1. Environmental sciences: Minor Sustainable Water technology

Available in semester 2: February 2023-July 2023

Prerequisites: a solid science background: chemistry mathematics, microbiology at at least 3 year Bachelor level.

Modulecode	EMES S2VE
Unit of study - name	Exchange Minor Environmental Sciences Semester 2
Competences	ES 1:Developing and balancing sustainable solutions; level 2 and 3 (Advanced and professional) ES 2 :To work interdisciplinary and internationally; level 2 (Advanced) ES 3: To think, act and perform research in a methodical and reflective level 2 and 3 (Advanced and professional) ES 4: Project work; level 3(Professional) ES 5: Advising professionally; level 2 and 3: (Advanced and professional) ES 6: To function responsibly: level 3 (professional)
Learning outcomes	LMK222:Dealing with large scale environmental risks: After successful completion of this module the student is able to: - Analyse and evaluate the effects of human activities on organisms, ecosystems, biodiversity and different types of landscapes. - Apply risk assessment methods in complex situations to map the different aspects of sustainability. - Take the factors concerning human behaviour into account in formulating solutions and advices - Take the international aspects of environmental issues into account. - Research scientific articles and makes a critical assessment of the selected material. - Formulate a problem description based on the outline of an (environmental)problem; make a problem analysis and design a methodological adequate research plan. - Execute the research plan systematically, and focus on the purpose of the research. - Apply simple analytical techniques to data processing. - Interpret the outcomes of the research. - Present the outcomes of the research to the client in an appropriate way. - Reflect on the used methods and research results. - Defend effectively the research plan, its execution, results and conclusions. - Keep up to date with the current situation and the (global) developments in his field of expertise. - Show an independent research attitude and acts responsibly. LMK230VE: Water treatment and soil remediation After successful completion of this module the student is able to: • Describe water treatment technologies and assess them in specific situations • Size waste water treatment plants (WWTP) • Operate water treatment techniques at lab scale and combine these techniques in a logical way

- Describe soil remediation techniques and assess them
- Choose between different soil remediation techniques in a specific situation of pollution
- Describe the most important microbial processes in soil remediation and waste water treatment
- Calculate degradation rates in the soil (predict) in specific situations
- Calculate transport rates in soils
- Integrate sustainability and recognize this in the different treatment systems
- Make simple calculations of heat transport

LMK231VE: Advanced Water Technology.
After successful completion of this module the student is able to:
to apply knowledge of different water treatment systems in the field of wastewater and drinking water treatment
Discern how to (re)use water from several sources for various applications
Perform basic design calculations for water treatment systems
Have an overview of possible nutrient recovery techniques
Operate pilot scale water treatment systems.
The fundamentals of sustainability in water treatment will be considered as a principle in this module.
LMK320: Sustainable Urban Environment (SURE)

After successful completion of this module the student is able to:
to integrate the concept of the UNSDG11 and the principles of urban planning into a product or an advice that can be used by the client in one of the aspects of sustainable urban development
to develop, monitor, control and participate in an interdisciplinary project. He is able to use technical, legal and financial resources efficiently and to organize the collaboration processes effectively.
to compare and use different tools effectively for the planning and qualitative research processes for developing the professional product

LDM 258: Basic GIS
After successful completion of this module the student is able to:
design and implement a suitability analysis;
have basic understanding about raster data;
recognize and make use of different policy instruments;
use GIS as an instrument in spatial planning;
carry out spatial analysis based on a layered approach using a GIS and supporting theory;
report the GIS operations effectively, in writing to professionals;
critically review his own findings with respect to the procedures.

Content

At the core of ES is the focus on developing and balancing sustainable solutions. While taking the three P'S: planet, people and profit into account. This minor prepares students to deal with different aspects of environmental sciences: Water and soil remediation technologies, large

scale environmental risks, sustainable urban environment and GIS as a supporting tool.

The minor consists of four ES major modules and a supplementary assignment.

LMK230VE: Water and Soil Remediation	7 credits
LMK 231VE: Advanced water technology/or LMK 320VE: SURE: Sustainable urban environment	7 credits
LMK222VE: Dealing with large scale environmental risks	7 credits
LDM 258VE : Basic GIS	7 credits
LMK410VNEX: Supplementary Assignment	2 credits

N.B.: 1 credit = 28 study hours.
More extensive Module descriptions can be obtained from the minor coordinator.

Teaching method(s) and student workload

LMK222VE:
Lectures, assignments, integral assignment, lab work, computer exercises
LMK222VE-01 Assignments, 90 study hours study load, mark
LMK222VE-02 Theory, 80 study hours study load, mark
LMK222VE-03 Practical 30 study hours study load, mark

LMK230VE:
Theory LMK230-01 (56 study hours)

Waste Water treatment	20 study hours
Soil remediation	14 study hours
Microbiology	14 study hours
Heat transfer	8 study hours

Learning tasks LMK230-02 (112 study hours)

Description processes in WWTP	18 study hours
Calculations for dimensioning	30 study hours
Writing soil remediation proposal	64 study hours

Practical LMK230-03 (28 study hours)

Execution	16 study hours
Presentation	4 study hours
Sludge practical	8 study hours

Teaching methods:
Lectures
Practical (lab and computer)
Case study (group assignment)
Excursion WWTP

LMK231VE:
40 hours (guest) lectures (guest lectures obligatory)
16 hours practical (obligatory)
16 hours excursion (obligatory)
16 hours exercises
56 hours design assignment
52 hours home work

LDM258VE:
Lectures, internet courses, computer practical, tutorial, group work, self-study, excursion. Total study 196 hour (7 credits), divided in (indication):

Report spatial analysis of case, including practical, tutoring, and self-study	86 hours
Exam on GIS, including specific thematic topics (e.g. Hydrology), including lectures and self-study	86 hours
ArcGIS certificate, including practical and self-study	28 hours

LMK320VE: Total 196 hours.
Lectures, workshops
Guest lectures
Group project and individual assignments
(International) excursion(s)
Self-study
Presentations professional products

LMK410VNEX: Supplementary assignment,
content depends on students' background 56 hours

Please note that this minor includes an excursion abroad(in LMK320VE), for which the total extra costs to be paid by the student will be approx. 300 euro

Rating scale 1-10 (pass = 5,5)

Assessment(s) LMK222VE:
LMK222VE-01 Assignments
LMK222VE-02 Theory (written exam)
LMK222VE-03 Practical

LMK230VE:
Written exam
Assessment of (group) assignments
Assessment practical (method & presentation)

LMK321VE:
LMK231DE – 01 Written exam (open book) – 70%
LMK231DE – 02 Report design assignment – 30%

LDM258VE:
Exam (3EC)
Report (3EC)
AcrGIS certificate (1EC)

LMK320VE:
Continuous assessment/Professional product (7EC)

	LMK410VNEX Report (2EC)
Mandatory literature	Materials will be published on Moodle Rooms in due course
Minor coordinator	
Language	English
Credits	30
Period	Period 3 and period 4
Entry requirements/ prerequisites	Two years of study in an environmental sciences-oriented or related program at a BSc level. A solid base in mathematics, physics, chemistry, micro biology and more specifically statistics, research, physiology, cell biology, biochemistry, ecology. Knowledge of physical/chemical characteristics of substances Knowledge of transport processes of substances in environment Lab skills (passed a course: 'work safely in the laboratory') Depending on your study background and motivational letter, you may be asked for additional information, e.g. in an intake interview with representatives of this minor. Their advice is binding.