part of a cooperative degree program [*duales Studium*]) in the fields of civil engineering, mechanical engineering, computer science, environmental sciences, geology (including engineering geology and hydrogeology), geosciences, geography, or geophysics at a public or publicly accredited higher educational institution subject to the German Basic Law, or
3. Another course of study in a comparable specialization and lasting at least three years, culminating in a completed bachelor's degree examination or a comparable final examination, at a public or publicly accredited higher educational institution, either subject to the German Basic Law or not. The Examination Board decides on the comparability. The programs will be considered comparable if it is determined that there are no substantial differences between the degrees and degree programs denoted in No. 1 and No. 2.

(2) The bachelor's degree must be a qualifying degree as defined in § 4 Para. 2 RPO-M. The bachelor's degree is a qualified degree if the bachelor's degree is completed with at least a grade of 2.7 [*based on the German grading system*].

(3) One additional prerequisite is proof of English-language proficiency at the B2 level under the Common European Framework of Reference for Languages (CEFR).

(4) Enrollment shall be denied to any applicant who has finally failed an examination required under these examination regulations in a degree program of substantially similar content to this degree program.

§ 5
Study Abroad and Internships

Neither study abroad nor internships are compulsory.

§ 6
Examination Board

(1) To handle the responsibilities denoted in § 8 RPO-M and in this article, Faculty IV: School of Science and Technology forms a Departmental Examination Board for the single subject degree program *Engineering of Hydro-Environmental Extremes*. The Examination Board may delegate tasks to the Office of Examinations.

(2) The Departmental Examination Board comprises

1. four members of the teaching faculty,

2. one member of the academic staff, and
3. two members of the student body.

(3) The term of office for members of the teaching faculty and members of the academic staff is two years. The term of office for members of the student body is one year.

(4) For members pursuant to Paragraph 2, deputies shall be elected in the event that appointed members are unable to attend, with a term of office based on Paragraph 3.

§ 7
Examiners, Observers

(1) Authority to conduct examinations is governed by § 9 RPO-M.

§ 8
Credit Point Requirements and Structure of the Degree Program

(1) Successful completion of the master's degree program in Engineering of Hydro-Environmental Extremes requires 120 credit points (CP).

(2) The standard term of study is four semesters. The course of studies can be undertaken full time. It is only possible to start the degree program in the winter semester.

(3) The structure of the master's degree program in *Engineering of Hydro-Environmental Extremes* varies based on the nature of the previously completed bachelor's degree. The course of study encompasses: an alignment block (6 CP; cf. Paragraph 4 and Paragraph 5) based on the student's previous education; a general compulsory block comprising six modules (36 CP; 4BAUMA26, 4BAUMA28, 4BAUMA29, 4BAUMA37, 4HDEMA01, and 4BAUMA24); the core elective block (48 CP; cf. Paragraph 6 in conjunction with Annex 4); and the master's thesis (30 CP; 4HDEMA100).

(4) Within the framework of the alignment block to be completed during the first semester, bachelor's degree holders in

1. the fields of civil engineering, environmental sciences, geology (including engineering geology and hydrogeology), geosciences, geography, geophysics, or a comparable degree program complete module 4INFMAEX901 ("Introduction to Programming");
2. the fields of mechanical engineering, computer science, or a comparable degree program complete module 4HDEMA02 ("Water challenges in a changing world").

If the previous educational level cannot be clearly categorized, then the Examination Board evaluates the individual case based on the underlying bachelor's degree as part of the admission to the master's degree program and assigns the candidate to the respective alignment block. If the module to be taken in the alignment block was already completed as part of the bachelor's program, then the Examination Board will decide on an alternative module to be taken in accordance with Sentence 2.

(5) From the core elective courses, modules totaling 48 CP must be completed from the catalog in Annex 4. If the module 2ARCHMAEX02 "Sustainable Urban Planning" is selected as a core elective module and more than 48 CP are acquired, then students must apply before the end of the degree program for recognition of the module as a core elective and indicate which 6 CP module will have only 3 CP recognized to ensure that 48 CP are earned in sum in the core elective area. The module that is assigned pursuant to Paragraph 4 to the relevant alignment block cannot be taken again.

(6) Module Overview:

No.	Module	CW[1]	GA[2]	CP[3]	C / CE[4]	Link to Module Description
Alignment Block				**6**	**C**	
Alignment block for prior education in civil engineering and environmental sciences, geology (including engineering geology and hydrogeology), geosciences, geography, and geophysics						
4INFMAEX901	Introduction to Programming	0	1	6	C	FPO-M INF
Alignment block for prior education in mechanical engineering or computer science						
4HDEMA02	Water challenges in a changing world	1	1	6	C	Annex 7
Compulsory Block				**36**	**C**	
4BAUMA24	Geotechnical Aspects in Water and Environment	0	1	6	C	FPO-M BAU
4BAUMA26	Integrated River Basin Management	0	1	6	C	FPO-M BAU
4BAUMA28	Process-based Hydrological Modelling	0	1	6	C	FPO-M BAU
4BAUMA29	Flood Risk and Resilience in Hydraulic Engineering	0	1	6	C	FPO-M BAU
4BAUMA37	Urban Flood Modelling	0	1	6	C	FPO-M BAU
4HDEMA01	Uncertainty in soil mechanics and water resources	0	1	6	C	Annex 7
Core Elective Courses				**48**	**CE**	
	Modules totaling 48 CP	0-6	7-9	48		Annex 4
Master's Thesis				**30**	**C**	
4HDEMA100	Master's Thesis Engineering of Hydro-Environmental Extremes	0	1	30	C	Annex 7

[1] CW = Coursework | [2] GA = Graded Assessment | [3] CP = Credit Points | [4] C/CE = Compulsory/Core Elective.

The recommended specialist semester (*Fachsemester*) is determined from the standard course sequence (Annex 1).

(7) Potential instructional formats are: Lecture, exercise, lecture with integrated exercise, seminar, specialty laboratory, and interdisciplinary project group. The instructional format can be determined from the module description.

(8) Instruction is typically conducted in English. Individual courses within the core elective module can also be conducted in German. The language of instruction is denoted in the module description. Insofar as the language of instruction is not clearly defined, the instructor announces the language of instruction no later than two weeks after the start of the respective course.

§ 9
Coursework and Graded Assessments

(1) In addition to § 10 para. 1 and § 11 para. 6 RPO-M, the following formats are stipulated for coursework and graded assessments:

1. Coursework:

   a) Written assignment (as project work or term paper; up to 60 pages; alongside the written assignment, an oral assignment (such as a report or presentation) of up to 30 minutes can be required);

   b) Active participation (such as in project presentations with follow-on discussion);

   c) Course engagement (such as through participation in field inspections);

   d) Written homework (up to 20 pages);

e) Presentation (such as a project; up to 30 minutes);

f) Excursion (1/2 to 5 days);

g) Online test (for example formative assessments using the E-Assessments tool in Moodle to check one's own understanding; up to 30 minutes)

h) Successful completion of exercises and project tasks (approx. 12 tasks; approx. 45 hours)

Form and scope of active participation and course engagement are announced by the instructors at the start of the course.

2. Graded assessments:

a) Written assignment:

Up to 120 pages; alongside the written assignment, an oral assignment (such as a report or presentation) of up to 60 minutes and/or an oral examination of up to 30 minutes can be required;

b) Project work:

In general, written assignments up to 120 pages; depending on the discipline and task, this scope can grow (for example for written assignments that primarily contain calculations, or surveys of literature);
Alternatively, the composition of an academic poster (in A0 format) can be required; in addition to the written work (assignment or poster), an oral component (such as a report or presentation) of up to 30 minutes and/or a submission appointment of up to 60 minutes can be required; the project work can also take place in small groups.

c) Oral examination (20–60 minutes)

(2) The following requirements must be satisfied for admission to graded assessments in the following modules:

Prerequisite	Module
Successful completion of the coursework in module	• 4HDEMA02 “Water challenges in a changing world” • 4INFMA202 “Scientific Visualization” • 4INFMA204 “Deep Learning” • 4INFMA207 “Numerical Methods for Visual Computing” • 4INFMA210 “Virtual Reality”

(3) Students can, upon application, perform additional coursework or graded assessments (supplemental coursework or assessments). Such supplemental coursework or assessments can involve coursework and graded assessments from modules that were not chosen. Supplemental coursework or assessments are not taken into account for the final grade; no credit points are awarded in this degree program for supplemental coursework or assessments. Passed supplemental coursework or assessments are by default included in the Transcript of Records; they can be removed by request. Students who wish to exercise this option must submit their application to the Office of Examinations prior to the announcement of examination results for the last graded assessment in the degree program. A module completed and denoted as supplemental coursework or assessments cannot be registered and denoted as completed academic work in the core elective area.

(4) Coursework and graded assessments can only be performed by students enrolled in the master's degree program Engineering of Hydro-Environmental Extremes. Students in the bachelor's degree programs civil engineering, mechanical engineering and computer science (including as co-op [*Duales Studium*]) at the University of Siegen can, upon application, complete coursework and graded assessments in the master's degree program Engineering of Hydro-Environmental Extremes insofar as the respective module description does not explicitly require a completed bachelor's degree. Prerequisite for an application as per Sentence 2 is that a student in the bachelor's degree program civil engineering or co-op degree in civil engineering at the University of Siegen has already completed study phases one and two of the respective degree program (c.f. Article 2a and b § 8 Para. 3(1) and (2) FPO-B BAU). Students from other degree programs must already have acquired at least 120 CP in their bachelor's degree program. Application for admission to the examinations in a master's degree program HDE must be submitted in writing to the responsible Examination Board.

§ 10
Repetition of Graded Assessments

(1) Repetition of examinations/assessments is governed by § 12 RPO-M.

(2) Appointments for repeating failed examinations/assessments are offered twice annually. For the module 2ARCHMAEX02, 4BAUMA24, 4BAUMA25, 4BAUMA26, 4BAUMA27, 4BAUMA28, 4BAUMA29, 4BAUMA30, 4BAUMA37, 4INFBA013, 4INFMAEX901, 4INFMA202, 4INFMA204, 4INFMA207, and 4INFMA2010, the regulations of the respective applicable departmental examination regulations may deviate.

(3) In the event of a finally failed written module examination, the candidate can apply to the Examination Board for an oral supplemental examination; such application must be made within two weeks after the announcement of examination results. Sentence 1 does not apply for modules 4INFBA013, 4INFMAEX901, 4INFMA202, 4INFMA204, 4INFMA207, or 4INFMA210, as no supplemental examination is possible for these. The supplemental examination does not represent a stand-alone repetition of the examination and should be completed within four weeks after application. Participation in the oral supplemental examination can lead to a raising of the grade for the failed repeat examination to 4.0 (Sufficient [*ausreichend*]); otherwise the assessment will be graded as failed and graded as a 5.0 (Failing [*mangelhaft*]). The supplemental examination is to last at least 45 minutes and will be conducted jointly by the examiners of the finally failed written module examination. The supplemental examination cannot be repeated. A supplemental examination is precluded in the cases of § 18 Paragraphs 1, 5, 5a, 6, and 8 as well as §18a RPO-B.

(4) If two core elective modules as per § 8 Para. 6 are finally failed, then the master's degree program *Engineering of Hydro-Environmental Extremes* is finally failed.

§ 11
Master's Thesis

(1) The Master's Thesis component (master's thesis and colloquium) accounts for 30 credit points (CP) in the master's degree.

(2) Application for admission to the Master's Thesis must be submitted in writing or electronically to the Examination Board. Admission to the Master's Thesis is governed by § 13 RPO-M. The Master's Thesis may not be registered until, depending on the applicable adjustment block pursuant to § 8, all modules in the first and second semester as per the respective standard course sequence (see Annex 1) have been successfully completed for a total of 60 CP.

(3) The maximum completion time allowed for the Master's Thesis is nine months. The Master's Thesis generally comprises up to 120 pages (although this can be increased depending on the specific discipline and task).

(4) The topic of the Master's Thesis will be issued by the Examination Board. The topic may only be returned once, within four weeks after registration. If the Master's Thesis is repeated, the topic for the Master's Thesis may only be returned if the candidate did not already do so during the preparation of the first work.

(5) Any portions of the work that quote other works, either verbatim or in substance, must be denoted as such, including a citation of the source. The candidate adds a written pledge to the thesis confirming that they completed it on their own, did not use any sources or aids other than those cited, and that all quotations are attributed as such.

(6) The Master's Thesis must normally be prepared in the English language. In exceptional cases and where agreed upon by the examiner, the candidate can apply for the Master's Thesis to be composed in German.

(7) The Master's Thesis comprises a German-language and an English-language synopsis, each one page, although the German synopsis is not considered for grading purposes. Two bound copies of the Master's Thesis, as well as an electronic and searchable version, together with all annexes (such as programming code, models, technical drawings, and circuit schematics) are to be submitted to the Examination Board no later than noon on the due date; extensive annexes or attachments (such as project documents or program documentation) may only be submitted in electronic form. The electronic copy, including all annexes and attachments, serves as the basis for grading by the first and second examiners. It may be used to review the originality of the work using plagiarism detection software.

(8) The Master's Thesis is defended in a colloquium (approx. 15-30 minute presentation followed by approx. 30-45 minute discussion) with both examiners. The grade for the colloquium represents 18% of the overall grade for the Master's Thesis.

§ 12
Grades, Calculation of Grades

(1) The assessment and calculation of grades is governed by § 21 RPO-M.

(2) When calculating an overall grade comprising several individual grades, only the first decimal place is taken into account; all further places are dropped without rounding.

§ 13
Application and Transitional Rules

These Departmental Examination Regulations apply for all students who have enrolled for the first time in this master's degree program at the University of Siegen starting with winter semester 2024/2025.

Article 3
Regulations for Study as a Degree Component as Part of a Combination Degree Program (Non-Teacher Education)

Not assigned.

Article 4

Not assigned.

Article 5
Cross-Disciplinary Export Modules

Not assigned.

Article 6
Entry into Effect and Publication

(...)

This set of regulations governs the entry into effect of the original Departmental Examination Regulations.

Annexes

Standard Course Sequences

Annex 1: Standard course sequences by degree model for single subject degree programs in Article 2

Single subject degree program for prior education in civil engineering and environmental sciences, geology (including engineering geology and hydrogeology), geosciences, geography, and geophysics

Standard Course Sequence					
No.	**Module**	**WS**	**SS**	**WS**	**SS**
Alignment Block (6 CP)					
4INFMAEX901	Introduction to Programming	6			
Mandatory Area (36 CP)					
4BAUMA26	Integrated River Basin Management	6			
4BAUMA28	Process-based Hydrological Modelling	6			
4BAUMA37	Urban Flood Modelling	6			
4BAUMA29	Flood Risk and Resilience in Hydraulic Engineering		6		
4HDEMA01	Uncertainty in soil mechanics and water resources	6			
4BAUMA24	Geotechnical Aspects in Water and Environment		6		
		Core Elective Modules (48 CP)			
	2 to 3 core elective modules from Annex 4		18		
	3 to 4 core elective modules from Annex 4			24	
	1 core elective module from Annex 4				6
4HDEMA100	Master's Thesis			6	24
		30 CP	30 CP	30 CP	30 CP

Single subject degree program if previous education in mechanical engineering and computer science

Standard Course Sequence					
No.	**Module**	**WS**	**SS**	**WS**	**SS**
Alignment Block (6 CP)					
4HDEMA02	Water challenges in a changing world	6			
Mandatory Area (36 CP)					
4BAUMA26	Integrated River Basin Management	6			
4BAUMA28	Process-based Hydrological Modelling	6			
4BAUMA37	Urban Flood Modelling	6			
4BAUMA29	Flood Risk and Resilience in Hydraulic Engineering		6		
4HDEMA01	Uncertainty in soil mechanics and water resources	6			
4BAUMA24	Geotechnical Aspects in Water and Environment		6		
		Core Elective Modules (48 CP)			
	2 to 3 core elective modules from Annex 4		18		
	3 to 4 core elective modules from Annex 4			24	
	1 core elective module from Annex 4				6

4HDEMA100	Master's Thesis			6	24
		30 CP	30 CP	30 CP	30 CP

Annex 2: Standard Course Sequences by Degree Model in Combination Degree Program (Non-Teacher Education) in Article 3

Not assigned.

Annex 3: Standard course sequences by degree model in teacher education in Article 4

Not assigned.

Core Elective Modules

Annex 4: List of core elective modules pursuant to Article 2 § 8 para. 4

No.	Module	CW	GA	Credit Points	Link to module description
4BAUMA25	GIS application — Development	0	1	6	FPO-M BAU
4BAUMA27	Wassergüte-/Wassermengenwirtschaft (Water Quality and Quantity Management)	0	1	6	FPO-M BAU
4BAUMA30	Bemessung wasserbaulicher Anlagen (Design of Hydraulic Structures)	0	1	6	FPO-M BAU
4HDEMA03	Reliability assessment for civil engineering structures	1	1	6	Annex 7
2ARCHMAEX02	Sustainable Urban Planning	0	1	3	Annex 7
4HDEMA05	Computational fluid Dynamics	0	1	6	Annex 7
4HDEMA04	Interdisciplinary project group	0	1	12	Annex 7
4HDEMA02	Water challenges in a changing world	1	1	6	Annex 7
4INFBA013	Introduction to Machine Learning	0	1	6	FPO-B INF
4INFMA202	Scientific Visualization	1	1	6	FPO-M INF
4INFMA204	Deep Learning	1	1	6	FPO-M INF
4INFMA207	Numerical Methods for Visual Computing	1	1	6	FPO-M INF
4INFMA210	Virtual Reality	1	1	6	FPO-M INF
4INFMAEX901	Introduction to Programming	0	1	6	FPO-M INF

Annex 5: List of core elective modules pursuant to Article 3 § 8 para. 4

Not assigned.

Annex 6: List of core elective modules pursuant to Article 4 § 8 para. 4

Not assigned.

Annex 7: Module Descriptions for Article 2-4

No.	4HDEMA01	
Module Title	Uncertainty in soil mechanics and water resources	
Compulsory/Core Elective	C	
Module Length	1 semester	
Frequency	WS	
Language of Instruction	English	
Credit Points	6	
Weekly Contact Hours	4	
On-Campus Study	60 h	
Independent Study	120 h	
Workload	180 h	
Instructional Format	**Courses/Module Elements (if applicable)**	**Weekly Contact Hours**
Lecture	Uncertainty in soil mechanics and water resources	3
Seminar	Uncertainty in soil mechanics and water resources	1
Academic Requirements	**Format**	**Length / Scope**
Graded Assessments	Written examination	120 min
Coursework	None	
Learning Outcomes	Students have a basic understanding of uncertainties related to environmental processes (spatial heterogeneity, soil properties, weather, flow processes), their interrelations and representation in environmental modelling. For this, the course is divided into three parts: <u>Part 1: Concepts of uncertainty characterization</u> • Basic understanding of uncertainty quantification and assessment, including the concept of predictive probability density. • Basic understanding of Bayesian theory (prior distributions, likelihood and posterior distributions) for model parameterisation. • Basic understanding of stochastic modelling of time-dependent environmental processes (e.g. Markov chain modelling). • Skill acquisition in the use of statistical and graphical libraries for representation in Python (scipy, matplotlib). <u>Part 2: Uncertainties in water resources</u> • Students learn to understand uncertainty in water resources-related problems (flow forecasting, reservoir management). Acquaintance of students with the relative role of uncertainties in water resources management (meteorological and climate uncertainty vs. model and parameter uncertainty). • Students will learn how to address parameter uncertainty through Bayesian inference. • Students become familiar with the concept of predictive uncertainty in flow forecasting. • Students are introduced to (stochastic) dynamic programming in water resources management under uncertainty.	

	Part 3: Uncertainties in soil mechanics • Students will understand the relationship between formation history of the ground and the composition of soil as a multiphase porous medium; they will further be able to reflect differences in the resultant mechanical behaviour. • Students are familiar with ground investigation methods and the procedure to establish a 3D ground model required for reliability-based geotechnical analyses. • Students will understand sources of uncertainties related to soil mechanics (inherent uncertainty of soils, model uncertainty and measurement errors, statistical uncertainty, uncertainties of structural loading) • Students will be able to establish procedures to address spatial variability of soil parameters in geotechnical design. • Students are familiar with the use and benefits of Bayesian updating in cases of scarce soil data.
Course Content	Part 1: Concepts of uncertainty characterization • Introduction to and repetition of basic statistical concepts (statistical moments, linear regression models of variates, correlation and autocorrelation). • Essential parametric distribution models and their properties (Normal, Log-normal, Beta, Gamma and Weibull distribution). • Brief introduction to Gaussian multivariate distributions and their use in uncertainty assessment. • Introduction to Bayesian inference (prior distribution, likelihood, posterior distribution) for addressing parameter uncertainty. Part 2: Uncertainties in water resources problems • Introduction to sources of uncertainty and their relative roles in hydrological and water resources models (model uncertainty, parameter uncertainty, weather and climate uncertainty). • The concept of predictive uncertainty for weather and flow forecasting, climate projections. • Assessing parameter uncertainty in hydrological models through Bayesian inference • Introduction to stochastic dynamic programming for optimal reservoir management under conditions of uncertainty. Part 3: Uncertainties in soil mechanics • Formation history of soils, types and composition of soils, soil classification, deformation and strength characteristics of soils, the role of water in soil mechanics. • Basic concepts of field and laboratory ground investigation; establishing the ground model. • Characterization of uncertainties related to soil mechanics and illustration of the resultant consequences for geotechnical design. • Procedures for uncertainty description within probabilistic analyses (e.g. selection of appropriate distribution type, spatial averaging, Bayesian updating)
Applicable in the following degree programs	MA Engineering of Hydro-Environmental Extremes
Prerequisites for Participation	None
Prerequisites for Awarding of CP	Passed graded assessment

No.	4HDEMA02	
Module Title	Water challenges in a changing world	
Compulsory/Core Elective	CE	
Module Length	1 semester	
Frequency	WS	
Language of Instruction	English	
Credit Points	6	
Weekly Contact Hours	4	
On-Campus Study	60 h	
Independent Study	120 h	
Workload	180 h	
Instructional Format	**Courses/Module Elements (if applicable)**	**Weekly Contact Hours**
Lecture with integrated exercise	Water challenges in a changing world	4
Academic Requirements	**Format**	**Length / Scope**
Graded Assessments	One graded assessment comprising: Project work (scientific poster; 1/3) with Presentation (1/3) and Oral examination (1/3) (The examination is typically conducted in German for the master's degree program in civil engineering and in English for the master's degree program in Hydro-Environmental Extremes.)	Poster (A0); approx. 25 min.; approx. 25 min.
Coursework	One piece of coursework, comprising: e-tests (10 online tests)	Each 10 min.
Learning Outcomes	• Students acquire an understanding of the importance of water in a changing climate. • The students acquire competences to classify the role of water in regional as well as in global issues. • The students correctly reproduce the essential aspects of the topics they have chosen. • Students interpret these aspects logically and solve appropriate challenges and online tests. • Students correctly classify their respective contents in discussions with their fellow students and the teachers and critically compare different objectives with each other (e.g. environmental protection vs. flood protection). • Students design a scientific poster and thus combine the learned knowledge from the self-study with the results from analysis/discussions to a synthesis and achieve an evaluation.	
Course Content	• Climate change • Water quality and resources • Water pollution and microplastics • Urban flood events • Resilience and Adaptivity • Disaster response and hazard communication	
Applicable in the following degree programs	MA Civil Engineering MA Engineering of Hydro-Environmental Extremes	
Prerequisites for Participation	Formal: Prerequisites for participation in the graded assessment is the successful completion of the coursework (all 10 online tests) in this module. Subject: None	
Prerequisites for Awarding of CP	Passed graded assessments and coursework	

Special provisions in examination law regarding the aforementioned module descriptions when applied across multiple degree programs

Repeatability of the graded assessment(s) (number / scheduling)	**Twice yearly**			
Supplemental oral examination possible	**Yes:**	**X**	**After each attempt:**	
			After last attempt:	**X**
	No:			
Exam may be repeated to improve grade	**Yes:**			
	No:	**X**		

No.	4HDEMA03	
Module Title	Reliability assessment for civil engineering structures	
Compulsory/Core Elective	CE	
Module Length	1 semester	
Frequency	SS	
Language of Instruction	English	
Credit Points	6	
Weekly Contact Hours	4	
On-Campus Study	60 h	
Independent Study	120 h	
Workload	180 h	
Instructional Format	**Courses/Module Elements (if applicable)**	**Weekly Contact Hours**
Lecture	Reliability assessment for civil engineering structures	2
Seminar	Reliability assessment for civil engineering structures	2
Academic Requirements	**Format**	**Length / Scope**
Graded Assessments	One graded assessment comprising: Written report (2/3) with presentation and Discussion (1/3)	Approx. 30- 40 pages 45 min.
Coursework	e-tests	
Learning Outcomes	• Students will understand the consequences of hydro-environmental extremes on the performance of civil engineering structures • Students will be able to understand the concepts of reliability-based design and assessment and will be able to transfer them to practical (geotechnical) engineering cases. • Students will be able to implement, apply and analyze the results of advanced numerical methods for reliability-oriented design optimization and will also be able to make educated and quantified estimates of the reliability level of a designed structure • Students will be able to perform a basic risk analysis of a structure or a system	
Course Content	• Discussion of hydro-environmental risks to civil engineering structures • Introduction to the objectives of probabilistic design of civil structures • Theoretical Background of Probability Theory from a civil engineering perspective and steps into a risk analysis • Current German safety standards and generally applicable international safety standards • Basics of reliability-based design and assessment at three levels (risk informed; reliability based; semi-probabilistic) • Describing uncertainties in (geotechnical) design and assessment • Fundamentals and application of reliability-based methods (Monte-Carlo method, FORM, SORM, ...) • Introduction into appropriate numerical tools for probabilistic analyses • Additional seminars with experts from practical application	
Applicable in the following degree programs	MA Engineering of Hydro-Environmental Extremes	
Prerequisites for Participation	None	

Prerequisites for Awarding of CP	Passed graded assessments and coursework

No.	4HDEMA04	
Module Title	Interdisciplinary project group	
Compulsory/Core Elective	CE	
Module Length	2 semesters	
Frequency	Both semesters	
Language of Instruction	English (potentially with some German)	
Credit Points	12	
Weekly Contact Hours		
On-Campus Study		
Independent Study		
Workload	360 h	
Instructional Format	**Courses/Module Elements (if applicable)**	**Weekly Contact Hours**
Interdisciplinary project group	Interdisciplinary project group	
Academic Requirements	**Format**	**Length / Scope**
Graded Assessments	One graded assessment comprising: Project group report with colloquium and Oral examination	 generally 100 pages Approx. 30 min.
Coursework	None	
Learning Outcomes	Students acquire the competence to work in groups on a topic in depth and in an interdisciplinary manner. In addition, references are made to interdisciplinary problems in practice. They learn the appropriate presentation of the project results in a group and the scientific discourse in the context of the colloquium.	
Course Content	Students should demonstrate that they are able to work on a problem in an interdisciplinary manner using scientific methods within a given period of time. The reports must be submitted in the form of a group work. The group report must be explained and defended in a colloquium in front of other peers.	
Applicable in the following degree programs	MA Engineering of Hydro-Environmental Extremes	
Prerequisites for Participation	None	
Prerequisites for Awarding of CP	Passed graded assessment	

No.	4HDEMA05	
Module Title	Computational Fluid Dynamics	
Compulsory/Core Elective	CE	
Module Length	1 semester	
Frequency	WS	
Language of Instruction	English	
Credit Points	6	
Weekly Contact Hours	4	
On-Campus Study	60 h	
Independent Study	120 h	
Workload	180 h	
Instructional Format	**Courses/Module Elements (if applicable)**	**Weekly Contact Hours**
Lecture with integrated exercise	Computational Fluid Dynamics	2
Specialty lab	Laboratory Computational Fluid Dynamics	2
Academic Requirements	**Format**	**Length / Scope**
Graded Assessments	Oral examination Project work	Up to 60 minutes 1 week
Coursework	None	
Learning Outcomes	**Computational Fluid Dynamics** Numerical methods for the simulation of fluids or other scientific areas are becoming more and more important. Oftentimes students are only taught in using ready to use commercial software (Fluent, CFX, etc.), without deeper understanding of the underlying algorithms and methods. **Therefore, this lecture intends to provide a good overview of the ingredients of numerical fluid mechanics from a more fundamental point of view.** The introduced algorithms are not only introduced in the context of fluid mechanics but in a more general fashion, which enables students to transfer the methods to other problems in physics or chemistry, or specifically in an engineering context to thermodynamics, structural mechanics or even electrical engineering. The difficulty is adjusted to serve engineering master students, but is equally suited to be attended by physics or mathematics students, who desire a more applied point of view of the underlying mathematical methods. During the lectures, the most important algorithms are discussed and demonstrated live using Python code. Furthermore, the students get exercises and examples written in Python to be able to learn applying the methods and solving various interesting topics from bicycle drag resistance to chaotic behavior in weather modelling.	
Course Content	• Basic equations (partial differential equations, hyperbolic, elliptic, hyperbolic, characteristics) • Approximation and interpolation (Lagrange, Spline, Broken-Line, Method of Weighted Residuals, Fourier approximation and analysis, Shannon-Sampling Theorem) • Discretization in space (finite differences, finite volume, spectral, modified wave number, influence of grid size) • discretization in time (e.g. multi step methods, Runge-Kutta, explicit vs. implicit etc.) • Stability of the discretization (includes consistency, convergence, spatial and temporal discretization, method-of lines, CFL-number, eigenvalue analysis, von-Neumann-analysis, Lax-stability, Lax-Richtmeyer, non-normality, Matrix-method, Trefethen pseudo-spectra)	

	• Boundary conditions (BC) (incompressible and compressible flows, i.e. non-reflecting/characteristic BC, Tam radiation BC, sponge layers) • Approximate factorization, operator splitting • Specific NS-solvers (projection methods, multigrid, Lattice-Boltzmann method) Laboratory Computational Fluid Dynamics Students achieve an understanding of the basic concepts taught in computational fluid dynamics. Contents: • Introduction to Python • Based on Python programs students have to complete short weekly tasks either alone or in groups of two • At the end of the semester a numerical project is accomplished, including a short report of the results. Students can do this at home and have 1 week for producing the results and report.
Applicable in the following degree programs	MA Engineering of Hydro-Environmental Extremes
Prerequisites for Participation	None
Prerequisites for Awarding of CP	Passed graded assessment

No.	4HDEMA100	
Module Title	Master's Thesis Engineering of Hydro-Environmental Extremes	
Compulsory/Core Elective	C	
Module Length	9 months	
Frequency	Both semesters	
Language of Instruction	English (potentially with some German)	
Credit Points	30	
Weekly Contact Hours		
On-Campus Study		
Independent Study		
Workload	900 h	
Instructional Format	**Courses/Module Elements (if applicable)**	**Weekly Contact Hours**
	Master's Thesis Engineering of Hydro-Environmental Extremes	
Academic Requirements	**Format**	**Length / Scope**
Graded Assessments	One graded assessment comprising: Master's Thesis With colloquium	 generally 120 pages Approx. 60 min.
Coursework	None	
Learning Outcomes	Students acquire the competence to work independently on a topic in great depth and in an interdisciplinary manner. In addition, references are made to problems in practice. They learn the proper presentation of the project results and the scientific discourse in the context of the colloquium.	
Course Content	The students should show that they are able to work independently on a problem using scientific methods within a given period of time. The thesis can also be submitted in the form of a group work; further details are regulated by the subject examination regulations. The Master's thesis must be supplemented by a German-language abstract (English-language abstract in the case of an German-language Master's thesis) of one page in length. The Master's thesis must be explained and defended in a colloquium with both examiners.	
Applicable in the following degree programs	MA Engineering of Hydro-Environmental Extremes	
Prerequisites for Participation	The master's thesis can only be registered once all modules of the 1st and 2nd semester as per the respective standard course sequences (see Annex 1) and in accordance with the respective alignment block pursuant to § 8 have been successfully completed, with a scope of 60 CP in total.	
Prerequisites for Awarding of CP	Passed graded assessment	

Annex 8: Module descriptions for modules only offered for export

Not assigned.

Annex 9*: Module descriptions for modules from other disciplines

*Annex 9 ceases to apply upon publication of the module description in the Departmental Examination Regulations FPO-M ARCH.

No.	2ARCHMAEX02	
Module Title	**Sustainable Urban Planning**	
Compulsory/Core Elective	CE	
Module Length	1 semester	
Frequency	SS	
Language of Instruction	English	
Credit Points	3	
Weekly Contact Hours	2 (alternative: block seminar)	
On-Campus Study		
Independent Study		
Workload		
Instructional Format	**Courses/Module Elements (if applicable)**	**Weekly Contact Hours**
Seminar	Sustainable urbanism	2
Academic Requirements	**Format**	**Length / Scope**
Graded Assessments	Overall grade comprising: Written report (1/3) with Presentation (1/3) and Oral examination (1/3)	 max. 60 pages; max. 30 min.; max. 30 min.
Coursework	None	
Learning Outcomes	• Teaching the connection between urban planning, urban design and sustainability. • Teaching the procedures, instruments and current urban planning projects with a focus on sustainability • Classification of historical development lines and the history and phases of sustainable urban planning in the context of current, transformative fields of activity • Creation of a broad understanding of the fields of action of sustainable urban planning and transformation • Enabling the development of problem- and solution-oriented sustainable action strategies in urban planning	
Course Content	• Presentation of sustainable urban planning and transformation as a continuous process • Concept and theory of sustainable urban planning and transformation • Phases of sustainable urban planning • Sustainable urban planning as a public planning task and the role of the state • Current fields of action of sustainable urban planning: funding and planning instruments, procedures	
Applicable in the following degree programs	MA: Engineering of Hydro-Environmental Extremes	
Prerequisites for Participation	None	
Prerequisites for Awarding of CP	Passed graded assessment	

Change Log							
Version No.	**Change Type**	**Description of Change**	**Requestor**	**Date Submitted**	**Date Implemented**	**Status**	**Comments**
1	Original Document	n.a.	n.a.	15 April 2026	n.a.	Complete	--