Part E – "Module Guide"

International Programme in Environmental Engineering B.Sc.

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Modules and Examinations in the Bachelor's Programme

(Excerpt from the examination regulations of the International Bachelor's Programme "Environmental Engineering", subject-specific part, Appendix 1: Exams and course work)

1st semester

No.	Exam no.	Module code	Module title	Contact hours p.w.[1)]	Credits[2)]	Language	Exam work[3)]	Course work[4)]
1.1	1110	PRO1	Project 1: Projects in Environmental technology		6	German	KL, PA	R
1.1.1			Technical Fundamentals of Environmental technology	2				
1.1.2			Methods in Environmental technology Projects	1				
1.1.3			Projects in Environmental technology	1				
1.1.4			Module-related tutorial	1				
1.2	1120	BIOL	Biology		6	German	KL	R, EX
1.2.1			Fundamentals of Cell and Microbiology	2				
1.2.2			Environmental Hygiene / Public Environmental Health	1				
1.2.3			Laboratory class	1				
1.2.4			Module-related tutorial	1				
1.3	1130	CHEM	Chemistry		6	German	KL, MP	EX
1.3.1			Fundamentals of Chemistry	3				
1.3.2			Laboratory class	1				
1.3.3			Module-related tutorial	1				
1.4	1140	MAT1	Mathematics 1		6	German	KL	
1.4.1			Mathematics 1	4				
1.4.2			Module-related tutorial	1				
1.5	1150	STRÖ	Solid and Fluid Mechanics		6	German	KL	EX, MP
1.5.1			Solid and Fluid Mechanics	3				
1.5.2			Laboratory class	1				
1.5.3			Module-related tutorial	1				

2nd semester

No.	Exam no.	Module code	Module title	Contact hours p.w.[1)]	Credits	Language	Exam work	Course work
2.1	1210	PRO2	Project 2: Water management		6	German or English	ENT + MP	
2.1.1			Fundamentals of Water management	2				
2.1.2			Project on Water management	2				
2.1.3			Module-related tutorial	1				
2.2	1220	ÖKOS	Ecosystems: Functionalities and Sustainable Use		6	German	R, ENT	EX
2.2.1			Ecosystems: Functionalities and Sustainable Use	2				
2.2.2			Environmental Computer Science	1				
2.2.3			Methodological Aspects of Applied Environmental Sciences	1				
2.2.4			Module-related tutorial	1				
2.3	1230	UMAC	Environmental Microbiology and Aquatic Chemistry		6	German	KL, MP	EX
2.3.1			Environmental Microbiology	2				
2.3.2			Aquatic Chemistry	1				
2.3.3			Laboratory class	1				
2.3.4			Module-related tutorial	1				
2.4	1240	MAT2	Mathematics 2		6	German	KL	
2.4.1			Mathematics 2	4				
2.4.2			Module-related tutorial	1				
2.5	12XX		Elective module 1		6	German		
2.5.1			Elective module 1	4				
2.5.2			Module-related tutorial	1				
		Elective modules: The module assigned to the chosen field of study must be completed.						
		“Process Engineering”						
2.6	1260	GUVT	Fundamentals of Environmental Process Engineering		6	German	KL	EX, MP
2.6.1			Fundamentals of Environmental Process Engineering	3				
2.6.2			Laboratory class	1				
2.6.3			Module-related tutorial	1				
		"Infrastructure“						
2.7	1270	NAIN	Fundamentals of Sustainable Infrastructure		6	German	KL	PA, MP
2.7.1			Environmental Systems and Sustainability	2				

2.7.2			Traffic and Communication Systems	2				
2.7.3			Module-related tutorial	1				

3rd semester

No.	Exam no.	Mod-ule code	Module title	Contact hours p.w.[1)]	Cred-its	Lan-guage	Exam work	Course work
3.1	1310	PRO3	Project 3: Environmental Law and Plan-ning		6	German or Eng-lish	KL, PA	R
3.1.1			Environmental Law and Planning	2				
3.1.2			Project: Planning	2				
3.1.3			Module-related tutorial	1				
3.2	1320	WABT	Water Treatment Technologies		6	German	ENT + MP	
3.2.1			Methods of communal waste water treatment	3				
3.2.2			Laboratory class	1				
3.2.3			Module-related tutorial	1				
3.3	1330	TDW Ü	Thermodynamics and Heat Transfer		6	German	KL	EX, MP
3.3.1			Thermodynamics and Heat Transfer	3				
3.3.2			Laboratory class	1				
3.3.3			Module-related tutorial	1				
3.4	13XX		Elective Module 2		6	German		
3.4.1			Elective Module 2	4				
3.4.2			Module-related tutorial	1				
3.5	13XX		Elective Module 3		6	German		
3.5.1			Elective Module 3	4				
3.5.2			Module-related tutorial	1				
			Elective modules: Depending on the specialization chosen, modules 3.6 and 3.8 (Process Engi-neering) or 3.7 and 3.9 (Infrastructure) must be completed.					
			“Process Engineering”					
3.6	1360	THVT	Thermal Process Engineering		6	German	KL	EX, MP
3.6.1			Thermal Process Engineering	3				
3.6.2			Laboratory class	1				
3.6.3			Module-related tutorial	1				
3.8	1380	UBTM	Environmental Biotechnology		6	German	R, MP	EX
3.8.1			Environmental Biotechnology	2				
3.8.2			Modelling of Environmental Biotechno-logical Processes	1				
3.8.3			Laboratory class	1				
3.8.4			Module-related tutorial	1				

			"Infrastructure"					
3.7	1370	SWWB	Fundamentals of Urban Water Management and Hydraulic Engineering		6	German	KL	
3.7.1			Fundamentals of Urban Water Management	2				
3.7.2			Fundamentals of Hydraulic Engineering	2				
3.7.3			Module-related tutorial	1				
3.9	1390	VERS	Fundamentals of Traffic Systems & Barrier-free Infrastructure		6	German	KL	
3.9.1			Fundamentals of Traffic Systems	2				
3.9.2			Fundamentals of Barrier-free Infrastructure	2				
3.9.3			Module-related tutorial	1				

4th semester

No.	Exam no.	Module code	Module title	Contact hours p.w.[1)]	Credits	Language	Exam work	Course work
4.1	1410	PRO4	Project 4: Baiscs of Management and Business Administration		6	German or English	KL, PA	R
4.1.1			Fundamentals of Business Administration	2				
4.1.2			Project: Implementation	2				
4.1.3			Module-related tutorial	1				
4.2	1420	KRWT	Circular Economy		6	German	KL + EX	MP
4.2.1			Waste Treatment Technologies	3				
4.2.2			Laboratory class	1				
4.2.3			Module-related tutorial	1				
4.3	1430	TENG	Technical English		6	English	KL, R	
4.3.1			Technical English	4				
4.4	1440	WETE	Materials Science and Engineering		6	German	KL	
4.4.1			Materials Engineering	4				
4.4.2			Module-related tutorial	1				
4.5	14XX		Elective module 4		6	German		
4.5.1			Elective module 4	4				
4.5.2			Module-related tutorial	1				
		Elective modules: Students must complete the module corresponding to the chosen specialization.						
		"Process Engineering"						
4.6	1460	PTRT	Process and Reaction Engineering		6	German	KL	EX, MP
4.6.1			Process and Reaction Engineering	3				

4.6.2			Laboratory class	1				
4.6.3			Module-related tutorial	1				
		“Infrastructure”						
4.7	1470	SWWN	Water Networks		6	German	ENT + MP	
4.7.1			Water Networks	4				
4.7.2			Module-related tutorial	1				

5th Semester

No.	Exam no.	Module code	Module title	Contact hours p.w.[1)]	Credits	Language	Exam work	Course work
5.1	15XX		Elective module 5		6	English		
5.1.1			Elective module 5	4				
5.1.2			Module-related tutorial	1				
5.2	1520	REME	Remediation Technologies		6	English	KL, EX	MP
5.2.1			Remediation Technologies	2				
5.2.2			Soil Properties	1				
5.2.3			Laboratory class	1				
5.2.4			Module-related tutorial	1				
5.3	1530	IWWM	Industrial Wastewater Management		6	English	KL	
5.3.1			Industrial Wastewater Management	4				
5.3.2			Module-related tutorial	1				
5.4	1540	CDBS	Construction and Design of Built Structures		6	English	KL	
5.4.1			Construction and Design of Built Structures	4				
5.4.2			Module-related tutorial	1				
5.5	1550	EMRT	Electrical Engineering, Measurement and Control Technology		6	English	R + MP	EX
5.5.1			Electrical Engineering, Measurement and Control Technology	3				
5.5.2			Laboratory Class	1				
5.5.3			Module-related tutorial	1				
		Elective modules: Students must complete the module corresponding to the chosen specialization.						
		“Process Engineering”						
5.6	1560	PRO5	Project 5: Apparatus- and Plant Engineering		6	English	HA + MP	
5.6.1			Apparatus- and Plant Engineering	2				
5.6.2			Project work	2				

5.6.3			Module-related tutorial	1				
		"Infrastructure"						
5.7	1570	PRO5	Project 5: Infrastructure		6	English	PA, HA, MP	
5.7.1			Hydraulic Engineering – Inland Waterways, Flood Protection	1				
5.7.2			Urban Water Management - Water Networks	1				
5.7.3			Traffic Facility Construction	2				
5.7.4			Module-related tutorial	1				

For all modules of semesters 1 to 5, except for the module 4.3, there is a module-related tutorial of 1 contact hour per week.

6th semester

The 6th semester must be studied abroad. In addition, the 5th semester can also be studied abroad as part of the mobility window. For the theoretical studies abroad to be evaluated as successful (*bestanden*= passed), students must comply with the following:

they must earn at least 24 credit points in accordance with the Learning Agreement
successfully complete the preparation and follow-up of their stay abroad
compile and present a report on their studies abroad.

Acting on the recommendation of the responsible Officer for Studies Abroad, the Examination Board decides on whether the above requirements have been satisfactorily complied with. The credits earned for modules studied in addition to the required 24 credit points according to the Learning Agreement will be counted together with modules of the 5th semester within the mobility window, and where possible, the grades will be taken over.

No.	Module code	Module title	Contact hours p.w.[1)]	Credits	Language	Exam work	Course work
6.1		Study-abroad period		30	English or other non German		B + PR
6.1.1		Preparation of studies abroad and follow-up	4				
6.1.2		Module-related tutorial	1				

7th semester

In the 7th semester, a period of at least 12 weeks of practical training must be completed in a company or other professional establishment. The practice phase is evaluated as passed if

the implementation of the practical phase is confirmed by the hosting company or other professional establishment and

the Module 7.1 has been passed; the examination is assessed as either “passed” or “failed”.

No.	Module code	Module title	Contact hours p.w.[1)]	Credits	Language	Exam work	Course work
7.1	PRAX	Practical Module		18	German or English	R	HA
7.1.1		Practical Seminar	4				
7.1.2		Module-related tutorial	1				
7.2	THES	Bachelor Thesis		12	German or English	Thsis + Coll.	
7.2.1		Thesis Seminar	4				

Legend:

[1)] Hours expressed in contact hours p.w. – German SWS = *Semesterwochenstunden*.
[2)] Credits points (credits) in accordance with ECTS (European Credit Transfer and Accumulation System).
[3)] Forms of examination work: EA = Development work, ENT = Draft, HA = Term paper, KL = Written exam, KOL. = Colloquium, R = Written assignment; PF = Portfolio, MP = Oral exam, PA = Project work, B = Bericht, PR = Presentation, EX = Experimental work, SDO= Software documentation, FS = Case study, in the event of combined exam work (e.g. ENT+ KOL) the individual grades are incorporated in the same proportion in the overall grade.
[4)] Course work is performed in the same form as exam work, however in less depth and processed to a lesser extent.

Module Description: Project 1: Projects in environmental technology

Module code	U1.1_PRO1

Semester	1st semester
Module Leader	Prof. Dr. Lars Jürgensen
Competency goals	A passing in this module means students can identify and describe technologies used in environmental engineering, understand key parameters of their future field of work, and identify necessary competencies. Students are able to • understand procedural thinking and the application of scientific fundamentals, • present and outline introductory fundamentals of the tasks, the procedural and the structural design of environmental installations, • discover and understand connections to the learning contents of the other courses, • describe the dependencies of environmental solutions on the overall objectives of environmental protection and concepts of policy implementation, and classify the main elements of control, • identify the dimension, complexity and diversity of engineering tasks and their importance to society, the economy and the environment, • understand the fundamentals of working in projects with scientific methodology as a qualification requirement for environmental engineers.
Course contents	The module teaches selected topics as an introduction into the technical processes and specialist methods of environmental engineering. The following aspects are covered: • Introduction to environmental installations in various applications: problems, tasks, effectiveness, effort and costs, overview of applied process techniques and applications in various fields, for example: - Downstream technologies and equipment - Integrated technologies and facilities • Introduction to strategies of environmental protection and their political implementation • Introduction to technology fields and their requirements • Projects on the associated work processes, the tasks of the participants and the methods to be used
Module Type	Compulsory module

Teaching and learning formats	Seminars, project Module-related tutorial
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) or project work (PL) Written assignment (SL)
Requirements for participation	none
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Görner, Hübner: HÜTTE-Umweltschutztechnik / Förstner: Umweltschutztechnik / Gessler: Einführung in Projektmanagement

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr. Lars Jürgensen	Fundamentals of Environmental Engineering	2
Prof. Dr. Lars Jürgensen	Methods in Projects of Environmental Engineering	1
ISU-Professors	Projects in Evironmental Engineering	1
Prof. Dr. Lars Jürgensen	Module-related tutorial	1

Module Description: Biology

Module code	U1.2_BIOL

Semester	1st semester
Module Leader	Prof. Dr.-Ing. Anja Noke
Competency goals	By successfully passing this module, students can: • understand and describe the structure and function of biomolecules and cell components, • understand and describe the effect of disease-causing agents (environmental chemicals, microbial toxins) on biological processes and identify possible precautionary measures, • describe and distinguish protozoa, fungi and eubacteria morphologically, under the microscope and with regard to their growth behaviour • carry out simple literature research on a topic and present the results with Powerpoint to a learning group.
Course contents	The module teaches fundamentals of cell and microbiology and sensitizes for the health hazards caused by pollutants and infectious germs. More specifically, the following aspects are covered: <u>Fundamentals of cell and microbiology</u> (50%) • Cell as a basic unit; habitats of microorganisms, microorganism groups, microscopy, air germ plates, • biochemistry of the cell membrane (phospholipids, amino acids, proteins), • mass transport, diffusion, osmosis, cell wall, • enzymes, enzyme kinetics, simple methods for calculating v_{max} and K_M, • structure and function of DNA, RNA, protein biosynthesis. <u>Environmental Health / Public Environmental Health</u> (25%) • Possibilities of exposure to pollutants, • cellular pollutant effects, in particular mutation, carcinogenesis (toxicodynamics), • intake, distribution, drug dose at the receptor (toxicokinetics), • laws and regulations dealing with chemical or physical pollution, • microorganisms as a disease factor, allergenic substances and their effects, • overview of the most important environmental infectious diseases, • technical and health-related hygiene measures. <u>Laboratory class in Fundamentals of Cell and Microbiology</u> (25%) • Introduction to microscope usage • diffusion / osmosis • cultivation and identification of microorganisms

Module Type	Compulsory module
Teaching and learning formats	Seminars Module-related tutorial Laboratory class
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) experimental work (SL) or presentation(SL)
Requirements for participation	none
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	• Dekant, W., Vamvakas, S. (2010): Toxikologie für Chemiker und Biologen. Spektrum Akademischer Verlag, Heidelberg (42.-€) • Madigan, M.T., Martinko, J.M., Stahl, D., Clark, D.P. (2011): Brock - Biology of Microorganisms. 13th edition, Pearson-Benjamin Cummings, San Francisco 62 € paperback (or 13th edition in German , bound 90 €) • Munk, K. (2008) Taschenlehrbuch Biologie: Biochemie - Zellbiologie, Thieme Verlag, 30 € • Reichl, F.R. (2000) Taschenatlas der Umweltmedizin. Thieme-Verlag, Stuttgart • Reichl, F.R. (2009) Taschenatlas der Toxikologie. Thieme-Verlag, Stuttgart (40.-€) • Suerbaum, S. et.al (2012) Medizinische Mikrobiologie und Infektiologie, Springer Verlag, (45.-€) • Vohr, H.W. (2010) Toxikologie (Set): Band 1: Grundlagen der Toxikologie / Band 2: Toxikologie der Stoffe , Wiley-VCH (72.-€)

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Anja Noke	Fundamentals of Cell and Microbiology	2
Prof. Dr.-Ing. Anja Noke	Environmental Hygiene /Public Environmental Health	1
Prof. Dr.-Ing. Anja Noke	Laboratory class in Cell- and Microbiology	1
Prof. Dr.-Ing. Anja Noke	Module-related tutorial	1

Module Description: Chemistry

Module code	U1.3_CHEM

Semester	1st semester
Module Leader	Dr. Florian Kuhnen
Competency goals	By successfully passing this module, students can: • apply basic chemistry knowledge (predict bonding properties, perform stoichiometric calculations, establish element and substance balance equations) • Estimate material properties (melting and boiling points, solubility in water, aspects of the behaviour of substances in environment and technology) • Quantify chemical systems (estimate reaction equilibrium, calculate heat-release, estimate mobilities, predict reaction rates) • Evaluate experimental data (dimensional analysis, equilibrium data, reaction kinetics)
Course contents	The module teaches selected topics of chemistry or the use of qualitative and quantitative principles of chemistry in an engineering or environmental context. More specifically, the following aspects are covered: • Systematics of atomic structure and periodic table of elements • Chemical bond models • Substance properties and substance classes (states of matter, solubilities, redox properties) • Concept of reaction in chemistry (acid-base reactions, redox reactions, precipitation and dissolution processes) • Energetics in Chemistry (thermochemistry, calorimeter studies, reaction enthalpy)
Module Type	Compulsory module
Teaching and learning formats	Seminars Module-related tutorial Laboratory class
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) or oral exam (PL) experimental work (SL)
Requirements for participation	none
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15

Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Peter Kurzweil, Paul Scheipers, Chemie, Vieweg, 2005

Courses		
Course Leader	Course Title	Contact Hours p.w.
Dr. Florian Kuhnen	Fundamentals of Chemistry	3
Dr. Florian Kuhnen	Laboratory class Chemistry	1
Dr. Florian Kuhnen	Module-related tutorial	1

Module Description: Mathematics 1

Module code	U1.4_MAT1

Semester	1st semester
Module Leader	Prof. Dr.-Ing. Thomas Rauscher
Competency goals	By successfully passing this module, students can: • think logically and abstractly, • understand mathematical derivations in other modules of the program, • solve problems by the sensible use and application of formu las, calculators and computer programs, and also visualize, interpret and verify the results, • use Internet-based learning aids (e-learning platform AULIS, • use the e-book library) for self-guided learning, • establish verifiable, comprehensible calculations – and by participating in the module-related exercise • work independently in small groups in a team, • develop problem-solving strategies, • communicate in the language of mathematics and computer science
Course contents	The module teaches selected topics for the introduction of engineering calculation methods. More specifically, the following aspects are covered: • Fundamentals of mathematical functions with one or two variables and their modelling • Display of measurement results and functions with a spread sheet programme (e.g. Excel, SciDAVis) (Cartesian, single and double logarithmic display and 3D diagrams) • • Differential calculus of single variate and multivariate functions • Integral calculus: rules and methods, numerical integration • Statistical evaluation of measured data: Fundamentals of statistics (mean, standard deviation, variance), frequencies and distributions • Correlation, linear and nonlinear regression
Module Type	Compulsory module
Teaching and learning formats	Seminars Module-related tutorial

Form & duration of examination (requirement for the award of credits)	Written exam (PL) or term paper (PL) or development work (PL) portfolio (SL)
Requirements for participation	none
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Lothar Papula, Mathematik für Ingenieure und Naturwissenschaftler, Band 1 bis 3, Vieweg+Teubner Verlag

Courses		
Course Leader	Course Title	Contact Hours p.w.
Dr. Florian Kuhnen	Mathematics 1	4
Dr. Florian Kuhnen	Module-related tutorial	1

Module Description: Solid and Fluid Mechanics

Module code	U1.5_STRÖ

Semester	1st semester
Module Leader	Prof. Dr. Lars Jürgensen
Competency goals	By successfully passing this module, students can: • Understand and apply the fundamentals of physics with a focus on mechanics • Describe problems in this area and solve simple tasks • Establish balance of forces, momentum and energy and solve the systems of equations involved • Gain an understanding of flow processes in pipelines and open channels • Dimension piping systems of medium complexity Use and apply operating numbers
Course contents	The module teaches basic knowledge of fluid mechanics and solidstate physics. The following aspects are dealt with: • Force, addition and decomposition of forces, inclined plane • Uniformly accelerated movement • Circular motion (rotation) • Harmonic vibrations • Static pressure, static balance, buoyancy •Viscosity, Newtonian and non-Newtonian fluids • Dynamics of fluids, incompressible flows • Laminar and turbulent flow, • Continuity equation, Bernoulli equation • Pressure loss in piping and piping elements • Channel flow, pressure loss at recesses and weirs • Flow around bodies • Introduction to compressible flows In addition, aerodynamic tests are carried out, logged and evaluated by the students.
Module Type	Compulsory module
Teaching and learning formats	Seminars Module-related tutorial Laboratory class
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) experimental work (SL) or oral exam (SL)

Requirements for participation	none
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Bohl, Willi: Strömungsmechanik Sirrenberg, Erich: Technische Mechanik Gerthsen, Christian, Meschede, Dieter: Physik

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr. Lars Jürgensen	Applied Mechanics and Fluid Mechanics	3
Prof. Dr. Lars Jürgensen	Laboratory class of Applied Mechanics and Fluid Mechanics	1
Prof. Dr. Lars Jürgensen	Module-related tutorial	1

Module Description: Project 2: Water management

Module code	U2.1_PRO2

Semester	2nd semester
Module Leader	Prof. Dr.-Ing. Jana von Horn
Competency goals	After successful participation, students will be able to: • Describe the tasks of domestic water management and the links to adjacent disciplines (hydraulic engineering, hydrology), • Manage water resources, • Carry out simple calculations for dimensioning of drinking water infrastructures • Select appropriate solutions according to the task and recognize as well as question planning constraints. o Scetch a drinking water treatment plantDesign an appropriate flow scheme o Preliminary calculation of treatment units
Course contents	The following topics are covered: • Water cycle (water in air and soil, water bodies) • Management of water resources • Elements of drinking water supply • Flow behaviour of water in the soil (inflow of wells and precipitation of rainwater) • Drinking water treatment methods
Module Type	Compulsory module
Teaching and learning formats	Seminars und module-related tutorials, simulation game (PC Lab), draft in group work
Form & duration of examination (requirement for the award of credits)	Draft (PL) and oral exam (PL) Project work (simulation game “Water Resources”) (SL)
Requirements for participation	none
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6

Duration and frequency of the offer	Once per academic year
Language of instruction	German or English
Literature	Wilhelm, S., 2007: Wasseraufbereitung. Springer. Berlin. ISBN978-3-540-25163-7 Jekel, Martin ; Czekalla, Christoph, 2017: DVGW Lehr- und Handbuch Wasserversorgung ; 6, DIV Deutscher Industrieverlag, ISBN 3835673203

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Jana von Horn	Fundamentals of Water management	2
Prof. Dr.-Ing. Jana von Horn	Project on drinking water treatment	2
Prof. Dr.-Ing. Jana von Horn	Module-related tutorial	1

Module Description: Ecosystems: Functionalities and Sustainable Use

Module code	U2.2_ÖKOS

Semester	2nd semester
Module Leader	Prof. Dr.-Ing. Anja Noke
Competency goals	By successfully passing this module, students can: • Understand the general functioning of ecosystems and the importance of biodiversity • Using examples of aquatic and terrestrial ecosystems, identify threatened habitats and biodiversity and existing options for the sustainable use of habitats • Name simple methods for characterizing the state of aquatic and terrestrial ecosystems and evaluate their informative value • Describe the methodology of an environmental impact assessment and apply it on an example • Name and apply methods to visualize and evaluate spatial processes using digital techniques • Recognize and evaluate the ecological principles in the field
Course contents	The module teaches fundamentals and methods of applied ecology and environmental sciences as well as methods for the digitalization of spatial representation. More specifically, the following aspects are covered <u>Ecosystems Functionalities and Sustainable Use (50%)</u> • What is Ecology, what is Landscape Ecology, what is Environmental Science: Definitions, Basic Terms, Methods • Ecological principles: energy flow, material cycle, food webs, creation and occupation of ecological niches • Why should we care about ecosystems? Biodiversity as an environmental protection task • Functionalities, loads, uses of aquatic Ecosystems: Methods for water quality assessment, European Water Framework Directive (WFD), water management • Functionalities, loads, uses of terrestrial ecosystems: spatial planning, soil protection, methods for recultivation of mining and industrial wastelands, • Environmental Impact Assessments (EIA) as a legal requirement, procedure • Cross-cutting issues of Environmental Science, such as climate change, population growth, energy production <u>Environmental Informatics</u> (25%) • Overview of different areas of application for the provision and use of environmental information, in particular use of the Internet • Processing algorithms for the classification of data and for the

	preparation of data • Problems of data collection and processing data structures and database concepts for efficient access to spatial data: Introduction into the practical handling of geographic information systems <u>Methodological aspects of applied environmental sciences</u> (25%) • Carrying out field excursions • site surveys and / or • laboratory experiments in the field of general and applied ecology and / or • exemplary environmental impact assessment
Module Type	Compulsory module
Teaching and learning formats	Seminars and PC lab, module-related tutorial, laboratory class and field practical
Form & duration of examination (requirement for the award of credits)	Written assignment (PL) or draft (PL) experimental work (SL)
Requirements for participation	none
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	• Nentwig, W. et al. (2011), Ökologie kompakt, Spektrum Akademischer Verlag • Cunningham, W & M. (2014) Environmental Science; McGraw-Hill Education • Jones, A., Duck, R., Reed, R., Weyers, J. (2000) Practical skills in environmental science. Prentice Hall. • Fischer-Stabel, P. (2005) Umweltinformationssysteme • Liebig, W., Mummenthey, R.D. (2008) ArcGIS-ArcView 9. 2Bde: Band 1: ArcGIS-Grundlagen und Band 2: ArcGIS-Geoverarbeitung. Points Verlag

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Anja Noke	Ecosystems: Functioning and Sustainable Usage	2
N.N. (teaching assignment)	Environmental Informatics	1
Prof. Dr.-Ing. Anja Noke	Methodological Aspects of Applied Environmental Sciences	1
Prof. Dr.-Ing. Anja Noke	Module-related tutorial	1

Module Description: Environmental Microbiology and Aquatic Chemistry

Module code	U2.3_UMAC

Semester	2nd semester
Module Leader	Prof. Dr.-Ing. Anja Noke
Competency goals	By successfully passing this module, students can: • Describe and evaluate chemical processes and reactions in aquatic systems • Differentiate microbial forms of energy production and describe them with their most important principles • Calculate and evaluate the potential energy gain (free energy) of microbial substrates • Freely develop stoichiometric equations of microbial reactions and use them to calculate theoretical substrate conversions • Identify and describe aquatic-chemical and microbial metabolic processes • Name, describe, evaluate and apply examples of methods for measuring microbial substrate turnover in environmental media regarding their applicability and significance
Course contents	The module teaches fundamentals of microbial energy conversion, environmental microbiology and aquatic chemistry. More specifically, the following aspects are covered: <u>Fundamentals of environmental microbiology</u> (50%) • microbial habitats and communities • degradation of biopolymers, exoenzymes; humification • principles of microbial energy conversion and storage; biochemical aerobic respiratory processes, practical significance • anaerobic respiratory processes (denitrification, desulfurization, iron respiration) • fermentation, acetogenesis and methane formation, • chemolithotrophy, biocorrosion, bioleaching; Bacterial photosynthesis, N_2 fixation, microbial symbioses, material cycles <u>Aquatic Chemistry</u> (25%) • chemical composition of natural waters • acid / base chemistry, carbonate equilibria • interaction water / atmosphere • metal ions in aqueous solution • precipitation and dissolution of solid phases • redox processes • Interface Chemistry • biogeochemical cycles of certain elements; application on aquatic systems

	Laboratory class Environmental Microbiology (25%) • Methods of aerobic and anaerobic metabolic rate measurement in soils (Nitrification, Denitrification) • Determination of growth kinetics of microorgnisms
Module Type	Compulsory module
Teaching and learning formats	Seminars, module-related tutorial, laboratory class
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) or oral exam, 30 min. (PL), experimental work (SL)
Requirements for participation	None, however Biology/Chemistry module of the 1st semester ISU (Bachelor) or comparable knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	• Cypionka, H. (2010) Grundlage der Mikrobiologie, 30 € • Madigan, M.T. Martinko, J.M., Parker, J. (2014) Brock- Biology of Microorganisms. Prentice Hall, International Edition (alternative; German edition 2013, bound 90.-€) • Munk, K. (2008) Taschenlehrbuch Biologie: Mikrobiologie, Thieme Verlag; 30 € • Fuchs et al. (2014) Allgemeine Mikrobiologie. ThiemeVerlag; 60 € Reineke, W., Schlömann, M. (2015) Umweltmikrobiologie. Spektrum Akademischer Verlag (esp. interesting for pollutant degradation); 40.- € • Sigg, L., Stumm, W. (2011) Aquatische Chemie: Einführung in die Chemie natürlicher Gewässer • Pepper, I.L., Gerba, C.P. (2005) Environmental microbiology: a laboratory manual.

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Anja Noke	Environmental Microbiology	2
Dr. Florian Kuhnen	Aquatic Chemistry	1
Prof. Dr.-Ing. Anja Noke	Laboratory class Environmental Microbiology	1
Prof. Dr.-Ing. Anja Noke	Module-related tutorial	1

Module Description: Mathematics 2

Module code	U2.4_MAT2

Semester	2nd semester
Module Leader	Prof. Dr.-Ing. Thomas Rauscher
Competency goals	Upon successful completion of the module, students will be able to handle application-oriented environmental engineering issues, • to understand mathematical modelling and to formulate own mathematical models • discuss functions with multiple variables • name, differentiate and use numerical approximation methods in a targeted manner • design algorithms to implement and verify in a high-level programming language on a computer • visualize and interpret numerical solutions using Matlab modules • use internet-based learning aids (e-learning platform AULIS, e-book library milibib) for self-guided learning. • develop problem-solving strategies and • communicate in the language of mathematics and computer science
Course contents	The module teaches selected topics for the deepening of engineering calculation methods. More specifically, the following aspects are covered: • Numerical root finders • Analytical and numerical solution of linear and nonlinear systems of equations • Differential calculus (partial derivatives, total differential, error propagation) • Extrema with functions of several variables • Integral calculus (including partial integration and partial fracture decomposition) • Derivation of ordinary differential equations for the dynamic mod elling of technical and environmental systems and application of so lution methods • Procedural programming in Matlab using libraries
Module Type	Compulsory module
Teaching and learning formats	Seminars, module-related tutorial

Form & duration of examination (requirement for the award of credits)	Written exam (PL) or term paper (PL) or development work (PL) Portfolio (SL)
Requirements for participation	None; however, mathematics module of the 1st semester ISU (Bachelor) or comparable knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Lothar Papula, Mathematik für Ingenieure und Naturwissenschaftler, Band 1 bis 3, Vieweg+Teubner Verlag

Courses		
Course Leader	Course Title	Contact Hours p.w.
Dr. Florian Kuhnen	Mathematics 2	4
Dr. Florian Kuhnen	Module-related tutorial	1

Module Description: Fundamentals of Environmental Process Engineering

Module code	U2.6_GUVT

Semester	2nd semester
Module Leader	Prof. Dr. Lars Jürgensen
Competency goals	By successfully passing this module, students can: • Recognize the structure of industrial production processes • Describe environmental processes using unit operations • Carry out basic environmental calculations • Derive basic flow diagrams from descriptions of processes • Set up and solve mass and energy balances for different processes • Describe phase equilibria and important basic operations on substance exchange processes • Recognize and apply basic procedural operations for mechanical separation of substances • Describe the operation and design of mechanical separators • Describe the operation and design of stirred reactors
Course contents	The module teaches selected topics on Fundamentals of Environmental Process Engineering and Mechanical Process Engineering. More specifically, the following aspects are covered: • Introduction to basic operations and the structure of environmental processes • Introduction to engineering calculation methods of stationary and transient processes • Representation of state variables, material data, material balances, energy balances, unit systems, concentration dimensions and process description variables • Description of the retention time behaviour of apparatuses • Creation of equilibrium relationships, mass and energy balance and basic flowcharts • Concept and description of mechanical separation processes • Design and application of sedimentation, flotation, centrifugation and membrane separation processes • Embodiments and operation of mechanical separating devices • Similarity theory for the description of stirring processes • Embodiments and mode of operation as well as dimensioning of stirred reactors
Module Type	Elective module (specialization in process engineering)
Teaching and learning formats	Seminar, laboratory class, module-related tutorial

Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) experimental work (SL) or oral exam (SL)
Requirements for participation	none
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Vauck/Müller: Grundoperationen chemischer Verfahrenstechnik, Hemming: Verfahrenstechnik, Stieß: Mechanische Verfahrenstechnik, Müller: Mechanische Grundoperationen und ihre Gesetzmäßigkeiten, Hemming, W.: Verfahrenstechnik

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr. Lars Jürgensen	Fundamentals of Environmental Process Engineering, Seminars	3
Prof. Dr. Lars Jürgensen	Laboratory Class in Fundamentals of Environmental process engineering	1
Prof. Dr. Lars Jürgensen	Module-related tutorial	1

Module Description: Fundamentals of Sustainable Infrastructure

Module code	U2.7_NAIN

Semester	2nd semester
Module Leader	Prof. Dr. Jürgen Knies
Competency goals	Passing this module allows students to describe functions, in particular of urban infrastructure systems, and to classify them in the context of sustainability. You are able to • provide introductory fundamentals on the tasks to present and outline technical and functional structure of infrastructure systems • describe the individual systems (water, waste, traffic, energy, etc.) in their interaction • describe the systems in their importance for society, economy and the environment with criteria of sustainability •determine the dimension, the complexity and the diversity of the engineering tasks
Course contents	The module teaches selected topics on infrastructure systems and the link to sustainability requirements. More specifically, the following aspects are covered: • System structure, functions, structural facilities, operation of the individual systems water, traffic, waste, energy, communication • Fundamentals and concepts of sustainability • Fundamentals of sustainability planning, especially in the urban environment
Module Type	Elective module (specialization in Infrastructure)
Teaching and learning formats	Seminar Module-related tutorial
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) Project work (SL) or oral exam, 30 minutes (SL)
Requirements for participation	none
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (the self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the anmount of 15 hours)

ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Students will receive a current list of literature at the beginning of the course.

Courses		
Course Leader	Course Title	Contact Hours p.w.
N.N. professorship infrastructure planning	Environmental Systems and Sustainability	2
N.N. professorship infrastructure planning	Traffic and Communication Systems	2
N.N. professorship infrastructure planning	Module-related tutorial	1

Module Description: Project 3: Environmental Law and Planning

Module code	U3.1_PRO3

Semester	3rd semester
Module Leader	N.N. professorship infrastructure planning
Competency goals	By successfully passing this module, students can define and plan engineering projects as part of a team and, if necessary, with external clients. They can identify the environmental legal requirements and integrate them into their projects as boundary conditions. They are able to • apply fundamentals of project management in their projects • organize and execute their work processes according to these fundamentals • document and present project results • understand and describe environmental legislation • understand and apply relevant technical standards (general rules of technology, state of the art) • identify approval requirements and competent authorities • understand relevant administrative procedures and identify potential participants in the proceedings • identify and describe rights and interests of third parties • determine legal design tasks and integrate them into the project tasks • understand and apply the work in projects with scientific methodology with special consideration of general conditions and project goals as a qualification requirement for environmental engineers.
Course contents	The module teaches selected topics as an introduction to environmental law and the application of environmental engineering project methods. In detail, the following aspects are covered: • Overview of relevant legal norms of federal and state environmental law, EU law and overview of relevant technical standards (DIN standards, leaflets, etc.): Building Planning and Planning Regulations (BauGB, building regulations), right of plant approval (BImschG and regulations , Integrated Project Permit), Waste Law (Recycling and Waste Act), Hazardous Substances Law / REACH, Federal and State Soil Protection Act and Ordinances, Law of Planning approval (VwVfG, law of specialization), Federal and State Water Law, Water Framework Directive, Wastewater Law (Wastewater Ordinance, Municipal Statute), Genetic engineering law, energy law / EEG, law of environmental impact assessment, nature conservation and landscape conservation law, environmental audit and EMAS, climate protection and emissions trading, environmental criminal law, environmental product law (§§ 22-24 KrW- / AbfG,

	Ecodesign-RiLi), environmental protection officer, professional / liability law • Advanced fundamentals of project management: techniques and processes for analysis and planning, tasks of project organization, tasks of the team, the project leader and the project staff, techniques and processes of project management • Project planning: selection of a topic and group formation, formulation of the project idea / project outline, foundation determination / process analysis / functional description, environment analysis • Definition of the task: project contract (specifications), development of a project schedule • Presentation of results
Module Type	Compulsory module
Teaching and learning formats	Seminars, project, module-related tutorial
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) or project work (PL) written assignment (SL)
Requirements for participation	None; however, modules of the 1st year of study in the ISU Bachelor or comparable knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German or English
Literature	Umweltrecht, Beck-Texte im DTV, latest edition Gas, T., Baurecht - Schnell erfasst, Springer, latest edition Kröger, Detlef, Umweltrecht - Schnell erfasst, Springer 2010 Gessler: Einführung in Projektmanagement

Courses

Course Leader	Course Title	Contact Hours p.w.
N.N. professorship infrastructure planning	Environmental and Planning Law	2
N.N. professorship infrastructure planning	Project: Planning	2
N.N. professorship infrastructure planning	Module-related tutorial	1

Module Description: Water Treatment Technologies

Module code	U3.2_WABT

Semester	3rd semester
Module Leader	Prof. Dr.-Ing. Jana von Horn
Competency goals	On successful participation, it is expected that the students • have a basic knowledge of function, design, operation and simple optimization options of a municipal sewage treatment plant • know the tasks and legal requirements of water management • understand technical and biological boundaries of (waste)water treatment • understand and apply basic design methods • are able to use a simulation program to optimize wastewater treatment plants • understand fundamentals of wastewater analysis and possible sources of error • know requirements for planning and its interrelations • are able to find new solutions
Course contents	The following topics are covered: • Fundamentals of wastewater treatment: biological, chemical and hydraulic fundamentals • Sewage plant design according to DWA-A 131 • Fundamentals of Sewage Treatment Simulation (IWA Models) • Simple options for optimizing wastewater treatment plants • Fundamentals of sewage sludge • Waste water analysis • Innovative sanitary systems
Module Type	Compulsory module
Teaching and learning formats	Seminar, laboratory class, module-related tutorial
Form & duration of examination (requirement for the award of credits)	Draft (PL) and oral exam (PL)
Requirements for participation	none

Relevant for	International degree programme Environmental Engineering BSc.; Civil Enginering BSc.
Student workload	60 contact hours + 120 hrs. Self-guided learning = 180 hrs.
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year in summer semester, 15 sessions per academic year.
Language of instruction	German
Literature	Abwasserbehandlung (2006). Hrsg. Weiterbildendes Studium Wasser und Umwelt, Bauhaus-Universität Weimar in fachlicher Kooperation mit der DWA, Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V.]. Weimar, Univ.-Verl., ISBN 9783860682722, DWA Regelwerk

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Jana von Horn	Methods of Municipal Wastewater Treatment	3
Prof. Dr.-Ing. Jana von Horn	Laboratory class	1
Prof. Dr.-Ing. Jana von Horn	Module-related tutorial	1

Module Description: Thermodynamics and Heat Transfer

Module code	U3.3_TDWÜ

Semester	3rd semester
Module Leader	Prof. Dr. Lars Jürgensen
Competency goals	By successfully passing this module, students can: • Understand and apply important fundamentals and relationships of thermodynamics • Describe simple processes of heat quantity, heat flow and enthalpy and solve tasks in this area • Understand and apply fundamentals of thermodynamic cycles • Understand and apply important fundamentals and relationships of heat conduction • Understand and apply important fundamentals and relationships of heat transfer • Describe simple heat transfer systems and solve tasks in this field
Course contents	The module teaches basic knowledge of the thermodynamics of heat transfer. More specifically, the following aspects are covered: • Importance of certain substance quantities such as vapor pressure, specific heat capacity, temperature, etc. • Equation of state of ideal gases • 0, 1st and 2nd law of Thermodynamics • States of matter, enthalpy of vaporization, heat of fusion • Change of state of substances in the pV-diagram, triple point • Isochore, isobaric, isothermal and adiabatic state change of gases • Right-flowing and left-flowing Carnot process • Efficiency of heat engines • Coefficient of performance of heat pumps and chillers • Stirling, diesel, petrol and joule process • Reversible and irreversible processes, meaning of entropy • Change of state of substances in the T / s diagram
Module Type	Compulsory module
Teaching and learning formats	Seminars, module-related tutorial, laboratory class
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) Experimental work (SL) or oral exam (SL)
Requirements for participation	None; however, modules of the 1st year of study in the ISU Bachelor or comparable knowledge and skills are recommended

Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Dietzel, F. & Wagner, W.: Technische Wärmelehre Baehr, H. D.: Thermodynamik: Grundlagen und technische Anwendungen Labuhn, D. & Romberg, O.: Keine Panik vor Thermodynamik!

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr. Lars Jürgensen	Thermodynamics and Heat Transfer, seminars	3
Prof. Dr. Lars Jürgensen	Laboratory class Thermodynamics and Heat Transfer	1
Prof. Dr. Lars Jürgensen	Module-related tutorial	1

Module Description: Thermal Process Engineering

Module code	U3.6_THVT

Semester	3rd semester
Module Leader	Prof. Dr. Lars Jürgensen
Competency goals	By successfully passing this module, students can: • Select basic operations or combinations of unit operations for the technical solution of thermal separation problems • Dimension thermal unit operations for material separation • Compare and evaluate the operation and design of thermal separators • Apply process-integrated environmental protection (PIUS) using Thermal separation processes • Perform, log and evaluate experiments for the thermal characterization of basic thermal operations
Course contents	The module teaches basic knowledge of thermal process engineering. More specifically, the following aspects are covered: • Introduction to the unit operations of thermal process engineering • Introduction to engineering calculation methods of stationary and transient processes • Conception, design and application of thermal separation processes in environmental engineering • Batch and continuous as well as fractional distillation • Absorption and desorption, extraction • Dry heat transfer systems • Embodiments and operation of thermal separators • Conception, dimensioning and application of process-integrated environmental protection (PIUS) by means of thermal separation processes • Implementation, logging and evaluation of process engineering experiments, such as fumigation of bioreactors (determination of the k_La value) on a laboratory scale and on a pilot plant scale
Module Type	Elective module (deepening Process Engineering)
Teaching and learning formats	Seminar Module-related tutorial Laboratory class

Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) Experimental work (SL) or oral exam (SL)
Requirements for participation	None; however, modules of the 1st year of study in the ISU Bachelor or comparable knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Mersmann, A.: Thermische Verfahrenstechnik Sattler, K. Till, A.: Thermische Trennverfahren Schönbucher, A.: Thermische Verfahrenstechnik

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr. Lars Jürgensen	Thermal Process Engineering, Seminar	3
Prof. Dr. Lars Jürgensen	Laboratory Class Thermal Process Engineering	1
Prof. Dr. Lars Jürgensen	Module-related tutorial	1

Module Description: Fundamentals of Urban Water Management & Hydraulic Engineering

Module code	U3.7_SWWB

Semester	3rd semester
Module Leader	Prof. Dr.-Ing. Jana von Horn
Competency goals	After successful participation, students will be able to: • Describe the tasks of domestic water management and the links to related disciplines (hydraulic engineering, hydrology), • Carry out simple calculations for dimensioning of hydraulic and municipal water infrastructure. • Explain fundamental hydrological relations • Estimate hydrological parameters and apply the water balance equation, • Describe hydrological, hydraulic and morphological measurement methods • Assign protection objectives, utilisation and structures of surface inland waters, • Present the main features of hydraulic engineering planning for standing and flowing inland water bodies Describe the hydraulic characteristics of tidal rivers.
Course contents	The following topics are covered in the Module “Fundamentals of Urban Water Management and Hydraulic Engineering”: • Elements of drinking water supply • Flow behaviour of water in the soil (inflow of wells and rainwater seepage) • Transport of water via pipe and pump • Preliminary calculation of the water supply network • Fundamentals of drainage and handling of rain water • Scope of wastewater treatment The module also provides basic knowledge as well as in-depth knowledge of selected topics in hydraulic engineering. More specifically, the following aspects are covered: • Occurrence of water and water balance, • Hydrological terms and dimensions • Measuring methods for data collection data in surface waters, • Standing surfaceinland waters - lakes and reservoirs, • Flowing surface inland waters - hydraulics and morphology, • Artificial waterways – significance, control profiles, structures • Tidal rivers - natural conditions.

Module Type	Elective module (deepening Infrastructure)
Teaching and learning formats	Seminar with module-related tutorial, partially in groups.
Form & duration of examination (requirement for the award of credits)	Written exam, duration 120 minutes
Requirements for participation	none
Relevant for	Engineering and science degree programmes, e.g. Civil Engineering B.Sc.
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Gujer, W., 2007: Siedlungswasserwirtschaft. Springer. Berlin. ISBN 9783540343295 Merkel, W., 2013: Einführung in die Wasserversorgung. Weimar, Univ.-Verl., ISBN 9783860682425 Strobl, T.; Zunic, F., 2006: Wasserbau: Aktuelle Grundlagen – Neue Entwicklungen. Springer-Verlag Berlin, Heidelberg Patt, H.; Jürging, P.; Kraus, W., 2011: Naturnaher Wasserbau – Entwicklung und Gestaltung von Fließgewässern. Springer-Verlag Berlin, Heidelberg

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. von Horn	Fundamentals of Urban Water Management	2
Prof. Dr. Ing. Koppe	Fundamentals of Hydraulic Engineering	1
Dipl.-Ing. Lankenau	Fundamentals of Hydraulic Engineering	1
Prof. Dr.-Ing. von Horn	Module-related tutorial	1

Module Description: Environmental Biotechnology

Module code	U3.8_UBTM

Semester	3rd semester
Module Leader	Prof. Dr.-Ing. Anja Noke
Competency goals	By successfully passing this module, students can: • Recognize the biotechnical potential of utilizing the metabolic activity of microorganisms for the treatment of contaminated environmental media, biogenic solid waste or renewable raw materials • Name and evaluate biologically relevant process parameters of such environmental biotechnological processes and develop proposals for optimizing them • Name modelling tools that can be used for this purpose and rate them regarding their informative value • Name, evaluate and apply important environmental biotechnology laboratory methods for water purification, as well as for the conversion of biogenic waste and renewable raw materials • Evaluate and discuss laboratory data critically and prepare a scientific laboratory report
Course contents	The module teaches concepts and methods of environmental biotechnology. More specifically, the following aspects are covered: <u>Environmental biotechnology</u> (50%) • Wastewater, pollutants and renewable materials as a substrate, mixed and pure microbial cultures as major entities •Kinetics of substrate degradation and microbial growth, monod kinetics, continuous reactor, • Biology of the activated sludge process and occurring process disturbances, residual COD • N-P elimination: denitrification, anammox, bio-P elimination • biofilm and trickling filter reactors, near-natural methods (constructed wetlands) • Industrial wastewater treatment, especially anaerobic processes • Biological methods of groundwater purification, pollutant removal by natural attenuation • Aerobic degradation of biogenic waste, especially composting • Anaerobic degradation of biogenic waste, methanation of sewage sludge, biogas production •Biotechnical ore leaching, production of ethanol and lactic acid from organic residues

	Modelling of environmental biotechnological processes (25%) • Material and energy balances • Biochemical reactions and reactors • Stationary state and transient state • Modelling Tools Laboratory class in Environmental Biotechnology (25%) Technical aspects of microbial conversion processes such as e.g. • Composting • Biogas production from waste • Lactic acid fermentation
Module Type	Elective module (deepening Process Engineering)
Teaching and learning formats	Seminar, PC lab, module-related tutorial, laboratory class
Form & duration of examination (requirement for the award of credits)	Written assignment (PL) or oral exam, 30 minutes (PL) Experimental work (SL)
Requirements for participation	None; however, the microbiological modules of the 1st/2nd year of study ISU (Bachelor) or comparable knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	• Janke, D. (2008), Umweltbiotechnologie. UTB 40.-€ • Kämpfer, P. (2013) Biologische Behandlung organischer Abfälle, Springer 65.-€ • Kunst, S. (2013) Betriebsprobleme auf Kläranlagen durch Blähschlamm, Schwimmschlamm, Schaum, Springer Verlag 170.-€ • Madigan et al. (2015): Brock Biology of Microorganisms Addison-Wesley 76,50 € • Mudrack, K., Kunst, S. (2009) Biologie der Abwasserreinigung. Spektrum Akad. Verlag 63.-€

	• Rosenwinkel, K.H. et al. (2014) Anaerobtechnik: Abwasser-, Schlamm- und Reststoffbehandlung, Biogasgewinnung Springer Vieweg 200.-€ • Sahm, H. et al. (2013) Industrielle Mikrobiologie. Springer Spektrum. • Wagner, R.(Hrsg.): Methoden zur Prüfung der biochemischen Abbaubarkeit chemischer Substanzen, VCH Weinheim, 1988 • actual scientific journals

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Anja Noke	Environmental Biotechnology	2
Dr. F. Kuhnen	Modelling of Environmental Biotechnical Processes	1
Prof. Dr.-Ing. Anja Noke	Laboratory class in Environmental Biotechnology	1
Prof. Dr.-Ing. Anja Noke	Module-related tutorial	1

Module Description: Fundamentals of Traffic Systems & Barrier-free Infrastructure

Module code	U3.9_VERS

Semester	3rd semester
Module Leader	Prof. Dr.-Ing. Carsten-W. Müller
Competency goals	By successfully passing this module, students can: • Understand the fundamentals of passenger and freight transport of land and air traffic in planning and operations • Recognize and reproduce the problem of accessibility in public spaces • Establish links to other fields of knowledge such as bridge building, architecture and urban planning At the end of this module, the students are able to identify basic questions of traffic planning independently and to solve them with the help of the set of rules presented in the module. They know the basic rules of barrier-free construction of traffic systems first hand.
Course contents	The module teaches selected topics as an introduction into traffic systems. More specifically, the following aspects are covered: • the most important regulations for road and air traffic planning • the main rules of accessibility in public spaces • barrier-free experience (excursion)
Module Type	Elective module (specialization Infrastructure)
Teaching and learning formats	Seminar Module-related tutorial
Form & duration of examination (requirement for the award of credits)	Written exam(s) (PL), 90 minutes (written tests on road, rail, air traffic and accessibility)
Requirements for participation	none
Relevant for	A requirement for traffic-related areas of “Infrastructure”, also suitable for ISU and architecture
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)

ECTS credits	6
Duration and frequency of the offer	Once per academic year / each year in 3rd semester (winter semester) / 15 sessions per academic year
Language of instruction	German
Literature	Students will receive a current literature list at the beginning of the course.

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Müller	Fundamentals of Traffic systems	2
Prof. Dr.-Ing. Müller	Fundamentals of Barrier-free Infrastructure	2
Prof. Dr.-Ing. Müller	Module-related tutorial	1

Module Description: Project 4: Basics of Management and Business Administration

Module code	U4.1_PRO4

Semester	4th semester
Module Leader	Prof. Dr.-Ing. Silke Eckardt
Competency goals	By passing this module, students can carry out engineering projects in a team and possibly with external clients, develop and present results. They can identify the Business Administration requirements and integrate them into their projects as constraints, and classify the project results into corporate structures. They are able to • apply fundamentals of project management in their projects • organize and execute their work processes according to these fundamentals • develop, document and present results in accordance with project goals • analyze, evaluate and justify project results • understand and apply basic management structures for environment-related processes • carry out an economic evaluation of companies, projects and environmental facilities • identify strategies for optimizing business processes • classify their subsequent professional activity as engineers in the environment of business enterprises, • understand and apply the work in projects using scientific methodology, with particular reference to involvement in business processes as a qualification requirement for environmental engineers.
Course contents	The module teaches selected topics for introduction to Business Administration Fundamentals and the application of Environmental Engineering Projectmethods. More specifically, the following aspects are covered: • Business Administration Fundamentals: Form and function of enterprises; External and internal accounting, bookkeeping, balance sheets, profit and loss account, cost accounting, revenue statement; elementary management functions: planning, taxes, controlling; special management functions; management techniques; optimization of business processes • Management systems: ISO 9001, ISO 50001 ISO 14001 and EMAS OHSAS 18001 • Project implementation Project execution (method application) Data collection and analysis Conception and evealuation Assessment / possibly a test

	Documentation Presentation of a project report
Module Type	Compulsory module
Teaching and learning formats	Seminars, project work Module-related tutorial
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) or project work (PL) Written assignment (SL)
Requirements for participation	None; however, modules of the 1st year of study in ISU (Bachelor) or equivalent knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German or English
Literature	Schwab: Managementwissen für Ingenieure, Kessler, Winkelhofer: Projektmanagement

Courses		
Course Leader	Course Title	Contact Hours p.w.
N.N.	Business Administration Fundamentals	2
Prof. Dr.-Ing. Silke Eckardt	Project: Implementation	2
Prof. Dr.-Ing. Silke Eckardt	Module-related tutorial	1

Module Description: Circular Economy

Module code	U4.2_KRWT

Semester	4th semester
Module Leader	Prof. Dr.-Ing. Silke Eckardt
Competency goals	The successful completion of this module will allow students to understand the basics of recycling and waste treatment technologies and apply them in simple problem solving. They are able to • systematically apply basic procedural operations to solids such as waste, • integrate the associated scientific fundamentals in problem solving, • understand waste treatment technologies and their basic principles as well as process engineering and technical solutions • fundamentally design and measure application examples • structure subject-related problems and process them according to project principles by means of smaller work projects (for example, preparation of written assignments and project tasks as well as practical examples) • plan and carry out methods for the processing of solid samples and analysis of waste parameters, and evaluate, interpret and document the test data in laboratory reports
Course contents	The module teaches selected topics to investigate waste and treatment technologies for recycling, recovery and disposal of waste. More specifically, the following aspects are covered: • Fundamentals for the technical design and arrangement of aggregates and plants, e.g. shredding, classifying and sorting technologies, composting plants, fermentation plants, mechanical-biological plants, waste incineration plants and refuse derived fuel (RDF) power plants, hazardous waste treatment plants, landfills • Methods for the evaluation of procedures and for the selection, planning and design of facilities. • Development of planning fundamentals based on a selected practical example in the context of an engineering project• Assessment of waste: Planning, execution and evaluation of experimental methods on selected examples: o Identification and evaluation of waste o Assessment of starting materials and end products o Impact on the treatment of waste o Assessment of the process guidance of plants
Module Type	Compulsory module
Teaching and learning formats	Seminars Laboratory class

	Module-related tutorial
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) and experimental work (PL) oral exam, 30 minutes (SL)
Requirements for participation	None; however, modules of the 1st year of study in ISU (Bachelor) or equivalent knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Kranert, M./Cord-Landwehr, K.: Einführung in die Abfallwirtschaft; Bilitewski, B./Härtle, G.: Abfallwirtschaft

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Silke Eckardt	Waste treatment technologies	3
Prof. Dr.-Ing. Silke Eckardt	Laboratory class	1
Prof. Dr.-Ing. Silke Eckardt	Module-related tutorial	1

Module Description: Technical English

Module code	U4.3_TENG

Semester	4th semester
Module Leader	Prof. Dr.-Ing. Anja Noke (provisionally)
Competency goals	By the passing of this module, students acquire knowledge about environmental processes and technologies in English and reproduce and discuss these in English. Upon completion of the module, students have reached B2 / C1 level according to the Common European Framework of Reference.
Course contents	• English grammar and vocabulary for reading, presenting and discussing English media in the fields of microbiology, analytical chemistry, water treatment and energy production • Rhetorical pactice in English to discuss technical contents • Rhetorical and stylistic means of writing texts in English
Module Type	Compulsory module
Teaching and learning formats	Language lab
Form & duration of examination (requirement for the award of credits)	Written exam, 120 minutes (PL) or written assignment (PL)
Requirements for participation	None; however, modules of the 1st/2nd year of study in ISU (Bachelor) or equivalent knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	English
Literature	Oxford Advanced Learner's Dictionary, Cornelsen, 2015 Cambridge Advanced Learner's Dictionary, Klett, 2013

	MacMillan English Dictionary For Advanced Learners, Hueber, 2013

Courses		
Course Leader	Course Title	Contact Hours p.w.
N.N. (lecturer from foreign language center)	Technical English	4

Module Description: Materials Science and Engineering

Module code	U4.4_WETE

Semester	4th semester
Module Leader	Prof. Dr. Lars Jürgensen
Competency goals	By passing this module, students can • assess the basic chemical-physical properties of building materials and recognize their importance in construction and, based on this, make a targeted selection of materials, • select building materials such as steel, concrete, plastics and morne composite materials for specific applications and assess the impact of aging and corrosion in aggressive environments, • take into consideration environmental issues (resource conservation, energy consumption, CO_2 emissions and pollutant dispersion) in the production, processing and long-term use of building materials in the case of material selection, • Identify the context and effects of building construction on nature and society and, together with the technical properties of the materials, contribute to aspects of sustainability.
Course contents	As a general introduction to materials science, students will • discuss chemical-physical fundamentals and explain which macroscopic properties can be derived from the microstructural structure of the materials, • illustrate the basic relationships between the physicochemical properties of materials and the design-relevant characteristics of building materials and their field of application in construction • investigate transport parameters, mechanical properties, deformation characteristics and time-dependent material behaviour and their influence on building structures • discuss manufacturing and processing of steel, concrete, plastics and composites • investigate the chemical and physical mechanisms of aging and corrosion Studies are accompanied by excursions into the building industry and the construction practice.
Module Type	Compulsory module
Teaching and learning formats	Seminars, module-related tutorial
Form & duration of examination (requirement for the award of credits)	Written exam, 120 minutes (PL)

Requirements for participation	none
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Students will receive a current literature list at the beginning of the course.

Courses		
Course Leader	Course Title	Contact Hours p.w.
N.N.	Materials Engineering	4
N.N.	Module-related tutorial	1

Module Description: Process and Reaction Engineering

Module code	U4.6_PTRT

Semester	4th semester
Module Leader	Prof. Dr. Lars Jürgensen
Competency goals	By passing this module, students can: • safely apply the scientific fundamentals of process and reaction technology • understand problems in the technical implementation of bio-chemical reactions • evaluate kinetic data as well as mass and energy balances • select suitable reactor types for environmental processes • calculate necessary process parameters and targets of environ mental reactors • solve special processes and reaction tasks • conduct economic feasibility studies of solution concepts • safely apply laboratory work essentials such as due diligence when conducting experiments, consideration of faults and safety measures, and collaboration and organization.
Course contents	The module teaches basic knowledge of Process and Reaction Engi-neering. More specifically, the following aspects are covered: • Balance equations for mass and energy conversions • Batch processes and continuous processes • Single-stage and multi-stage reactors • Reactions with different reaction orders • Kinetics of biochemical reactions • Michaelis-Menten and Monod kinetics as well as kinetics with sub strate and product inhibition • Modelling batch processes using balance equations • Modelling continuous processes using balance equations • Determination of kinetic coefficients of simple biochemical reac tions • Determination of kinetic coefficients of wastewater purification processes • Estimation of investment and operating costs • Profitability comparison based on annual costs
Module Type	Elective module (deepening Process Engineering)
Teaching and learning formats	Seminars Module-related tutorial Laboratory class
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) Experimental work (SL) or oral exam (SL)

Requirements for participation	None; however, modules of the 1st year of study in ISU (Bachelor) or equivalent knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	German
Literature	Hagen, Jens: Chemiereaktoren Baerns, Manfred; Hofmann, Hanns; Renken, Albert: Chemische Reaktionstechnik Wiesmann, Udo: Fundamentals of Biological Wastewater Treatment Hemming, W.: Verfahrenstechnik

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr. Lars Jürgensen	Process and Reaction Engineering, Seminar	3
Prof. Dr. Lars Jürgensen	Laboratory class in Process and Reaction Engineering	1
Prof. Dr. Lars Jürgensen	Module-related tutorial	1

Module Description: Water Networks

Module code	U4.7_SWWN

Semester	4th semester
Module Leader	Prof. Dr.-Ing. Jana von Horn
Competency goals	After successful participation, it is expected that the students • know the tasks and legal requirements of urban drainage systems • understand relationships between elements of urban drainage • know the technical limitations • have a good knowledge of function, design, operation and possibilities for optimizing sewer systems • understand and apply design methods • can apply a simulation program for optimization • can include new solutions in planning processes and apply problem-solving thinking • Can solve extensive tasks in a team
Course contents	The following topics are covered in the module: • Function, design, operation and optimization possibilities of sewer networks • Sewer network simulation: input data, calibration options, stormwater calculation • Sewer network optimization (variant analysis) • Optimization of mixed water discharge by means of simulation • Fundamentals of stormwater simulation • Operation of sewer networks • Innovativel sanitary systems, TRIZ method
Module Type	Elective module (deepening Infrastructure)
Teaching and learning formats	Seminar, module-related tutorial
Form & duration of examination (requirement for the award of credits)	Draft (PL) and oral exam 30 min (PL)
Requirements for participation	None; however, modules of the 1st year of study in ISU (Bachelor) or equivalent knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15

Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year in summer semester, 15 sessions per academic year.
Language of instruction	German
Literature	Abwasserableitung (2009). Hrsg. Weiterbildendes Studium Wasser und Umwelt, Bauhaus-Universität Weimar in fachlicher Kooperation mit der DWA, Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V.]. Weimar, Univ.-Verl., ISBN 9783860682838

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Jana von Horn	Water Networks	4
Prof. Dr.-Ing. Jana von Horn	Module-related tutorial	1

Module Description: Remediation Technologies

Module code	U5.2_REME

Semester	5th semester
Module Leader	Prof. Dr.-Ing. Anja Noke
Competency goals	By passing of this module, students are able to understand the fundamentals of environmental remediation practices and technologies. They are able to: • Describe the characteristics of soils in terms of of construction and environmental purposes • Understand fundamentally the behaviour of water molecules and relevant pollutants in the soil system as well as interactions between particles, air and water • Select methods to study soil, groundwater and soil air and to evaluate the results • Apply unit operations of process engineering to the purification of air, water and soil • Understand decision-making processes for the assessment of suspected contaminated sites and to use evaluation criteria professionally • Plan and carry out the processing of solid samples and analysis of soil parameters, to evaluate the data, to interpret it and to document the same in laboratory reports
Course contents	The module conveys methods and processes for the investigation, evaluation and remediation of contaminated sites. In detail, the following aspects are covered: • Soil properties: Soil physical and soil mechanical properties, tensions in the soil, deformation of the subsoil (soil settlements), movement of water and pollutants in the soil • Exploration of contaminated sites and remediation planning: Overview of the remediation of contaminated sites from identification to exploration as well as evaluation and follow-up, to the legal aspects and the organizational structure of remediation of contaminated sites, on-site investigations, and remediation processes • The remediation process: Procedures for the protection and decontamination of contaminated sites and possible applications depending on the type of contamination, development of remediation concepts • Evaluation of remediation procedures, selection and plant design, and development of planning fundamentals on the basis of practical examples • Assessment of soils: Planning, implementation and evaluation of experimental methods on selected examples, identification and assessment of soils, effects on the use and treatment of soils

Module Type	Compulsory module
Teaching and learning formats	Seminars, lab, module-related tutorial
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL) or experimental work (PL) oral exam, 30 minutes (SL)
Requirements for participation	None; however, modules of the 2nd year of study in ISU (Bachelor) or equivalent knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	English
Literature	Neumaier, Weber: Altlastensanierung / Franzius: Handbuch der Altlastensanierung und Flächenmanagement / Held: In-Situ-Verfahren zur Boden- und Grundwassersanierung

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Anja Noke	Soil Properties	1
Prof. Dr.-Ing. Anja Noke	Soil Lab	1
Prof. Dr.-Ing. Anja Noke	Remediation Technologies	2
Prof. Dr.-Ing. Anja Noke	Module-related tutorial	1

Module Description: Industrial Wastewater Management

Module code	U5.3_IWWM

Semester	5th semester
Module Leader	Prof. Dr.-Ing. Peter Hartwig
Competency goals	After successful participation, students can: • understand the legal framework for industrial wastewater treatment • understand and apply the structure and procedure in industrial waste water and sludge treatment projects • develop and evaluate the characteristics of industrial wastewater • reproduce and apply essential process techniques and relevant design parameters • understand and reproduce newer technological developments (ZLD, membrane technology) • verify and reproduce co-fermentation technologies and practice examples • reproduce evaluation options for residues from industrial wastewater treatment • render simple optimization options for the energy efficiency of industrial wastewater plants
Course contents	The following topics are covered in the module: • Structuring projects for industrial wastewater treatment • Legal requirements • Process techniques for pre-treatment and complete treatment of industrial wastewater • Zoo Liquid Discharge (ZLD) technologies • Co-fermentation of organic residues • Carrying out experiments on a laboratory and semi-technical scale • Realization of wastewater plants • Operating experience of industrial wastewater plants
Module Type	Compulsory module
Teaching and learning formats	Seminars, module-related tutorial
Form & duration of examination (requirement for the award of credits)	Written exam, 90 min (PL)
Requirements for participation	none
Relevant for	International Programme in Environmental engineering BSc.; Civil Engineering BSc.

Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year in summer semester, 15 sessions per academic year.
Language of instruction	English
Literature	Literature: Gujer: Siedlungswasserwirtschaft, Gujer: Systems Analysis for Water Technology

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Peter Hartwig	Industrial Wastewater Management	2
Prof. Dr.-Ing. Jana von Horn	Industrial Wastewater Management	2
Prof. Dr.-Ing. Jana von Horn	Module-related tutorial	1

Module Description: Construction and Design of Built Structures

Module code	U5.4_CDBS

Semester	5th semester
Module Leader	Prof. Dr. Lars Jürgensen
Competency goals	By passing this module, students are able to explain and present the essential framework conditions, load assumptions and supporting structures of environmental engineering structures, describe them quantitatively and qualitatively using suitable methods and apply them in simple planning and design tasks. They are able to • recognize the flow of forces in supporting structures and to formulate and calculate static equilibrium conditions • understand states of force and deformation and describe stress states in simple support structures • understand the fundamentals of steel and reinforced concrete construction as well as the support dimensioning in steel and reinforced concrete • recognize fundamentals of framework design as well as principles of structural design • name fundamentals of construction design with regard to heat protection, moisture protection, sound insulation and fire protection
Course contents	The module teaches selected topics on structural design and construction. More specifically, the following aspects are covered: • Stress mechanics: concepts, modelling • Stress mechanics: external loads, calculation of forces and moments • Stress mechanics: internal forces, state lines • Stress mechanics: stresses, strains • Constructions in environmental engineering: Fundamentals, requirements, forms • Functions and implementations • Construction principles • Constructions in wastewater systems • Constructions when handling water-polluting substances
Module Type	Compulsory module
Teaching and learning formats	Seminars Module-related tutorial
Form & duration of examination (requirement for the award of credits)	Written exam, 90 minutes (PL)

Requirements for participation	None; however, modules of the 1st and 2nd year of study in ISU (Bachelor) or equivalent knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	English
Literature	Students will receive a current literature list at the beginning of the course.

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Sommer	Construction and Design of Built Structures	4
Prof. Dr.-Ing. Sommer	Module-related tutorial	1

Module Description: Electrical Engineering, Measurement and Control Technology

Module code	U5.5_EMRT

Semester	5th semester
Module Leader	Dr. Florian Kuhnen
Competency goals	By passing this module, students can: • Understand and apply the basic parameters of electrical engineering • Describe the concept of the electromagnetic field, whose different manifestations are recognized and translated into practical applications • Understand and apply the structure and operation of various measurement techniques • Carry out a targeted selection of measurement technologies for a given environmental or process measurement task • Understand and apply key analytical techniques in environmental engineering • Describe uncertainties of measurements and measuring instruments • Understand and apply fundamentals of control technology • Describe and analyse single-loop controllers
Course contents	The module teaches advanced knowledge of electrical engineering and measurement technology. The following aspects are dealt with: • Electrostatic field: charge, field, potential, voltage, capacity • Stationary electric flow field: current, Ohm's law, resistance, power, Kirchhoff's laws • Stationary magnetic field: inductance, magnetic circuits • Capacity induction: inductance, energy, motion induction, quiescent induction • Systematic and random measurement errors, statistics, presentation of measurement results • Meaning and definition of SI base units • Measurement of physical quantities (e.g. force, length, speed, torque, moment of inertia) •Measurement methods for process state variables (for example pressure, temperature, flow, level) • Measuring method for pH value, conductivity, O2 or CO2 concentration, redox potential • Analysis methods for BOD, COD, TOC, TS, oTS, NH4, NO3 • Strain gauges and Wheatstone bridge • Introduction to control engineering, rules and steering • Static and dynamic behaviour of control circuits and control processes • Mathematical description of simple control loops

Module Type	Compulsory module
Teaching and learning formats	Seminars, laboratory class, module-related tutorial
Form & duration of examination (requirement for the award of credits)	Written assignment (PL) and oral exam (PL) Experimental work (SL)
Requirements for participation	None; however, modules of the 1st year of study in ISU (Bachelor) or equivalent knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	English
Literature	Albach, M.: Grundlagen der Elektrotechnik Freudenberger, A.: Prozessmesstechnik Reuter/Zacher: Regelungstechnik für Ingenieure

Courses		
Course Leader	Course Title	Contact Hours p.w.
Dr. Florian Kuhnen	Electrical Engineering, Measurement and Control Technology	3
Dr. Florian Kuhnen	Laboratory class	1
Dr. Florian Kuhnen	Module-related tutorial	1

Module Description: Project 5: Apparatus and Plant Engineering

Module code	U5.6_PRO5

Semester	5th semester
Module Leader	Prof. Dr. Lars Jürgensen
Competency goals	By passing this module, students can: • Recognize essential questions of an environmental task and create solutions • Represent the solution concept in the form of basic and procedural images • Create simple technical drawings with AUTOCAD and R + I-CAD • Describe processes based on balance-sheet equations • Dimension the system required for the solution concept with all system components, apparatus and pipelines • Design the measurement and control technology required for optimum operation and present it in the form of R + I flow diagrams • Explain the developed solution concept of an environmental installation in English
Course contents	The module teaches basic knowledge of apparatus and plant planning. In detail, the following aspects are covered: • Analysis of environmental questions with the aim of a solution concept • Optimal choice of possible solutions, e.g. batch or continuous process • Presentation of the developed solution concept based on basic and process flow diagrams with AUTOCAD and R + I-CAD • Choice of optimal pumps as well as dimensioning and representation of pumping stations • Dimensioning and representation of pipelines • Choice of optimal plant components such as reactors and separators • Presenting the advantages and disadvantages of these system components for the present concept • Dimensioning of this plant component by applying balance equations • Determining the optimal embodiment of the equipment used • Defining a measurement technique required for optimum operation • Optimal choice between manual control or control loops • Fundamentals of R + I flow diagrams and representation of the MSR technique of the solution concept
Module Type	Elective module (deepening Process Engineering)
Teaching and learning formats	Seminar, project work in small groups

Form & duration of examination (requirement for the award of credits)	Term paper (PL) and oral exam (PL)
Requirements for participation	None; however, modules of the 1st and 2nd year of study in ISU (Bachelor) or equivalent knowledge and skills are recommended
Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 contact hours
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year
Language of instruction	English
Literature	Hemming, W.: Verfahrenstechnik Bock, H.: Fließbilder, ihre Funktion und ihr Zusammenbau aus Geräten Helmus, F. P.: Anlagenplanung Ullrich, H.J.: Anlagenbau

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr. Lars Jürgensen	Apparatus and Plant Planning	2
Prof. Dr. Lars Jürgensen	Project work	2
Prof. Dr. Lars Jürgensen	Module-related tutorial	1

Module Description: Project 5: Infrastructure

Module code	U5.7_PRO5

Semester	5th semester
Module Leader	Prof. Dr. Jürgen Knies
Competency goals	By passing this module, students can: • Apply the methods of scientific work concerning infrastructure planning, domestic water management and hydraulic engineering as part of a project • • Organize and complete project work in the aforementioned disciplines Apply project management basics and organise projekts themselves • work in a team • present scientific projects • actively participate in scientific discussions At the end of Project module 5, students will be able to apply in-depth rules for infrastructure design planning and to work independently on a project in a team, as well as to reflect and meaningfully document the results.
Course contents	The module teaches interdisciplinary work areas for project work in infrastructure planning, domestic water management and hydraulic engineering. More specifically, the following aspects are covered: • Planning and building of infrastructure from the point of view of the civil engineer or the environmental engineer • Basic work processes in infrastructure planning, domestic water management and hydraulic engineering • Planning details in the individual disciplines • Building Information Management (BIM) with costing and scheduling
Module Type	Elective module (deepening Infrastructure)
Teaching and learning formats	Seminar with practical tutorials, project diaries, work in small groups, subprojects, learning coaching
Form & duration of examination (requirement for the award of credits)	Project work (PL) or term paper (PL) or oral exam (PL)
Requirements for participation	None; however, modules of the 1st and 2nd year of study in ISU (Bachelor) or equivalent knowledge and skills are recommended

Relevant for	Engineering and science degree programmes
Student workload	60 + 120
Classroom learning	60 + 15
Self-guided learning	120 (The self-guided learning also includes the workload for the module-related tutorial as supervised self-guided learning in the scope of 15 hours)
ECTS credits	6
Duration and frequency of the offer	Once per academic year / each year in 5th semester (winter semester) / 15 sessions per academic year
Language of instruction	English
Literature	Students will receive a current literature list at the beginning of the course.

Courses		
Course Leader	Course Title	Contact Hours p.w.
N.N. Prof. Infrastructure plannning	Methodology, Task Definition - Infrastructure panning	2
Prof. von Horn	Methodology, Task Definition - Domestic Water Management - Water Networks	2
Prof. von Horn	Module-related tutorial	1

Module Description: Study-abroad period

Module code	

Semester	6th semester
Module Leader	Prof. Dr.-Ing. Anja Noke
Competency goals	After successful participation in accordance with the examination regulations of the host university and the City University of Applied Sciences Bremen (HSB), it is expected that the students have expanded their knowledge and skills in terms of subject, methodological, cultural and social aspects in the new study environment under the local requirements and framework conditions. They have: • acquired initial insights into other disciplines of environmental engineering or environmental sciences or environmentally relevant other disciplines, based on the fundamental, conceptual and procedural knowledge acquired at HSB • Deepened meta-cognitive knowledge by being able to analyze and assess their expertise in (international) contexts, both professionally and in terms of their own strengths and weaknesses, After participating in the intercultural trainings, the students are able to classify and interpret foreign behaviours and to act appropriately in a foreign culture.
Course contents	The study abroad period teaches selected environmental technical and methodological topics with the following exemplary main elements: • Analysis and evaluation of environmental media and environmental impacts • Technical solutions for minimizing environmental impact as well as material and energy efficiency • Management of environmentally relevant procedural and business processes According to our own selection and after individual coordination with the international representative of the International Environmental Engineering degree programme, the following topics are possible (non-exhaustive list of examples): • Water management, water and wastewater treatment • Circular economy and waste management • Climate protection and air pollution control • Soil protection and remediation of contaminated sites • Environmental biotechnology • Material and energy efficient production and services in companies • Sustainable energy conversion and use • Technical solutions in nature conservation • Ecological construction

	<u>Preparation for the study abroad period:</u> Intercultural Trainings
Module Type	Compulsory module
Teaching and learning formats	Seminar, project work, module-related tutorial
Form & duration of examination (requirement for the award of credits)	Report and Presentation (SL) PL pusuant to the examination regulations of the host institution
Requirements for participation	78 ECTS from the 1st to 3rd semester or in accordance with the admission requirements of the host institution
Relevant for	Engineering and science degree programmes
Student workload	In accordance with the study regulations of the host institutuion
Classroom learning	In accordance with the study regulations of the host institutuion
Self-guided learning	In accordance with the study regulations of the host institutuion
ECTS credits	Altogether 30 or equivalent on the basis of the workload attached to a relevant single-subject degree programme at the host institution
Duration and frequency of the offer	In accordance with the study regulations of the host institutuion
Language of instruction	English or other non German
Literature	

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr.-Ing. Anja Noke	Preparation and follow-up	4
Prof. Dr.-Ing. Anja Noke	Module-related tutorial	1

Module Description: Practical Phase

Module code	U7.1_PRAX

Semester	7th semester
Module Leader	Prof. Dr. Lars Jürgensen
Competency goals	The practical phase familiarizes students with engineering activities in the field of environmental engineering or related fields. By successfully passing this module, students can: • independently work on projects in a professional environment, • work in an interdisciplinary manner in project teams, • place the engineering skills acquired during their studies in the context of company processes and tasks, •formulate further engineering questions (for example, in preparation for their Bachelor's Thesis) from the results of the project carried out in the practical phase.
Course contents	The learning content results from the students' chosen future occupation in a company, an authority, a scientific institution or other institutions. In order to enable optimum technical support, the tasks and fields of activity during the practical phase should be oriented towards the teaching areas of the professors in the degree program Environmental Engineering and can include: • engineering and planning offices, • private and municipal supply and disposal facilities, • recycling, • companies of mechanical and plant engineering, • energy, • food and biotechnology companies, • chemical and pharmaceutical industry, • economic and environmental consulting, environmental management, • public service, • non-governmental organizations, non-profit organizations, • Scientific institutions, colleges and universities The practical phase is to be carried out coherently. The practical course includes the topics: • Self-management and work planning in everyday working life • Formulation of interim reports, accounts and reports • Practice of project management • Task, function and structure of business enterprises (business organization) • Canditature • Lectures from the practice (by students and external guests)

Module Type	Compulsory module
Teaching and learning formats	Internship, seminar, module-related tutorial, written assignment
Form & duration of examination (requirement for the award of credits)	Written assignment (PL) Term paper (SL)
Requirements for participation	None
Relevant for	Engineering and science degree programmes with practice phase, preparation for master course Bau und Umwelt at HS Bremen for bachelor graduates with 180 credits
Student workload	60 contact hours + 480 hrs. practice phase = 540 hrs.
Classroom learning	60
Self-guided learning	480
ECTS credits	18
Duration and frequency of the offer	Once per academic year
Language of instruction	German or English
Literature	

Courses		
Course Leader	Course Title	Contact Hours p.w.
Prof. Dr. Lars Jürgensen	Practice accompanying seminar	4
Prof. Dr. Lars Jürgensen	Module-related tutorial	1

Module Description: Bachelor Thesis

Module code	U7.2_THES

Semester	7th semester
Module Leader	NN
Competency goals	By successfully passing the Bachelor thesis module, students can: • Systematically apply their methodological, scientific and technical knowledge and skills to an engineering question or development task from company practice or applied research in the field of environmental engineering • Develop the state of science and technology for the respective question or development task, • Apply appropriate scientific methods or development strategies to answer the question, • Evaluate the results obtained, • Evaluate the findings or the new state of development critically against the background of their environmental knowledge and skills as well as the state of science and technology. • Present and defend the results of the work in a written (Bachelor thesis) as well as in oral form (Colloquium).
Course contents	Bachelor thesis (300 hours): The specific learning content results from the topics selected and prepared by the students in the field of environmental engineering. The topic of the Bachelor thesis should be in accordance with the areas of teaching represented by the professors working in the degree program Environmental Engineering (Environmental Chemistry, Recycling and Waste Management, Environmental Biotechnology, Process Engineering, Water Management). The Bachelor thesis should be carried out in close thematic and temporal context with the practice phase. The accompanying seminar includes the following topics (60 hours): • Formulation of technical-scientific tasks, project planning, method selection and application or development strategies • Structuring scientific or technical texts • Presentation of technical and scientific work results • Preparation, implementation and discussion of technical lectures
Module Type	Compulsory module
Teaching and learning formats	Thesis supervision, colloquia (lectures and subsequent discussion)
Form & duration of examination (requirement for the award of credits)	Bachelor thesis (PL) and colloquium (PL)

Requirements for participation	144 credits from the modules of the International Environmental Engineering degree programme including studies abroad or comparable knowledge and skills
Relevant for	Engineering and science degree programmes
Student workload	60 contact hours + 300 hrs. Bachelor thesis = 360 hrs.
Classroom learning	60
Self-guided learning	300 hrs.
ECTS credits	12
Duration and frequency of the offer	Once per academic year
Language of instruction	German or English
Literature	

Courses		
Course Leader	Course Title	Contact Hours p.w.
ISU Professors	Thesis accompanying Seminar	4