University of Debrecen

Faculty of Engineering

Environmental Engineering MSc Program

Environmental Technology, Planning, Constructions Specialization

Built Environment Specialization

2020

TABLE OF CONTENTS

DEAN'S WELCOME

Welcome to UD's Faculty of Engineering!

The Faculty of Engineering of the University of Debrecen has become an outstanding centre of education and research in the Eastern Hungarian region. Following the footsteps of our predecessors, the academic and administrative staff of the Faculty work hand in hand to make our training programmes and researches meet both national and international standards.

The Faculty of Engineering is one of Hungary's most significant institutions of higher-education, and its 3000 students make it a dominant faculty of the University of Debrecen which - having the most international students, offering the most academic programmes among Hungarian universities and having been classified as a research university, the highest of qualifications - is officially listed among the best universities in the country.

We welcome the most outstanding and inquisitive students of the region with an enthusiastic and professional team of academics and researchers, and a set of laboratories unique in the country. We consciously aspire to develop the quality of education and research further, based on a close cooperation between the Faculty and the industry. Our students enter many prestigious competitions and they are becoming increasingly successful and acclaimed, while our instructors are working on a growing number of national and international projects of basic and applied research.

The Faculty bridges the gap between theory and practice and provides a high-quality theoretical background merged into practice-oriented training based on industrial relations. We do our best to maintain the high prestige of the engineering diplomas awarded by the University of Debrecen and to make sure that the knowledge and achievements of students who graduate from our Faculty continue to be recognised in the labour market.

All things considered, you are kindly advised to read this bulletin which hopefully reflects our endeavours appropriately and provides all the information you need to know about your chosen training programme. We are looking forward to supporting the personal and professional growth of our future engineers.

With the best of wishes for the years to come,

Géza Husi

Dean

HISTORY OF THE UNIVERSITY

The history of Debrecen's higher education dates back to the 16th century. The Calvinist Reformed College, established in 1538, played a central role in education, teaching in the native language and spreading Hungarian culture in the region as well as in the whole country. The College was a sound base for the Hungarian Royal University, founded in 1912. Apart from the three academic faculties (arts, law, theology) a new faculty, the Faculty of Medicine was established, and the University soon became one of the regional citadels of Hungarian higher education. Today, University of Debrecen is classified as "University of National Excellence" and offers the highest number of academic programs in the country, therefore it is considered to be one of the best universities in Hungary. Its reputation is the result of its quality training, research activities and the numerous training programs in different fields of science and engineering in English. With 14 faculties and a student body of almost 30.000, out of which about 3700 are international students, the University of Debrecen is one of the largest higher education institutions in Hungary.

The history of the Faculty of Engineering dates back to 1965, when the Technical College was established. In 1972 it was renamed Ybl Miklós Polytechnic and in 1995 it became part of Kossuth Lajos University. In 2000 the Faculty of Engineering became part of the integrated University of Debrecen.

In 2005 the Bologna System was introduced which supports the competitiveness of qualifications received at the University of Debrecen against universities all over Europe.

The Faculty of Engineering is practice-oriented and develops skills required for the current needs of the national and international labour market. The teaching staff is involved in numerous domestic and international research and design projects. The recently-opened new building wing with its ultra-modern design hosts several lecture halls, seminar rooms and laboratories equipped with the latest technology. Our students are provided with practical knowledge, training and field practice from numerous prestigious domestic and multi-national industry partners. The internship periods are excellent opportunities for students to experience how theory is put into practice at the most renowned industry representatives and become more successful in the labour market of this highly competitive sector. Students learn how to work in the working environment of multi-national companies and adapt to challenges easily. After graduation they will be able to work at a strategic decision-making level, giving priority to efficiency and engineering ethics.

The Faculty of Engineering offers a great variety of BSc, MSc courses and post-graduate training courses tailored to the needs of the rapidly changing world of engineering and focusing on European and international trends. In 2011 the Faculty of Engineering launched engineering trainings in English. In order to optimize the quality of training, the Faculty continuously strives to expand the number of industrial and educational partners at home and abroad.

The Faculty of Engineering has been a pioneer in the introduction of Quality Management System at faculty level to measure and evaluate the efficiency of its education and teaching staff in order to improve the quality of education and training from the feedback received.

The Faculty of Engineering has a vivid student life. There is a film club waiting for movie buffs and the door of the Faculty library is always open. The library is not only the host to the latest technical books, exhibitions and tea afternoons with invited speakers, but students can also purchase theatre and concert tickets from the librarians. The Borsos József Dormitory is also a hub of activities for students.

The increasing number of international students brings cultural and ethnic diversity to the faculty.

Our aim is to aid students to become efficient members of the labour market and enrich the world of engineering in Hungary and abroad with their knowledge and expertise.

ADMINISTRATION UNITS FOR INTERNATIONAL PROGRAMMES

COORDINATING CENTER FOR INTERNATIONAL EDUCATION

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Administrative Assistant	Ms. Annamária Rácz

The Coordinating Centre for International Education supports the international degree programmes of the University of Debrecen in giving new students information on admission and entrance exam. It has tasks in promoting and is in charge of tasks like enrolment, study contracts, modifying student status or degree programme, activating student status, modifying students' personal data, requesting and updating student cards, providing certificates for the Immigration Office (for residence permit), issuing student status letters and certificates on credit recognition, concluding health insurance contract and providing Health Insurance Card, helping students with visa process application.

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The International Office has been functioning since 2014 in order to ensure the smooth running of the international degree courses. The office is responsible for student administration (full-time students, full-time transfer students, visiting/Erasmus students), providing certificates for students, considering and accepting requests, solving problems related to course registration, giving information **about internship, final exam, thesis, etc.**

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Department of Architecture
Department of Basic Technical Studies
Department of Building Services and Building Engineering
Department of Civil Engineering
Department of Engineering Management and Enterprise
Department of Environmental Engineering
Department of Mechanical Engineering
Department of Mechatronics
Off-Site Department of Aviation Engineering

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ACADEMIC CALENDAR

General structure of the academic year:

Study period	1st week	Registration*	1 week
	2nd – 7th week	Teaching Block 1	6 weeks
	8th week	1st Drawing Week	1 week
	9th – 14th week	Teaching Block 2	6 weeks
	15th week	2nd Drawing Week	1 week
Exam period	directly after the study period	Exams	7 weeks

*Usually, registration is scheduled for the first week of September in the fall semester, and for the first week of February in the spring semester.

ACADEMIC CALENDAR OF THE FACULTY OF ENGINEERING 2020/2021

Opening ceremony of the academic year	6 September 2020 (Sunday)
Registration week	31 August - 4 September 2020
Revision week (exams in Exam coursess may be scheduled during this week)	31 August - 4 September 2020
1st semester study period in MSc and BSc programs	7 September - 11 December 2020 (14 weeks) In case of finalist courses: 7 September 2020 - 6 November 2020 (9 weeks)
Reporting period I (Drawing week I)	19 - 22 October 2020 (4 working days without scheduled lessons, consultation schedule announced previously)
Faculty Conference of Scientific Students' Association	12 November 2020
Reporting period II (Drawing week II)	7-11 December 2020 (5 working days without scheduled lessons, consultation schedule announced previously)
1st semester examination period	14 December 2020 - 29 January 2021 (7 weeks) In case of finalist courses: 9 November - 11 December 2020 (5 weeks)

Thesis (BSc, MSc) submission deadline	As defined by the departments; max. 14 days of the beginning of the final examination period.
Final examination period	As defined by the departments; at least one occasion between 14 December 2020 and 29 January 2021. The departments shall announce the date of the final examination until 15 September 2020.
Registration week	1 - 5 February 2021
2nd semester study period in MSc and BSc programs	8 February - 14 May 2021 (14 weeks) In case of finalist courses: 8 February - 9 April 2021 (9 weeks)
Conferences	
Reporting period I (Drawing week I)	22 - 26 March 2021 (5 working days without scheduled lessons, consultation schedule announced previously)
Career Days – "Industry Days in Debrecen 2021" (working days without teaching for Mechanical Eng. BSc, Mechanical Eng. MSc, Environmental Eng. MSc, Mechatronics Eng. BSc, Mechatronical Eng. MSc, Civil Eng. BSc students)	31 March - 2 April 2021
10th "Árkádia" Conference (organised by the Department of Architectural Engineering)	31 March - 2 April 2021
Career Days in Civil Engineering (organised by the Department of Civil Engineering)	31 March - 2 April 2021
8th ISCAME (International Scientific Conference on Advances in Mechanical Engineering) *VIII. Exhibition on Mechanical Engineering* (organised by the Department of Mechanical Engineering)	31 March - 2 April 2021
Career Days in Environmental Engineering (organised by the Department of Environmental Engineering)	31 March - 2 April 2021

*Career Days in Mechatronics (exhibition, company presentations) (*organised by the Department of Mechatronics)	31 March - 2 April 2021
International conference entitle *"Electrical Engineering and Mechatronics Conference EEMC'21"* (organised by the Department of Mechatronics)	31 March - 2 April 2021
"Challenges and Opportunities in the Field of Management" Conference (organised by the Department of Enginering Management and Enterprise)	31 March - 2 April 2021
"Problem-Based Learning in Engineering Education" Conference (organised by the Department of Basic Technical Studies)	1 April 2021
Career Days in and Exhibition on Building Services Engineering	6-7 May 2021
Reporting period II (Drawing week II)	10 – 14 May 2021 (5 working days without scheduled lessons, consultation schedule announced previously).
2nd semester examination period	17 May - 2 July 2021 (7 weeks) In case of finalist courses: 12 April - 14 May 2021 (5 weeks)
Thesis (BSc, MSc) submission deadline	As defined by the departments; max. 14 days of the beginning of the final examination period.
Final examination period	As defined by the departments; at least one occasion between 17 May and 25 June 2021. The departments shall announce the date of the final examination until 15 February 2021.

THE ENVIRONMENTAL ENGINEERING MASTER PROGRAM

INFORMATION ABOUT THE PROGRAM

Name of master's program:	Environmental Engineering Master Program
Specializations available:	(1) Environmental Technology, Planning, Constructions (2) Built Environment
Field, branch:	engineering; bio-, environmental- and chemical engineering
Level:	MSc
Qualification:	Environmental Engineer
Mode of attendance:	Full-time
Faculty:	Faculty of Engineering
Program coordinator:	Prof. Dr. János Tamás, Full Professor
Person in charge of the specialization:	Environmental Technology, Planning, Constructions: Prof. Dr. János Tamás, Full Professor Built Environment: Ildikó Bodnár PhD, College Professor
Program length:	4 semesters
Credits total:	120 (thesis: 30, optional subjects: 6)

Aim of the master program and professional competencies

The objective of the program is to train environmental engineers with up-to-date scientific, ecological, engineering, economic and management knowledge who are able to identify and assess the existing and potential environmental threats, to prevent or reduce environmental damage, and to prepare and control damage control projects. They are able to provide complex engineering and scientific design and analytical procedures as a result of their up-to-date knowledge of informatics with the help of design, modelling and simulation software. They are prepared to set out and apply adequate technological solutions to prevent environmental pollution and to provide engineering design and managing tasks in the field of waste processing and recycling. They are able to optimize environmental technologies and environmental impacts. Thus, the program also functions as preparation for students interested in doing a PhD.

Professional competencies to acquire

An environmental engineer

a) knowledge

- knows and applies scientific and engineering theory and practice in the field of environmental engineering.
- has acquired the comprehensive knowledge of measurement techniques and measurement theory.
- knows and applies the procedures of environmental protection (operations, equipment, device) and remediation methods.
- is aware of the operations and the units of environmental premises (especially water and water treatment plants, hazardous and communal landfill sites, incinerator plants) and the possible options for their development.
- knows and applies the rules of environmental engineering documentation and carrying out an environmental impact assessment.
- knows the organisational and motivational devices related to management, and the methods and laws required to pursue the profession.
- knows and applies the methods and tools of environmental informatics and modelling in a complex manner.
- knows the fundamentals, boundaries and requirements of the professional fields of work and fire safety, safety, information technology, law, economics and management related to environmental engineering.
- knows the promotional and opinion-forming methods in the field of environmental engineering.

b) abilities

- is able to apply his/her acquired the general and specific principles, rules, interrelations and procedures of natural and social sciences and mathematics to solve environmental problems.
- is able to carry out publication activities and negotiations in his/her mother tongue and in at least one foreign language (English) in his/her field of profession.
- is able to achieve tasks related to leadership and consultancy.
- is able to accomplish tasks in international or cross-border projects and to present his/her test results and elaborated design documentation at social and professional forums.
- studies the possible objectives in research, development and innovation While carrying out his/her work, and endeavours to implement them.
- is able to design, implement and maintain the occurring engineering interventions in a complex way in the fields of soil, geological formation, water, air, noise and vibration protection, ecosystem protection, remediation and waste reduction, treatment and recycling.
- is able to arrange and implement environmental sample taking, complex laboratory tests and analyses, the application of monitoring systems and the evaluation and documentation of test results.

- is able to apply damage control methods in a complex manner, to prepare and coordinate damage control.
- is able to design and implement environmental impact assessment and to set up a plan for carrying out and managing an impact study.
- is able to apply integrated knowledge in the field of environmental equipment, processes, technologies and in the related areas of electronics and informatics.
- is able to model, operate and control environmental engineering systems and processes.
- is able to design, launch and operate environmental management systems.
- is able to conduct energy efficiency analyses, surveys and audits, and to define the necessary measures and support their implementation.
- is able to arrange and accomplish complex (environmental, economic, social) tasks.

c) attitude

- open and apt to learn, accepts and credibly mediate professional and technological developments and innovations in the field of environmental engineering.
- identifies with the professional and moral values of environmental engineering.
- endeavours to plan and implement all his/her tasks at a high professional level both individually and as member of a team.
- endeavours to take a complex approach when working which is based on a system-based perspective and process-oriented thinking.
- endeavours to increase both his/her own and his/her colleagues' knowledge through lifelong learning.
- determined to work at a professional level, and endeavours to convey this approach to his/her colleagues as well.
- shares his/her experience with his/her colleagues to promote their development.

d) autonomy and responsibility

- is able to accomplish environmental engineering tasks on his/her own. He/she makes decisions carefully, discussing them with the experts of other relevant fields (primarily law, economics and energetics), and taking overall responsibility for them.
- when making a decision, he/she respects the regulations of workplace health and safety, engineering, economics and law and the fundamental principles of engineering ethics.
- takes a pro-active role in solving environmental problems, identifies the faults of the applied technology and the risks of the processes and initiates actions to reduce them.

- shares his/her acquired knowledge and experience with other experts of the field through formal and informal media.
- respects the efforts of his/her subordinates, and promotes their professional development by sharing his/her critical remarks with them, and encourages responsible and moral professional work among them.
- constantly follows the legal, technical and technological changes of his/her field of expertise.

COMPLETION OF THE ACADEMIC PROGRAM

Credit System

Majors in the Hungarian Education System have generally been instituted and ruled by the Act of Parliament under the Higher Education Act. The higher education system meets the qualifications of the Bologna Process that defines the qualifications in terms of learning outcomes: statements of what students know and can do on completing their degrees. In describing the cycles, the framework uses the European Credit Transfer and Accumulation System (ECTS).

ECTS was developed as an instrument of improving academic recognition throughout the European Universities by means of effective and general mechanisms. ECTS serves as a model of academic recognition, as it provides greater transparency of study programmes and student achievement. ECTS in no way regulates the content, structure and/or equivalence of study programmes.

Regarding each major, the Higher Education Act prescribes which professional fields define a certain training program. It contains the proportion of the subject groups: natural sciences, economics and humanities, profession-related subjects and differentiated field-specific subjects.

The following professional fields define the training program of the **Environmental Engineering MSc**:

Professional fields which define the training program:

- Natural Sciences: 10-40 credits;
- Economics and Humanities: 10-20 credits;
- Knowledge of environmental engineering: 10-35 credits
- The specialization provided by the training institute including thesis comprises 50-60 credits that contains at least 6 credits for project practice in the complete master program.
- Credit points assigned to thesis: 30
- Credits total: 120

Taking into account the specializations available, specific knowledge can be acquired in the field of environmental technology design and implementation, environmental problems arisen in built environment, water quality protection, advanced noise and vibration measurement, advanced noise and vibration protection, air pollution control, waste management and recycling, health protection and work safety, protection of soil and geological medium, renewable energy, analysis of environmental impact, design and operation of environmental and quality management systems which meets the professional needs. The specialization provided by the training institute including thesis comprises 50-60 credits that contains at least 6 credits for project practice in the complete master program.

During the program students have to complete a total amount of 120 credit points. It means approximately 30 credits per semester. The curriculum contains the list of subjects (with credit points) and the recommended order of completing them, which takes into account the prerequisite(s) of each subject. You can find the recommended list of subjects in chapter "Guideline".

Guideline (List of Subjects/Semesters)

The total number of credit points (120) of the training program can be obtained by completing the subjects of the curriculum. There is a certain degree of freedom in the order students can complete the subjects. However, it is recommended that the suggested order be followed because some subjects can only be taken after the completion of the prerequisite subject(s), and/or can be the prerequisites for other subjects.

The list of subjects to complete in the semesters according to the model curriculum of Environmental Engineering MSc programme **Environmental Technology, Planning, Constructions Specialization**:

1st semester	2nd semester
Applied Statistics	Mathematical modelling and optimization
Environment Biology and Nature Protection	Environmental Chemistry and Environmental Toxicity
Geosciences	Ecology for Engineers
Environmental Law and Economics	Production Management and Life Cycle Analysis
Environmental and Quality Management	Environmental Engineering Measurement Techniques, Monitoring
Environmental Modelling and Environmental Informatics	Environmental Health
Environmental Operations	Environmental Resource Management
Safety and Environmental Risk	Environmental State Assessment, Auditing
	Optional subject I
3rd semester	**4th semester**
Environmental Technologies I (Soil Protection)	Environmental Technologies II (Water Protection)
Environmental Technologies III (Air and Noise Protection)	Environmental Technologies IV (Waste Recycling)

Recovery Systems of Renewable Energy Sources I	Recovery Systems of Renewable Energy Sources II
Near-natural and Cleaner Production Technologies	Complex Environmental Engineer Planning II
Complex Environmental Engineer Planning I	Thesis II
Thesis I	Optional Subject II
Environmental Summer Professional Practice	

The list of subjects you have to complete in the semesters according to the model curriculum of Environmental Engineering MSc programme **Built Environment Specialization**:

1st semester	2nd semester
Applied Statistics	Mathematical Modelling and Optimization
Environment Biology and Nature Protection	Environmental Chemistry and Environmental Toxicity
Geosciences	Ecology for Engineers
Environmental Law and Economics	Production Management and Life Cycle Analysis
Environmental and Quality Management	Environmental Engineering Measurement Techniques, Monitoring
Environmental Modelling and Environmental Informatics	Environmental Health
Environmental Operations	Environmental Resource Management
Safety and Environmental Risk	Environmental State Assessment, Auditing
	Optional subject I
3rd semester	**4th semester**
Urban Climate	Urban Hydrology
Air Pollution Control	Waste Management
Bridges and Structures	Greenfield Management
Noise and Vibration Protection	Complex Environmental Engineer Planning II
Complex Environmental Engineer Planning I	Thesis II

Thesis I	Optional Subject II
Environmental Summer Professional Practice	

Work and Fire Safety Course

According to the Rules and Regulations of the University of Debrecen, students must complete the online course for work and fire safety. Registration for the course and its completion are necessary for graduation. For MSc students the course is only necessary if their BSc diploma has not been awarded by the University of Debrecen.

Registration in the Neptun system by the subject: MUNKAVEDELEM

Students have to watch/read an online material to get the signature on Neptun for the completion of the course. The link of the online course is available on the website of the Faculty.

Internship

Internship is a mandatory and integral part of the course of studies and strongly related to thesis. The duration of internship is at least 4 weeks and undertaken at a production company.

Credit points: 0

Internship in Environmental Technology, Planning, Constructions Specialization

Aim of internship

To obtain specific practical skills from the field of environmental technologies, alternative environmentally-friendly technologies, solving problems of natural protection which form the basis for the final semester of the training program, the efficiency of thesis preparing and the period after graduation.

Focal tasks during internship

Students can be involved in work based on the skills acquired during their studies from the following fields: water, noise, soil, radiation and noise protection, waste management and treatment, investigations of environmental impact and environmental impact assessment, environmental remediation, fundamentals of energy management, energy production, main goals of the sustainable development, characteristics of the engineering software, regulations and methods of work and fire safety, safety and elimination.

Completion of internship

During the internship and while working in a given field, students must prepare a report the topic of which is selected by them with the assistance of their supervisor(s). The report can only contain publicly available data on the company, or information previously approved by the company.

The following skills shall be considered when evaluating student performance: professional and personal attitude, diligence, adaptive skills, and successfully completed specific tasks.

Internship in Built Environment Specialization

Aim of internship

The aim of the internship is to make it possible for students to obtain specific practical skills from the field of urban environment, alternative environmentally-friendly technologies, solving problems of natural protection which form the basis for the final semester of the training program, the efficiency of preparing thesis and the period after graduation.

Focal tasks during internship

Students can be involved in work as a result of the skills acquired during their studies from the following fields: urban hydrology, climate, noise, soil, radiation and noise protection, waste management and treatment, investigations of environmental impact and environmental impact assessment, the fundamentals of energy management, energy production, renewable energy utilization, characteristics of the engineering software, regulations and methods of work and fire safety, safety and elimination.

Completion of internship

During the internship and while working in a given field, students must prepare a report the topic of which is selected by them with the assistance of their supervisor(s). The report can only contain publicly available data on the company, or information previously approved by the company.

The following skills shall be considered when evaluating student performance: professional and personal attitude, diligence, adaptive skills, and successfully completed specific tasks.

Physical Education

According to the Rules and Regulations of the University of Debrecen, students must complete Physical Education course at least in one semester during his/her Master's training. Our University offers a wide range of facilities to complete them. Further information is available from the Sport Centre of the University, its website: http://sportsci.unideb.hu.

Optional Courses

According to the Rules and Regulations of the University of Debrecen, students must complete elective courses during their MSc studies. These elective courses are opened by the Departments at the Faculty of Engineering at the beginning of the actual semester. The list of such subjects for a given semester is to be found under "Current Students" >" Useful Information about your Study" >" Optional subjects" on the Faculty's website.

Students can also select optional courses offered by other faculties of University of Debrecen to complete.

In the Environmental Engineering MSc program, one must gain at least 6 credits by completing elective subjects.

Pre-degree Certification

A pre-degree certificate is issued by the Faculty after completion of the master's (MSc) program. The pre-degree certificate can be issued if a student has successfully completed the study and exam requirements as set out in the curriculum, the requirements relating to Physical Education as set out in Section 10 in Rules and Regulations, internship

(mandatory) – with the exception of thesis preparing – and gained the necessary credit points (120). The pre-degree certificate verifies (without any mention of assessment or grades) that the student has fulfilled all the necessary study and exam requirements defined in the curriculum and the requirements for Physical Education. Students who obtained the pre-degree certificate can submit the thesis and take the final exam.

Thesis

A Thesis is the creative elaboration of a professional task (scientific, engineering, design, development, research or research development) in a written form. By solving the task, the student relies on his/her studies using national and international literature under the guidance of an internal and external supervisor (referee). By writing and successfully defending a thesis, students of the Environmental Engineering Master program prove that they are able to apply the acquired knowledge in practice, to summarize the work done and its results in a professional way, to solve the tasks related to their topic creatively, and to complete individual professional work.

Students in the master program must write a thesis as a prerequisite of the final exam. Requirements regarding the content of the thesis, the general aspects of evaluation and the number of credits assigned to it are defined based on the requirements of the program. In case of the Environmental Engineering Master Program, the number of credits assigned to the thesis is 30.

Thesis topics are announced by the departments no later than the end of the fourth week of the study period of the last but one semester. Students may also offer a topic for the thesis, which the competent head of department may accept or reject. The conditions on the acceptance of a SSS (Student Scientific Society) paper as a degree thesis are defined by the Faculty. SSS papers are supposed to meet the requirements of a thesis both in form and content. Furthermore, it is necessary that the committee of the Pre-SSS make suggestions on the SSS papers to be accepted as theses.

Formal requirements of thesis shall be designated by the Department of Environmental Engineering and must be announced in writing together with other thesis-related assignments.

The preparation of a thesis shall be overseen by an internal supervisor approved by the department, and may be assisted by an external supervisor (also approved by the department).

The thesis submission deadline is defined in the academic calendar of the Faculty (issued by the Vice-Rector for Education) or, failing that, it is 12 a.m. on the 14th day before the first day of the final exam. The thesis can be submitted only if both the internal and the external supervisors approve. It is evaluated by an independent external reviewer, and the Head of the Department of Environmental Engineering makes a suggestion to the final examination board on its classification based on a five-grade scale.

If the reviewer evaluates the thesis firmly as fail, the student may not take the final exam and must create a new thesis. Students must be informed about it. Conditions on resubmitting the thesis are designated by the head of the relevant educational unit responsible for the major or specialization.

Final exam

After receiving the pre-degree certificate, students conclude their studies by taking the final exam of Environmental Engineering master program. The final exam shall test and assess the knowledge, skills and abilities requisite to the award of the degree, whereby students shall also prove their ability to apply the acquired knowledge in practice. The conditions for taking the final exam and the parts of the final exam itself shall be defined in the requirements for the training program (see entry 'Completion of studies').

The final exam shall be taken in front of a board in the examination period following the award of the pre-degree certificate. If a candidate does not pass the final exam until the termination of his/her student status, that student can sit for the final exam any time after the termination of his/her student status according to the provisions regarding the final exam, effective at the time of taking the final exam.

The Final exam consists of 3 parts:

1. The core material of the final exam, which includes the assessment of environmental status and the technological introduction of their solutions.
2. Filed-specific knowledge, the topics of which are based specialization chosen by the candidate. These topics are built heavily on the workshops assigned to the MSc training programme, providing the elaboration of realistic engineering tasks.
3. Thesis defence, based on an oral exam.

The procedure of the final exam in the Environmental Engineering Master program goes according to the traditions of engineer training.
Requirements and number of credits assigned to the thesis: 30 credits

According to the prerequisites of taking a final exam:

- compiling all the subjects provided from semester 1 to 4 in the model curriculum, obtaining at least 120 credits including subjects of criterion on the basis of curriculum;
- fulfilling internship in full-time programme (minimum of 4 weeks);
- writing and submitting a thesis.

The final exam (oral exam):
Subjects:

The core material of the final exam (A):

- Assessment and modelling of environmental status
- Environmental Operations.

Filed-specific knowledge (B, on the basis of the specialization):

- B1: Built environment
- B2: Environmental Technology, Planning, Constructions

Thesis defence (D)

Calculation of a final exam grade **(SE)** according to this formula:

$$SE = (A+B+D)/3$$

The requirements for the oral part of the final exam and the agenda of the topics with the indication of their literature are announced by the department no later than the last week of the study period. The oral examination shall be assessed on a five-grade scale by the members of the final examination board. The board shall then consult behind closed doors and vote about the final grade for the final exam. In case of equal division of the votes, the chairperson shall be given the casting vote. The result of the final exam shall be announced by the chairperson of the board. Minutes shall be taken during the final examination. The Department awards an Academic Award for Environmental Protection to the student who achieves the best result at the final exam, which shall be conferred to him/her at the graduation ceremony.

Retaking a failed final exam

If any part of the final exam is evaluated as fail, according to the existing rules of the university, it can be retaken. The retake of the final exam may be attempted in the following examination period at the earliest. If a thesis is evaluated unanimously as fail, the student may not take the final exam and shall write another thesis. The final exam can be retaken twice per each subject.

Final exam board

The members of the final examination board shall be delegated and commissioned with the consent of the Faculty Council by the dean of the faculty. They are selected from among the acknowledged internal and external experts of the professional field. Traditionally, a chairperson and, in case of his/her absence or indisposition, a vice-chair shall be commissioned. The final examination board shall have a minimum of two members apart from the chairperson and as many questioners as needed. At least one of the members of the board shall be a university or college professor. The length of the appointment of membership in the final exam board shall be one year. The division of students to individual commissioned final exam boards shall be announced by the Department of Environmental Engineering.

COURSE DESCRIPTIONS FOR ENVIRONMENTAL ENGINEERING MSC

The order of subject follows the subject list in the model curriculum above.

Subject group "Basic Natural Sciences" for all Specialization

Mathematical Modelling and Optimization

Code: MK5MMO1A04KX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 1st year/2nd semester

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Survey of the basic notions of linear algebra, Matrices, operations, determinants, eigen values, eigen vectors. Differentiation and integration for real functions; some applications in physics. Searching of local and global extremas. Differentiation and integration of multivariable and vector-valued functions. Linear programming: simplex algorithm, duality.

Literature:

Required: -

Recommended:

- Thomas' Calculus, Addison Wesley (11th edition, 2005), ISBN: 0-321-24335-8
- S. Minton, Calculus Concept and Connections, McGraw Hill (2006), ISBN 0-07111200-6
- M. D. Greenberg, Fundamentals of engineering analysis, Cambridge University Press, ISBN 978-0-521-80526-1

Schedule

1st week Registration week	
2nd week: **Lecture:** The arithmetic of matrices, determinants and their properties. The notion of linear (or vector) space, linear combinations of vectors, linearly dependent and independent systems, basis, dimension, coordinates.	**3rd week:** **Lecture:** Linear functions: eigenvalues, eigenvectors. The linear transformation on the plane and in the place. **Practice:** Determination of eigenvalues, eigenvectors.

Practice: The algebra of vectors in 2 and 3 dimensions: operations. Cross product, scalar product.	
4th week: **Lecture:** Differential calculus of the real functions: differentiation, L'Hospital's rule, tangent line, linear approximation, analysis of differentiable functions. **Practice:** Determination of tangent line and local and global extremas of a differentiable real function.	**5th week:** **Lecture:** Differentiation of multivariable vector-valued functions. Parametric curves, curvature, torsion. Scalar field, gradient. Directional derivative. Parametrized surface, Vector fields, divergence and curl. **Practice:** Determination of curvature, torsion, directional derivative, divergence, curl.
6th week: **Lecture:** Integral calculus of the real functions: primitive function (antiderivative), indefinite integral, the Riemann integral, the Newton-Leibniz theorem. **Practice:** Calculations of area, volume, covered distance.	**7th week:** **Lecture:** Double and triple integrals, applications in physics. **Practice:** Calculations of volume, mass, centre of the mass, surface area. Determination of potential function of a vector field.
8th week: 1st drawing week	
9th week: **Lecture:** Line integral, surface integral. Connection between integrals: The theorems of Gauss and Stokes. **Practice:** Calculation of line integral, surface integral.	**10th week:** **Lecture:** Ordinary differential equations. **Practice:** Numerical solution methods.
11th week: **Lecture:** Linear regression, interpolation **Practice:** Least squares method, Taylor polynomials.	**12th week:** **Lecture:** Linear programming, primal problem. **Practice:** graphical solution method.
13th week: **Lecture:** Simplex algorithm, duality. **Practice:** Simplex algorithm, duality.	**14th week:** **Lecture:** About some mathematical software. **Practice:** Calculations by software.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group.

Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

The course ends in a written end-term test.

The minimum requirement of the end-term test is 50%. The grade is given according to the following (score/grade): 0-49 = fail (1); 50-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5). If the score of the test is below 50, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Applied Statistics

Code: MK5AST1A04KX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 1st year, 1st semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

The series of lectures are based on the topics of engineering statistics. It reviews the concepts and methods used in stochastic modelling of technical systems and processes. Sample spaces and events. Axioms of probability. Conditional probability. Multiplication and total probability rules. Independence. Discrete and continuous random variables, probability distribution, density function. Numerical characteristics of random variables. Limit theorems. Joint probability distributions. Correlation, independence. Descriptive statistics. Point and interval estimation. Confidence interval. Hypothesis testing (probability, mean, standard deviation), normality test, ANOVA. Regression analysis. System reliability. Time series. Markov chain. Statistical process control. Statistical tools in 6σ process improvement.

Literature:

Required:

- Montgomery, D. C., Runger, G. C., Applied Statistics and Probability for Engineers, John Wiley & Sons Inc., 2003
- Soong, T. T., Fundamentals of probability and statistics for engineers, John Wiley & Sons, Inc., 2004

Recommended:

- DeCoursey, W. J., Statistics and Probability for Engineering Applications With Microsoft® Excel, Newnes, 2003
- Allen, T. T., Introduction to Engineering Statistics and Six Sigma, Springer, 2006
- Pham, Hoang (Ed.), Springer Handbook of Engineering Statistics, Springer, 2006, ISBN 978-1-85233-806-0
- NIST/SEMATECH e-Handbook of Statistical Methods, http://www.itl.nist.gov/div898/handbook/

Schedule

1st week Registration week	
2nd week: **Lecture:** Sample spaces and events. Axioms of probability. Conditional probability. Multiplication and total probability rules. Independence. **Practice:** Calculation of probability.	3rd week: **Lecture:** Discrete and continuous random variables, probability distribution, density function. **Practice:** Random variables.
4th week: **Lecture:** Numerical characteristics of random variables. Limit theorems. **Practice:** Random variables.	5th week: **Lecture:** Joint probability distributions. **Practice:** Joint probability distributions.
6th week: **Lecture:** Correlation, independence. **Practice:** Correlation, independence.	7th week: **Lecture:** Descriptive statistics. **Practice:** Descriptive statistics.
8th week: 1st drawing week	
9th week: **Lecture:** Point and interval estimation. Confidence interval. **Practice:** Point and interval estimation. Confidence interval.	10th week: **Lecture:** Hypothesis testing (probability, mean, standard deviation), normality test, ANOVA. **Practice:** Hypothesis testing (probability, mean, standard deviation), normality test, ANOVA.
11th week: **Lecture:** Regression analysis. **Practice:** Regression analysis.	12th week: **Lecture:** System reliability. **Practice:** System reliability.
13th week: **Lecture:** Time series. Markov chain. **Practice:** Time series. Markov chain.	14th week: **Lecture:** Statistical process control. Statistical tools in 6σ process improvement. **Practice:** Statistical process control. Statistical tools in 6σ process improvement.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance at **lectures** is recommended, but not compulsory.

Attending practices is compulsory. Students have to attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date previously discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are two tests: a mid-term test on the 8th week and an end-term test on the 15th week. Students have to sit for the tests.

B, for a grade:

The course ends in an **end-term grade**, it is based on the total scores of the mid-term and the end-term tests.

The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests, the grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of tests is below 60%, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Environmental Chemistry and Environmental Toxicity

Code: MK5KKTOK04KX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 1st year/2nd semester

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Within the environmental chemistry part of the course, students will learn about the significance, tasks and basic concepts of environmental chemistry, environmental elements and compounds. We are discussing the biogeochemical cycle of some important elements in the environment. The curriculum covers the typical effects of the pollutants on the environment, their reaction mechanisms, their sources, their spreads, their limits. The characteristics of different spheres (their structure, composition and properties) and

the effects of any anthropogenic contaminants on these spheres are also presented. The curriculum covers the relationship between environmental chemistry and environmental analytics, the role of environmental analytical methods.

In the environmental toxicity we discuss the basic knowledge of toxicology, the grouping options of the poison and the poisoning, and the mechanism of the action of the poisons. Furthermore, we present the students to the role and the significance of environmental toxicology and ecotoxicology in the environmental engineering training. We describe the methods, tasks and the possibilities of carrying out of the different types of eco toxicological tests (single species and multispecies) and we discuss the risk of environmental toxicity and chemicals and risk assessment possibilities.

Literature:

Required:

- Lecture and Practice Notes by the instructors (Presentation materials will be available in the Moodle system. Available at: https://elearning.unideb.hu/)
- M. Doble, A. Kumar Kruthiventi: Green Chemistry and Engineering, Elsevier, USA, 2007; ISBN 987-0-12-372532-5
- Donald W. Sparling: Basics of Ecotoxicology (CRC Press Taylor & Francis Group, Boca Raton, USA, 2017. ISBN13: 9781138031715)
- Erik Jorgensen: Ecotoxicology (Cambridge, Academic Press, USA, 2010. ISBN13: 9780444536280)

Recommended:

- D. M. Whitacre: Reviews of Environmental Contamination and Toxicology (Springer, New York, 2013. ISBN: 978-1-4614-6898-1)

Schedule

1st week Registration week	
2nd week: **Lecture:** The significance, tasks and basic concepts of environmental chemistry. **Practice:** The history, the definition, and the classification possibilities of toxicology.	3rd week: **Lecture:** Environment-building elements and compounds. The cycle of some important elements in the environment. **Practice:** The classification possibilities of the poison and poisoning.
4th week: **Lecture:** Characterization of biogeochemical circles. Contaminants in the environment. **Practice:** The definition, the scope, the importance and the classification possibilities of ecotoxicology Categorization of the contaminants. The role and the location of environmental toxicology in the environmental protection.	5th week: **Lecture:** Pollutants in the environment, their characteristic effects, reaction mechanisms, source, spread, limits. **Practice:** Description of the ecological test using a single species: acute and chronic test.

6th week: **Lecture:** The structure, composition and properties of the atmosphere. **Practice:** The methods and the tasks of ecotoxicological tests.	7th week: **Lecture:** Anthropogenic pollutants in the atmosphere. **Practice:** Mid-term exam (1st test) from environmental toxicity part.
8th week: 1st drawing week, Mid-term exam (1st test)	
9th week: **Lecture:** Characterization of the hydrosphere, circulation of water. **Practice:** Description of the ecological test using a single species: algae, plants test animal test.	10th week: **Lecture:** Anthropogenic contaminants in the hydrosphere. **Practice:** Description of the ecological test using multispecies: microcosm and mesocosm tests.
11th week: **Lecture:** Characterization of the lithosphere and soil chemistry. Anthropogenic contaminants in the pedosphere. **Practice:** Description of the ecological test using multispecies: field trials and biomonitoring.	12th week: **Lecture:** Basic concepts of environmental analytics. The process and characteristics of the analysis. **Practice** Ecotoxicology and the risk of chemicals.
13th week: **Lecture:** Methods for the analysis of inorganic pollutants in environmental samples. **Practice:** Environmental management decisions based on the ecotoxicological results.	14th week: **Lecture:** Methods for the analysis of organic pollutants in environmental samples. **Practice:** End-term exam (2nd test) from environmental toxicity part.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Students have to attend lectures or practices and may not miss more than three lectures or practices during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Attendance at lectures and practice classes will be recorded by the practice leader. Being late counts as an absence. In case of further absences, a medical certificate needs to be presented. Students are required to bring a calculator and the printed materials of the lectures with them to each lecture and practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class.

During the semester there are two tests: a mid-term test in the 8th week and an end-term test in the 14th week. A student can retake both tests once, if it is necessary.

B, for an exam grade:

The minimum requirement of the written exam test is 60% separately. The grade for each test is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of any test is below 60%, the student once can take a retake test of the whole semester material.

Environment Biology and Nature Protection

Code: MK5KBTVK04KX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 1st year/1st semester

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The aim of the environmental biology curriculum we are discussing about the parts of biosphere where the living organisms play an important role. "Soil, water, air as well as environment" - a way of life. We present biomass and ecosystems as well as abiotic and biotic components of ecosystems.

Soil habitats play an important role in the formation of soil (the first step in biological melting), soil organic matter transformation (humus formation) and degradation processes (mineralization), circulation of elements and ecosystem energy flow. The impact of human activity on the soil. We present the processes in river and standing waters. Water quality. The impact of human activity on living waters. Protecting the biosphere. Our goal is to enable students to integrate new knowledge about soil, water and air. As we pass on knowledge, we strive to emphasize the harmony of sustainable, environmentally friendly farming, environmental and nature conservation.

Within the nature conservation part of the curriculum we are discussing the main nature conservation directives, the development of nature protection regulation and administration and the international status of nature conservation.

Students will get acquainted with the central and regional organizations of the Nature Conservation Administration, nature conservation groups, their status and the possibilities of their protection.

Students acquire the basics of conservation biology and the essential elements of biodiversity protection.

Students acquire knowledge of the most important practices of nature conservation, the operation of national parks, and the importance of nature conservation in practice, international nature conservation conventions and the European Union's nature conservation regulations.

Literature:

Required:

- Bardgett, R.: (2005) The Biology of Soil. A Community and Ecosystem Approach. Oxford University Press
- The material of the lectures is available in the form of ppt.

Recommended:

- Paul, E. A. (ed) 2007. Soil Microbiology, Ecology and Biochemistry Academic Press is an imprint of Elsevier.
- Wall, D. H. et al. (eds.) (2012) Soil Ecology and Ecosystem Services, Oxford University Press
- R. B. Primack (2014): Essentials of Conservation Biology. Sinauer Associates, Inc. ISBN: 978-1-0535-293-3

Schedule

1st week Registration week	
2nd week: **Lecture:** The significance, tasks and basic concepts of environmental biology. **Practice:** The significance, tasks and basic concepts of nature conservation.	3rd week: **Lecture:** Ecosystems. **Practice:** The significance, tasks and basic concepts of nature conservation.
4th week: **Lecture:** Abiotic and biotic components of ecosystems. **Practice:** Essential elements of biodiversity protection.	5th week: **Lecture:** Characterization of soils. **Practice:** Nature conservation directives.
6th week: **Lecture:** Soil organic matter transformation (humus formation) and degradation processes (mineralization). **Practice:** Nature conservation directives.	7th week: **Lecture:** Circulation of elements and ecosystem energy flow. **Practice:** Development of nature protection regulation and administration.
8th week: 1st drawing week	
9th week: **Lecture:** The impact of human activity on the soil. **Practice:** The international status of nature conservation.	10th week: **Lecture:** The structure, composition and properties of the hydrosphere. **Practice:** Central and regional organizations of the Nature Conservation Administration.
11th week: **Lecture:** The impact of human activity on hydrosphere. **Practice:** Nature conservation groups.	12th week: **Lecture:** The impact of human activity on living waters.

	Practice Basics of conservation biology and the essential elements of biodiversity protection.
13th week: **Lecture:** The impact of human activity on biosphere. **Practice:** Basics of conservation biology and the essential elements of biodiversity protection.	**14th week:** **Lecture:** Protecting the biosphere. **Practice:** European Union's nature conservation regulations.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Students have to attend lectures or practice classes and may not miss more than three lectures or practices during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. The attendance of lectures and practices is recorded by the practice leader. Being late counts as an absence. In case of further absences, a medical certificate needs to be presented. Students are required to bring the printed materials of the lectures with them to each lecture and practice class. Active participation is evaluated by the teacher in every class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class.

B, for an exam grade:

The minimum requirement of the written exam test is 60% separately. The grade for each test is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of any test is below 60%, the student once can take a retake test of the whole semester material.

Ecology for Engineers

Code: MK5MOKLK03KX17-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade

Year, Semester: 1st year/2nd semester

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Within the course of the Engineering Ecology students become acquainted with the ecological and biological basics necessary for environmental work. Students learn about the relationship between living and inanimate environmental factors.

The curriculum covers ecological water management, water quality protection, river corridor restoration technologies, rehabilitation methods and solutions of the aquatic, wetland and terrestrial habitats.

Students acquire a basic ecological knowledge for environmental technologies, waste management, sewage treatment, and nature conservation interventions.

Other important parts of the curriculum: application of microbial ecology in environmental practice, ecological based management of artificial wetlands, management of organic and inorganic waste and reduction of environmental impacts.

Literature:

Required:

- The material of the lectures is available in the form of ppt.

Recommended:

- Mitsch, W.J.; Jørgensen, S.E (2003): Ecological Engineering and Ecosystem Restoration ISBN: 978-0-471-33264-0
- Riisgård, H. U. (2017): General Ecology: Outline of contemporary ecology for university students. Bookboon.com ISBN 978-87-403-1821-0

1st week Registration week	
2nd week: **Lecture:** Introduction, Ecology and Engineering ecology Subject and Tasks. **Practice:** The principles of ecology. The history of ecology.	3rd week: **Lecture:** Abiotic and biotic environmental factors. The most important element cycles. **Practice:** C, N, P, S, H_2O roundabouts. Pollution.
4th week: **Lecture:** Spatial properties of populations. **Practice:** Spatial distribution, zoning, stratification.	5th week: **Lecture:** The temporal properties of populations. **Practice:** Prospectuses, succession, eutrophication, etc. Changes in populations.
6th week: **Lecture:** Interactions between populations. Bioindication. **Practice:** Predation, symbiosis, parasitism, etc. The Lotka-Volterra equations.	7th week: **Lecture:** Life strategies. **Practice:** R and K strategists. The Malthus Principle.
8th week: 1st drawing week	
9th week:	10th week:

Lecture: Hydro ecological basics. Types of water bodies. **Practice:** Types of aquatic habitats, aquatic life and living things. Water, hydraulic and water chemistry bases.	**Lecture:** Ecology of aquatic and wet habitats. Ecological basics of river basin management. **Practice:** Material flow in the waters. Eutrophication and water pollution. Ecology of irrigation and water supply systems.
11th week: **Lecture:** Water resource management and water quality protection. Rehabilitation of aquatic and wet habitats. **Practice:** Technological methods of water quality control. Coastal protection. Prevention and treatment of pollution. River bed-morphological and hydraulic interventions.	**12th week:** **Lecture:** Ecological applications in sewage treatment. **Practice**. Ecology of biological wastewater treatment. Nature-Close Methods. Treatment of artificial wetlands.
13th week: **Lecture:** Ecological aspects of landfill and biological waste management. **Practice:** Environmental impacts of waste and landfills. Treatment of leachate waters. Air purity protection and depot gas. Ecology of biogas production and composting.	**14th week:** **Lecture:** Rehabilitation and ecological management of terrestrial habitats. Use of bioindication in environmental qualification. **Practice:** Closure and after-care of landfills. Rehabilitation of defectors. Treatment of forest fire affected areas. Biotic indices. MMCP. Biological Quality Elements, BQEs WFD., 10/2010. (VIII.18.) VM decree. Biodiversity.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Students have to attend lectures or practices and may not miss more than three lectures or practices during the semester. In case a student misses more than three, the subject will not be signed and the student must retake the course. Attendance at lectures and practice classes will be recorded by the practice leader. Being late counts as an absence. In case of further absences, a medical certificate needs to be presented. Students are required to bring the printed materials of the lectures with them to each lecture and practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class.

B, for a mid-semester grade:

The minimum requirement of the written mid-semester test is 60% separately. The grade for each test is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of any test is below 60%, the student once can take a retake test of the whole semester material

Geosciences

Code: MK5FDTIS03KX17-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade

Year, Semester: 1st year/1st semester

Number of teaching hours/week (lecture + practice): 2+0

Topics:

Geological and geotechnical exploration; sampling, description of localities, field measurements and their instruments. Geological, hydrogeological data collection, archive data bases, and their application. Protection of the geological environment and the groundwater sources. Pollutants and limits. Pollution transport, risk analysis and assessment. Documentation of concerning the geological environment and groundwater systems (preliminary studies, environmental impact assessment, revision, steady state analysis, site assessment, remediation). Review of remediation and treatment technologies; planning and performance of remediation; monitoring. Basic concepts of protection of water resources, diagnostics and securing of water resources. Geological and hydrogeological background of waste disposal.

Literature:

Required:

- Foley, D et al. 2009: Investigation in environmental geology. Prentice Hall, N.J.
- Reichard, J.S., 2009: Environmental geology. McGraw-Hill.

Recommended:

- White , W.M., 2007: Geochemistry. John Hopkins University Press.

Schedule

1st week Registration week	
2nd week: Origin of Solar System. The Earth's system. Earth materials: rock-forming minerals, igneous rocks.	**3rd week:** Weathering, sedimentary rocks. Metamorphic rocks.
4th week:	**5th week:**

Rock cycle. Earth's interior. Plate tectonics. Hazardous Earth processes. Volcanic activity and volcanic hazards.	Mass wasting, slope stability, landslides, avalanches and their hazards.
6th week:	**7th week:**
Streams and floods and their hazards. Coastal processes and hazards. Soil resources, human activity and soils.	Elements of hydrologic cycle. Surface and ground water. Basics of hydrology and hydrogeology. Sources of freshwater.
8th week: 1st drawing week	
9th week:	**10th week:**
Pollution and contamination. Various types of contaminants, their physical-chemical properties and effects on human health and ecosystem.	Transport processes: contaminant in surface and groundwater, soil and soil gas. Human risk assessment.
11th week:	**12th week:**
Strategies and techniques in environmental geology; field and laboratory techniques. Soil, soil gas and groundwater sampling, drilling techniques, well installing.	Introduction to sustainability. Geological resources resource planning. Environmental impact assessment, environmental site assessment, remediation.
13th week:	**14th week:**
Remediation techniques and technologies for cleaning up contaminated sites.	Solid and liquid wastes. Waste disposal regarding geological and hydrogeological backgrounds. Effect of mining of mineral resources..
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance at lectures is recommended.

B, for a grade:

The course ends in a written end-term test.

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Environmental Law and Economics

Code: MK5KJGDK04KX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 1st year, 1st semester

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Legal bases, subject matter and basic concepts of environmental regulation. The system of environmental regulation. International EU- and national level of environmental law. Local governments’ roles in the environmental protection. Regulation methods (legal, economical, sectoral and integration methods, self-regulation). Principles of environmental regulation. Environment protection in the Fundamental Law. The environmental permit and impact assessment system (EEA, IPPC, SEA, etc.). Legal institutions of soil protection, air protection, climate protection, water conservation, waste management, nature protection and Regulation of GMOs.

The environmental Economics course provides an introduction to economic perspectives on contemporary environmental issues. We will study economic theories related to natural resources and the environment, and their application to environmental policy. The first part of the course will focus on concepts and theory, and the second part will deal with applications including population and food supply, renewable and non-renewable resources, pollution control policy, global climate change, international trade, and environmental politics.

Literature:

Required:

- Gyula Bándi: Hungary (IEL Environmental Law National Monographs). Kluwer Law International (ISBN: 9789065449450), Alphen aan den Rijn, 2016, 264 p.
- Harris, Jonathan M. – Roach, Brian: Environmental and Natural Resources Economics: A Contemporary Approach (3rd Edition), Routledge, 2013, 584 p.

Recommended:

- Gergely Horváth: The renewed constitutional level of environmental law in Hungary. Acta Juridica Hungarica (ISSN: 1216-2574) 2015/4, pp. 302–316.
- David Langlet and Said Mahmoudi: EU Environmental Law and Policy. Oxford University Press (ISBN: 9780198753933), 2016
- Costanza, R., Norgaard, R., Daly, H., Goodland, R., & Cumberland, J. (2007). An Introduction to Ecological Economics (e-book). Available at: http://www.eoearth.org/view/article/150045
- Brown, Lester R.: Plan B 4.0: Mobilizing to Save Civilization. W.W. Norton & Company, 2009 – Earth Policy Institute, http://www.earthpolicy.org/index.php?/books/pb4

- Available at: http://www.earthpolicy.org/images/uploads/book_files/pb4book.pdf

Schedule

1st week Registration week	
2nd week: **Lecture:** Legal bases, subject matter and basic concepts of environmental regulation. **Practice:** basic definitions of environmental law. **Lecture:** Introduction to Environmental Economics. **Practice:** Recognition of ecological crisis.	3rd week: **Lecture:** The system of environmental regulation. **Practice:** International EU- and national level of environmental law. Local governments' roles in the environmental protection. **Lecture:** Global Ecological Problems **Practice:** Recognition of major environmental issues.
4th week: **Lecture:** Local governments' roles in the environmental protection. **Practice:** local planning and regulation of environmental protection. **Lecture:** Economic growth and the environment. **Practice:** Connecting economic and ecological concerns of the world development.	5th week: **Lecture:** Regulation methods (legal, economical, sectoral and integration methods, self-regulation). **Practice:** Tools of environmental regulation. **Lecture:** Sustainable development. **Practice:** Knowledge on wide range of sustainability concepts.
6th week: **Lecture:** The environmental permit and impact on assessment systems (EEA, IPPC, SEA, etc.). **Practice:** Permitting procedures. **Lecture**: National strategy for sustainable development. **Practice**: Recognition of NSSD.	7th week: **Lecture:** Legal institutions of protection of each element. **Practice:** Soil protection, air protection, climate protection, water conservation, waste management, nature protection and Regulation of GMOs. **Lecture:** The theory of externalities. **Practice:** Examples of externalities.
8th week: 1st drawing week	
9th week: **Lecture:** Economic growth and environment. **Practice:** Connecting economic and ecological concerns of the world development.	10th week: **Lecture:** Common property resources and public goods. **Practice:** An example – the tragedy of commons; Knowledge on environmental management of public goods.
11th week:	12th week:

Lecture: Resources allocation over time. **Practice:** Knowledge on the role of time in management of resources.	**Lecture:** Environment valuing. **Practice:** Tools and examples of monetary valuation.
13th week: **Lecture:** National income and environmental accounting. **Practice:** Information of environmental performance of states.	**14th week:** **Lecture:** Environment, trade and development. **Practice:** Environmental impacts of trade, institutions and policies for sustainable development.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance at **lectures** is recommended, but not compulsory.

Attending practices is compulsory. Students have to attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date previously discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

B, for a grade:

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Environmental and Quality Management

Code: MK5KMMMM03KX17-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade

Year, Semester: 1st year/1st semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

Basics of management review, forms of organization, management styles, etc.

Operating management concepts, types of functions, input-output approach. Strategy, goals, Hayes and wheelwright model, development of operational strategies. The

relationship between production and service, common properties, differences. Process engineering: process models, environmental planning. Product and service design: ingredients, the basic process, screening, assessment methods, aggregate planning. Supply chain in operating management: Basic concepts, decisions, aspects of do or buy decision. Process technologies: typing, general features, criteria of selection.

Scheduling, managing, controlling of the production (service). Management strategies. Statistical process control, continuous improvement. Inventory management, inventory management models. Features of inventories formed by economic and production considerations. ABC inventory analysis. Consumption definition, overview of MRP, MRP input - output data, identify capacity requirements. Queueing models. Principles and objectives of lean manufacturing.

The requirements for quality management systems (ISO 9001: 2008). The development of operation (ISO 9004: 2010). Environmental Management System (ISO 14001: 2005). MSZ 28001: 2008 occupational health and safety management system. ISO / IEC 27001: 2005 elements and structure of information security management system.

Literature:

Required:

- Kim-Soon Ng (2012): Quality Management and Practices. InTech, Chapters published. ISBN 978-953-51-0550-3
- Garg A. K. (2011): Production and Operations Management. McGraw-Hill. ISBN-13 9780071077927
- Sven Erik Jørgensen, Joao Carlos Marques, Søren Nors Nielsen, Integrated Environmental Management: A Transdisciplinary Approach, CRC Press, 2015, ISBN 9781498705103

Recommended:

- Kanishka Bedi: Quality Management, Oxford University Press, 2016, ISBN 9780195677959

Schedule

1st week Registration week	
2nd week: **Lecture:** Basics of Quality management. **Practice:** Analysing examples.	3rd week: **Lecture:** The role of quality management in the industry. **Practice:** PDCA project.
4th week: **Lecture:** Process Management. **Practice:** Create a flowchart.	5th week: **Lecture:** Quality Planning. **Practice:** Developing a Quality Plan.
6th week: **Lecture:** Quality Management Methods I. **Practice:** Ishikawa, Pareto Analysis, 5W.	7th week: **Lecture:** Quality Management Methods II. **Practice:** QFD, Kano model, 5s, 8D report.
8th week: 1st drawing week	

9th week: **Lecture:** Industrial ecology and sustainability. **Practice:** Investigating case studies.	**10th week:** **Lecture:** Environmental factors and environmental impacts. **Practice:** Impact Sheet, Leopold Matrix, ABC Analysis, Eco-mapping.
11th week: **Lecture:** Life cycle assessment, analysis of life-cycle phases. **Practice:** Life cycle analysis.	**12th week:** **Lecture:** Environmental audit and benchmarking. **Practice:** Creating an audit plan.
13th week: **Lecture:** ISO 14001 standard. **Practice:** Legislation for acquisition of information and data about different waste streams.	**14th week:** **Lecture:** Process of assessing environmental performance. **Practice:** The relationship between environmental indicators and performance appraisal.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

Students have to write two midterm tests during the semester. The first (40 points max) in the 8th, the second (40 points max) in the 14th week.

The minimum requirement of the tests is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If students fail to pass a test, they have to write both tests in the 1st week of the exam period again. If the result is 40 points (50%) or better, then he can take an exam.

There will be homework from week to week. Only students who have handed in all their homework at the time of the midterm test will be allowed to write it. The problems in the midterm tests will be selected from the homework assignments.

Production Management and Life Cycle Analysis

Code: MK5TMEEM03KX17-EN

ECTS Credit Points: 3

Evaluation: exam

Year, Semester: 1st year/2nd semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

The course focuses on the advanced aspects of the production and service management. Emphasis is placed on the practical implementation of recommendations generated from the advanced modelling and system's understanding gained in the full range of Industrial engineering. The primary goal of the course is to allow students to see the applications of theories in a more realistic and intricate setting to gain a broader view of production and service management. The course covers the following topics: business forecasting and product lifecycle, time series forecasting, capacity analysis of machine, models and indicators in production system, inventory design, aggregate planning, life cycle assessment (LCA). At the end of the semester students should have a basic understanding of design, and schedule manufacturing system.

Literature:

Required:

- W. J. Stevenson: Operations management 12th ed. (2014) Boston, McGraw-Hill/Irwin
- Stephen N. Chapman, J. R. Tony Arnold, Ann K. Gatewood, Lloyd M. Clive: Introduction to Materials Management, 8th. global ed., (2016) New Jersey, Pearson

Recommended:

- S. Nahmias: Production and Operations Analysis. 5th Edition. (2004) McGraw Hill/Irwin

Schedule

1st week Registration week	
2nd week: **Lecture:** Introduction to operation management. **Practice:** Examples, case studies.	3rd week: **Lecture:** Building of process management systems. **Practice:** Examples, case studies.
4th week: **Lecture:** Production planning, creating value flow. **Practice:** Examples, case studies.	5th week: **Lecture:** Capacity analysis of machine. **Practice:** Examples, case studies.
6th week: **Lecture:** Business forecasting, time series forecasting.	7th week: **Lecture:** Design of goods, product lifecycle.

Practice: Examples, case studies.	**Practice:** Test 1
8th week: 1st drawing week	
9th week: **Lecture:** Inventory Planning Deterministic Models EOQ models. **Practice:** Examples, case studies.	**10th week:** **Lecture:** Inventory control: MRP I-II, ERP. **Practice:** Examples, case studies.
11th week: **Lecture:** JIT comparison of push and pull systems, MTO-MTS dilemma. **Practice:** Examples, case studies.	**12th week:** **Lecture:** Service and production development (Six sigma). **Practice:** Examples, case studies.
13th week: **Lecture:** Life cycle assessment – LCA. **Practice:** Examples, case studies.	**14th week:** **Lecture:** LCA programming. **Practice:** Test 2
15th week: 2nd drawing week	

Requirements

A, for a signature:

Participation at practice is compulsory. Students have to attend lectures and may not miss more than three of them during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at lectures will be recorded by the lecturer. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed lectures have to be made up for at a later date previously discussed with the tutor.

During the semester there are two tests: a mid-term test and an end-term test. Students must sit for both tests. The minimum requirement of the mid-term and the end-term test is 60% respectively. If the score of any test is below 60%, students can retake the test of the whole semester material only once. If somebody fails, he/she has to write both tests in the 1st week of the exam period again. If the result is 60 % or better the retake test is considered successful.

B, for a grade:

The course ends in an examination in the exam period.

The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Subject group “Professional Subjects” for all Specialization

Environmental Engineering Measurement Techniques, Monitoring

Code: MK5KMMMK04KX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 1st year/2nd semester

Number of teaching hours/week (lecture + practice): 2+2

Topics:

In the field of environmental engineering measurement and monitoring, students will be able to learn the basic concepts related to the monitoring system, the process and purpose of the analysis, the correct sampling and the importance of the basic concepts in environmental analytics, the topic of analytical chemistry.

The subject details the methods of measurement used in environmental analytics.

This course will be described the electroanalytical, atom spectrometry, molecular spectroscopy, chromatographic, mass spectrometry and coupled mass spectrometry methods (GC-MS, HPLC-MS, ICP-MS). Lastly, elemental speciation methods will also be presented.

During instrumental analytical chemistry practice, the following topics are addressed: UV / VIS spectrophotometry, flame photometry (FES), flame atomic absorption analysis (FAAS), ion chromatography.

Literature:

Required:

- Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, (2014) Fundamentals of Analytical Chemistry, 9th Edition, Brooks/Cole, ISBN 978-0-495-55828-6
- Dr. Mahmood M. Barbooti (2015) Environmental Applications of Instrumental Chemical Analysis, CRC Press, Boca Raton, ISBN 978-1-4822-6264-3

Recommended:

- Skoog, Douglas A.; Holler, F. James; Crouch, Stanley R. (2007). Principles of Instrumental Analysis. Thomson. Brooks/Cole, ISBN 0-495-01201-7.

Schedule

1st week Registration week	
2nd week: **Lecture:** Monitoring, analysis process, good sampling and importance in environmental analytics. **Practice:** -	**3rd week:** **Lecture:** Basic concepts in analytical chemistry, accuracy, specification and validation of measurement methods. **Practice:** -
4th week:	**5th week:**

Lecture: Sample processing and sample preparation procedures. **Practice:** -.	**Lecture:** Measurement methods used in environmental analytics: electroanalytical methods. **Practice:** -
6th week: **Lecture:** Atomic spectroscopy methods. **Practice:** -	**7th week:** **Lecture:** Molecular spectroscopy methods. **Practice:** -
8th week: 1st drawing week	
9th week: **Lecture:** Chromatographic methods. **Practice:** -	**10th week:** **Lecture:** Mass Spectrometry, coupled systems in mass Spectrometry (GC-MS, HPLC-MS, ICP-MS). Grouping of coupled techniques and elemental specification testing methods. **Practice:** -
11th week: **Lecture:** - **Practice:** UV / VIS spectrophotometry.	**12th week:** **Lecture:** - **Practice:** Flame photometry (FES). Flame Atmospheric Analysis (FAAS).
13th week: **Lecture:** - **Practice:** Chromatography.	**14th week:** **Lecture:** -. **Practice:** ICP demonstration practice.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at lectures is recommended. Students have to attend practice classes and cannot miss the practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. Students must write correct lab notes on every practice classes and must submit those to the practice leader. If a lab note is not correct, students can revise it.

B, for a grade:

The course ends in a written end-term test.

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Environmental Health

Code: MK5KEGTK03KX17-EN

ECTS Credit Points: 3

Evaluation: exam

Year, Semester: 1st year/ 2nd semester

Number of teaching hours/week (lecture + practice): 2+0

Topics:

During the course students learn the goals and methods of environmental health. It describes the health effects of air, surface, ground and drinking water, soil and food pollutants, environmental noise and radiation, components of hazardous and non-hazardous wastes, along with the environmental health aspects of global challenges and preventive measures of environmental diseases. Students learn the theory and methods of environmental toxicology and epidemiology, and get acquainted with the consequences of real environmental exposures through environmental case studies.

Literature:

Required:

- lecture notes

Recommended:

- Dade W. Moeller: Environmental Health, 4th edition, Harvard University Press, USA, 2011, ISBN 9780674047402
- Friis RH. Essentials of Environmental Health, 2nd edition, Jones & Bartlett Learning, Burlington, 2012, ISBN 9781284026337

Schedule

1st week Registration week	
2nd week: **Lecture:** The subject, development and methods of environmental health.	**3rd week:** **Lecture:** Principles of environmental toxicology, harmful environmental exposures.
4th week:	**5th week:**

Lecture: The effects of air pollution on human health.	**Lecture:** The effects of water pollution on human health.
6th week:	**7th week:**
Lecture: The effects of soil pollution on human health.	**Lecture:** The effects of harmful chemicals in food on human health.
8th week: 1st drawing week	
9th week:	**10th week:**
Lecture: Environmental noise exposure.	**Lecture:** The effects of radiation exposure on human health.
11th week:	**12th week:**
Lecture: The effects of workplace environment on human health.	**Lecture:** Modern waste management.
13th week:	**14th week:**
Lecture: Global environmental challenges. Case studies in environmental epidemiology. Preparation for student presentations.	**Lecture:** Environmental epidemiology, risk assessment. Case studies in environmental epidemiology. Student presentations.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance at lectures is recommended.

B, for a grade:

The course ends with a written end-term exam comprising multiple choice questions. Students may hold presentations discussing various environmental health problems in the last semester week. The presentations are scored which adds to the score achieved in the written exam.

The minimum requirement of the end-term exam is 50%. The grade is given according to the following (score/grade): 0-49 = fail (1); 50-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Environmental Modelling and Environmental Informatics

Code: MK5KMKIK04KX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 1st year/1st semester

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Students learn surveying, evaluation of changing and concerning decision support of the renewables and exhaustible resources in GIS environment. This knowledge serves such theoretical and practical skills in remote sensing and GIS, which provides opportunities to elaborate and operate environmental monitoring systems.

The aim of the practise is to have the basic concepts of environmental modelling acquainted with students, to give an inspection into the operation practice of models connecting to the soil-water-air-pollution. Students get acquainted with the major application possibilities connecting to the environmental respects of modelling systems, and learn human- and ecotoxicological risk assessment.

Literature:

Required:

- Colombo, A. G. (2012): Environmental Impact Assessment. Springer Verlag. 334 p.
- Bastmeijer, K., Koivurova, T. (2008): Theory and Practice of Transboundary Environmental Impact Assessment. Martinus Nijhoff Publishers. 397 p.
- Wathern, P. (2013): Environmental Impact Assessment. Theory and Practice. Routledge (Taylor and Francis Group). 352 p.

Recommended:

- Lichtfouse, E., Goyal, A. (2015): Sustainable Agriculture Reviews. Springer International Publishing. 214 p. (ISBN: 978-331-916-987-3)
- Raju, N. J., Gossel, W., Sudhakar, M. (2015): Management of natural resources in a changing environment. Springer International Publishing. 298 p. (ISBN: 978-331-912-558-9).

Schedule

1st week Registration week	
2nd week: Lecture: National and international environmental protection GIS projects. Practice: Principles of modelling.	3rd week: Lecture: Environmental informatics systems on the Internet, data warehouses and metadata. Practice: Importance of environmental risk assessment.
4th week: Lecture: Elaboration and operation of environmental management information systems, environmental elements and its concern with IT. Practice: Characteristics of soil plant atmosphere systems.	5th week: Lecture: Characterization, acquiring of digital data in environmental management, requirement of data structures. Spatial certainty and its role and use. Practice: Modelling of the impacts on soil and groundwater effects.
6th week:	7th week:

Lecture: Soil and environmental modelling. **Practice:** -	**Lecture:** Elevation modelling. **Practice:** Modelling of the impacts on atmosphere effects.
8th week: 1st drawing week	
9th week: **Lecture:** Environmental models in hydrology. Surface and ground water modelling. **Practice:** Modelling the impacts on surface water effects.	**10th week:** **Lecture:** Landscape protection and land evaluation models. **Practice:** Modelling the impacts on biomass and landscape effects.
11th week: **Lecture:** Geostatistical background of spatial and temporal changing. **Practice:** Modelling the impacts on the human health effects. Socio-economic consequence of the impacts on the environmental effects.	**12th week:** **Lecture:** Geostatistical background of spatial and temporal changing. The basis of remote sensing. **Practice:** Preparing of environmental impact studies. Practical application of pollution transmission models, processing of remediation and monitoring.
13th week: **Lecture:** Geoinformatics model of single-factor decision support systems. **Practice:** Remediation of soil, groundwater and surface water. Cost-benefit analysis of remediation.	**14th week:** **Lecture:** Applied, complex multi-factor decision support systems. Solutions of decision support systems. **Practice:** Development of simulation and modelling software.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

The course ends in a written exam.

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Environmental Operations

Code: MK5KVMK04KX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 1st year/1st semester

Number of teaching hours/week (lecture + practice):2+2

Topics:

Substance of environmental operations. Unit operations of environmental engineering. Thermodynamics basis of environmental operations. Description of environmental operations. Measurement, units and dimensions of environmental engineering. Transport processes. Mass, component, heat and momentum streams. The general transport equation. The classification of operational units. The theory of similitude, dimensional analysis.

Flow of fluids, energy and momentum relationships. Pumping of fluids. Separation of heterogeneous systems: Sedimentation, filtration, centrifugation, mixing of liquid, gas cleaning. General characterization of transfer processes. Classification of transfer processes.

Heat transfer. Heat transfer by convection, conduction and radiation. Heating and cooling. Heat transfer at standard- and changeable temperature difference. Unsteady- and steady state transfer of heat. Heat exchangers.

Evaporation and crystallization. Evaporators and crystallizers. Cooling and coolers. Mass transfer processes. The two-film theory. Common interpretation of the operating line and the equilibrium curve. Mass transfer processes. Absorption. Evaporation. Distillation. Rectification. Extraction. Adsorption. Chemical reaction engineering. Chemical reactors. Classification of reactors and choice of reactor type in environmental protection.

Literature:

Required:

- H. F. Hemond; E. J. Fechner-Levy: Chemical Fate and Transport in the Environment. Second Edition, AP.2000. ISBN-13: 978-0-12-340275-2
- Bruce E. Logan: Environmental Transport Processes. John Wiley and Sons, Inc. 1999. ISBN: 0-471-18871-9
- Waren L. McCabe; Julian C. Smith; Peter Harriott: Unit Operation of Chemical Engineering. Seventh Edition, McGraw Hill Higher Education. 2005. ISBN 007-124710-6
- Christie J. Geonkoplis: Transport Processes and Separation Processes Principles. (Includes Unit Operations). Forth Edition, 2008. ISBN 0-13-101367-X
- Yanus A. Cengel – John M. Cimbala: Fluid Mechanics Fundamentals and Applications. Second Edition. McGraw Hill Higher Education, 2010, ISBN 978-0-07-352926-4
- H. Scott Fogler: Elements of Chemical Reaction Engineering. Fourth Edition, 2006.Personal Education International 2006. ISBN 0-13-127839-8

Recommended:

- D. W. Green – R. H. Perry: Perry's Chemical Engineers' Handbook. 8th Edition, McGraw-Hill 2008. ISBN 978-0-07-142294-9

Schedule

1st week Registration week	
2nd week: **Lecture:** Subject of environmental operations. Unit Operations of Environmental Engineering. **Practice:** Problems and problem solving.	3rd week: **Lecture:** Description of unit operations. Measurement, units and dimensions. **Practice:** Problems and problem solving.
4th week: **Lecture:** Transport processes. Mass, component, heat and momentum streams. **Practice:** Problems and problem solving.	5th week: **Lecture:** Transport equations. Classification of operational units. Theory of similitude, dimensional analysis. **Practice:** Problems and problem solving.
6th week:. **Lecture:** Flow of fluids, energy and momentum relationships. **Practice:** Problems and problem solving.	7th week: **Lecture:** Sedimentation, filtration, centrifugation, mixing of liquid. **Practice:** Mid-term exam (1st test) from environmental operations
8th week: 1st drawing week	
9th week: **Lecture:** General characterization and classification of transfer processes. **Practice:** Problems and problem solving.	10th week: **Lecture:** Heat transfer by convection, conduction and radiation. **Practice:** Problems and problem solving.
11th week: **Lecture:** Heat transfer at standard- and changeable temperature differences. Heat exchangers. **Practice:** Problems and problem solving.	12th week: **Lecture:** Mass transfer processes. Operating line and equilibrium curve. Absorption. Evaporation. Distillation. **Practice:** Problems and problem solving.
13th week: **Lecture:** Rectification. Extraction. Adsorption. **Practice:** Problems and problem solving.	14th week: **Lecture:** Chemical reactors in environment and in environmental protection. **Practice:** End-term exam (2nd test) from environmental operations.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Students have to attend on lectures or practices and may not miss more than three lectures or practices during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Attendance at lectures and practice classes will be recorded by the practice leader. Being late counts as an absence. In case of further absences, a medical certificate needs to be presented. Students are required to bring a calculator and the printed materials of the lectures with them to each lecture and practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class.

During the semester there are two tests: a mid-term test on the 8th week and an end-term test on the 14th week. Students can retake both tests once, if it is necessary.

B, for an exam grade:

The course ends in an **examination**. Based on the average of the grades of the mid-term exam and the end-term exam and the examination, the exam grade is calculated as an average of them:

- the average grade of the two exams
- the result of the examination

The minimum requirement for the mid-term and end-term exams and the examination respectively is 60%. Based on the score of the exams separately, the grade for the exams and the examination is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of any exam is below 60, students can retake that exam in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

An offered grade: grades may be offered for students if the average of the mid-term and end-term exams is at least satisfactory (3). The offered grade is the average of the two exams.

Environmental Resource Management

Code: MK5KEGDK03KX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 1st year/2nd semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

Description of the most important non-renewable (fossil, soil), renewable (atmospheric, water, biomass) resources. Sustainability of resource utilization, energy balance calculation, environmental impact analysis with life-cycle perspective according the following themes: General questions of the sustainable use of natural resources, classification of natural resources; renewable resources: solar energy , wind energy,

energy of flowing water; social and environmental problems associated with the use of non-renewable natural resources; ozone in the stratosphere and the troposphere; relationship between resource utilization and the carbon cycle; greenhouse effect, greenhouse gases: carbon-dioxide (CO_2); methane (CH_4), nitrous-oxide (N_2O); air-, water- and soil related environmental problems: acidification, eutrophication; climate change, impacts and responses; soil, as a natural resource; (fresh)water resources; utilization of biomass for energy; bioethanol, biodiesel, biogas raw materials and their manufacturing processes; material and energy balances for natural resource management.

Literature:

Required:

- Conroy, M. J., Peterson, T.: Decision Making in Natural Resource Management: A Structured, Adaptive Approach. Published: 2013, ISBN: 9780470671757 |Online ISBN:9781118506196 |DOI:10.1002/9781118506196, Copyright © John Wiley & Sons, Ltd. 2013.
- Zhongchao, Tan: Air Pollution and Greenhouse Gases 2014, From Basic Concepts to Engineering Applications for Air Emission Control, ISBN 978-981-287-212-8 Springer, 2014.

Recommended:

- Faragó T., Láng I., Csete L. (Eds): Climate Change and Hungary: Mitigating the Hazard and preparing for the Impacts (The VAHAVA Report) Budapest 2010

Schedule

1st week Registration week	
2nd week: Lecture: General questions of the sustainable use of natural resources, classification of natural resources. Practice: Solving problems based on the theme of the lecture.	3rd week: Lecture: Renewable resources: solar energy, wind energy, energy of flowing water. Practice: Solving problems based on the theme of the lecture.
4th week: Lecture: Renewable resources: solar energy, wind energy, energy of flowing water. Practice: Solving problems based on the theme of the lecture.	5th week: Lecture: Social and environmental problems associated with the use of non-renewable natural resources. Practice: Solving problems based on the theme of the lecture.
6th week: Lecture: Ozone in the stratosphere and the troposphere. Practice: Solving problems based on the theme of the lecture.	7th week: Lecture: Relationship between resource utilization and the carbon cycle. Practice: Case study.
8th week: 1st drawing week	

9th week: **Lecture:** Greenhouse effect, greenhouse gases: carbon-dioxide (CO_2), methane (CH_4), nitrous-oxide (N_2O). **Practice:** Solving problems based on the theme of the lecture.	**10th week:** **Lecture:** Air-, water- and soil related environmental problems: acidification, eutrophication. **Practice:** Solving problems based on the theme of the lecture.
11th week: **Lecture:** Climate change, impacts and responses. **Practice:** Case study.	**12th week:** **Lecture:** Soil, as a natural resource. (Fresh) water resource. **Practice:** Case study.
13th week: **Lecture:** Utilization of biomass for energy. **Practice:** Bioethanol, biodiesel, biogas raw materials and their manufacturing processes.	**14th week:** **Lecture:** Material and energy balances for natural resource management. **Practice:** Case study.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Students have to attend on lectures or practices and may not miss more than three lectures or practices during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Attendance at lectures and practice classes will be recorded by the practice leader. Being late counts as an absence. In case of further absences, a medical certificate needs to be presented. Students are required to bring the calculator and the printed materials of the lectures with them to each lecture and practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class.

B, for an exam grade:

The course ends in an **examination**. The minimum requirement for the written examination respectively is 60%. Based on the score of the exams separately, the grade for the exams and the examination is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of any exam is below 60, students can retake that exam in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Environmental State Assessment, Auditing

Code: MK5KAEAK03KX17-EN

ECTS Credit Points: 3

Evaluation: exam

Year, Semester: 1st year/2nd semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

The goal of this subject is to provide possibility for students to do image analyses and to learn the basics of remote sensing and hydrological data collection. Within this subject students get acquainted with the modern spatial resolution support methods as well. They can build up and manage several geo-database systems and learn the theoretical and practical essentials of water management models.

The general purpose of the practice is to make students able to carry out environmental data collection and processing independently by applied geoinformatics and remote sensing. They will also be able to build and maintain independent geodatabase systems. They will learn about the main water management models and their theoretical and practical background.

Literature:

Required:

- Li, Z., Zhu, Q., Gold, C. (2005): Digital terrain modeling: Principles and Methodology. CRC Press. 318 p. (ISBN: 0-415-32462-9)
- Khorram, S., van der Wiele, C. F., Koch, F. H., Nelson, S. A. C., Potts, M. D. (2016): Principles of Applied Remote Sensing. Springer. 307 p. (ISBN: 978-331-922-593)

Recommended:

- Maquire, D. J. (2005): GIS, Spatial Analysis and Modeling. ESRI Press. 479 p. (ISBN: 978-158-948-130-5)p.

Schedule

1st week Registration week	
2nd week: Lecture: Spatial objects. Practice: GIS modelling in environmental status assessment.	3rd week: Lecture: GIS models. Practice: Lengthwise profile levelling.
4th week: Lecture: Primer data collection methods. Practice: Cross-section profile levelling.	5th week: Lecture: Secondary data collection methods. Practice: The structure of surface water geo database. The structure of ground geo database.
6th week: Lecture: The structure of geo-database for surface waters. Practice: Digital elevation modelling.	7th week: Lecture: The structure of geo-database for underground waters. Practice: Runoff modelling.

8th week: 1st drawing week	
9th week: **Lecture:** Spatial decision support in water management. **Practice:** Infiltration modelling.	10th week: **Lecture:** Spatial uncertainty and risk analysis in water management. **Practice:** Evaporation modelling.
11th week: **Lecture:** Physically background of remote sensing. **Practice:** Climate modelling.	12th week: **Lecture:** Space borne and airborne remote sensing. **Practice:** Spatial uncertainties and risk analysis in water management.
13th week: **Lecture:** Image analysis and land use. Image analysis and water quality management. **Practice:** Image analyses and water quality protection. Hydrological modelling.	14th week: **Lecture**: Hydrological modelling. Hungarian and international hydrology databases and data mining. **Practice:** National and international hydrological databases and data mining.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

The course ends in a written exam test.

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Safety and Environmental Risk

Code: MK5BTKKK03KX17-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade

Year, Semester: 1st year/1st semester

Number of teaching hours/week (lecture + practice): 2+0

Topics:

Within the framework of this course, students learn about the following topics: The concept of risk, its types, environmental risk. Risk metrics, activity groups of risk analysis. Identification, analysis of risk sources, response strategies, risk management. Environmental risk of companies, effective risk policy. Used risk analyses, non-technical and technical risks. Types and analysis of errors: fault tree analysis, error mode and impact analysis. Analysis of health risks. Analysis of ecological risks. Risk of natural hazards and disasters. Environmental risk of toxic elements. The concept and conditions of work safety. Personal protective equipment, accidents.

Literature:

Required:

- John Ridley and John Channing: Safety At Work (Sixth Edition), 2003, ISBN: 978-0-08-047429-8
- Elearn: Managing Health, Safety and Working Environment Revised Edition, 2011, ISBN: 978-0-08-055740-3
- Shroder, John F and Sivanpillai, Ramesh: Biological and Environmental Hazards, Risks, and Disasters, Elsevier, 2015

Recommended:

- Richard P. Pohanish: Sittig's Handbook of Toxic and Hazardous Chemicals and Carcinogens (Seventh Edition), 2017, ISBN: 978-0-323-38968-6

Schedule

1st week Registration week	
2nd week: Lecture: Subjects of safety and environmental risk.	3rd week: Lecture: Introduction to the integrated safety system. Definition of hazard and risk.
4th week: Lecture: Hazard analysis as the first step in a process used to assess risk. Identification of different type of hazards.	5th week: Lecture: Hazard as a potential condition and exists or not, probability is 1 or 0. Risk as a combination of probability and severity
6th week:. Lecture: Safety related topics: catastrophic, hazardous, major, minor, the 'no safety effect'.	7th week: Lecture: Likelihood of occurrence: probable, remote, extremely remote, extremely improbable
8th week: Mid-term exam (1st test).	
9th week:	10th week:

Lecture:. Risk analysis: acceptable risk, unacceptable risk, residual risk.	**Lecture:** Analysis of environmental risk. Definition of PEC (Predicted Environmental Concentration), PNEC (Predicted No Effect Concentration), and RQ **(**Risk Quotient).
11th week:	**12th week:**
Lecture: Safety and risk. Safety engineering. Traditional methods for safety analysis: failure mode and effects analysis (FMA) and fault tree analysis (FTA).	**Lecture:** Occupational safety. Lab and research safety. Personal protective equipment types.
13th week:	**14th week:**
Lecture: Tool and machine safety. Cranes and hoists, and Contractor safety. Fall preventions and confined spaces.	**Lecture:** Hot work and welding safety, and pressure vessels. Fire safety and facility fire safety equipment types.
15th week: End-term exam (2nd test).	

Requirements

A, for a signature:

Attendance at **lectures** is recommended, but not compulsory.

During the semester there are two **tests**: a mid-term test around the 8th week and an end-term test in the 15th week. Students have to sit for the tests and earn at least 51% of the maximum points.

B, for a grade:

The grade is determined based on the total points of the two mid-semester tests. The minimum requirement is 51% of the total points. Based on the score of the tests, the grade for the course is given according to the following (score/grade): 0-50 = fail (1); 51-62 = pass (2); 63-75 = satisfactory (3); 76-88 = good (4); 89-100 = excellent (5).

If the score of the test is below 50, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Subject group "Differentiated Professional Subjects" for
Environmental Technology, Planning, Constructions Specialization

Environmental Technologies I (Soil Protection)

Code: MK5KVT1K03K117-EN

ECTS Credit Points: 3

Evaluation: exam

Year, Semester: 2nd year/1st semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

Presentation of the causes and consequences of the most important soil degradation processes (acidification, salinisation, reduction of organic material content, soil contamination, structural depletion, soil compaction, wind and water erosion, soil sealing).

Description of the technical and agronomic possibilities of soil protection, chemical, mechanical soil amelioration and remediation, recultivation procedures suitable for mitigating adverse effects according to the following themes: forms of soil degradation; the importance of soil protection; the acidification of the environment and the soils; amelioration of acid soils; chemical, physical and biological improvement of sandy soils; natural and secondary (man-caused) sodium and salt accumulation; amelioration and land use possibilities of salt affected soils; soil structure degradation, soil compaction, improving the soil structure; problems with the soil - water system. Soil moisture regulation, improving the water management of soils; water erosion, technical and agronomic possibilities of erosion control; wind erosion and possibilities of erosion control; the concept and process of land recultivation (rehabilitation), technical and biological recultivation; technical and biological recultivation in mining exploitations and landfills; soil contamination; remediation of contaminated soils.

Literature:

Required:

- Kátai J (2013): Applied Soil Science https://www.tankonyvtar.hu/en/tartalom/tamop412A/2011_0009_Katai_Janos-Applied_Soil_Science/ch03s07.html

Recommended:

- Godone, D. (Ed.): Soil Erosion Issues in Agriculture Published: October 21st 2011; DOI: 10.5772/926, ISBN: 978-953-307-435-1
- Sarkar, A. K. (Ed.) Acid Soils: Their Chemistry and Management , 2013 ISBN-10: 9381450382
- Gupta, S.K., Megh R. Goyal (Eds): Soil Salinity Management in Agriculture Technological Advances and Applications SBN: 9781771884433 E-Book ISBN: 978-1-315-36599-2 Pub Date: March 2017
- Hartge,K. H.; Horn, R.: Essential Soil Physics. An introduction to soil processes, functions, structure and mechanics. Eds.: Horton, R.; Horn, R; Bachmann, J; Peth, S. 2016. ISBN 978-3-510-65339-3, Soil Amelioration Presentation (PDF Available) 2017; Intensive Growers Association, Cedara College, Omnia, DOI:10.13140/RG.2.2.26686.08000; https://www.researchgate.net/publication/316035053_Soil_Amelioration

Schedule

1st week Registration week	
2nd week: **Lecture:** Forms of soil degradation. The importance of soil protection. **Practice:** Practical assignments and case studies related to the lecture.	3rd week: **Lecture:** The acidification of the environment and the soils. **Practice:** Practical assignments and case studies related to the lecture.
4th week: **Lecture:** Amelioration of acid soils. **Practice:** Practical assignments and case studies related to the lecture.	5th week: **Lecture:** Chemical, physical and biological improvement of sandy soils. **Practice:** Practical assignments and case studies related to the lecture.
6th week: **Lecture:** Natural and secondary (man-caused) sodium and salt accumulation. **Practice:** Practical assignments and case studies related to the lecture.	7th week: **Lecture:** Amelioration and land use possibilities of salt affected soils. **Practice:** Practical assignments and case studies related to the lecture.
8th week: 1st drawing week	
9th week: **Lecture:** Soil structure degradation, soil compaction, improving the soil structure. **Practice:** Practical assignments and case studies related to the lecture.	10th week: **Lecture:** Problems with the soil - water system. Soil moisture regulation, improving the water management of soils. **Practice:** Practical assignments and case studies related to the lecture.
11th week: **Lecture:** Water erosion, technical and agronomic possibilities of erosion control. **Practice:** Practical assignments and case studies related to the lecture.	12th week: **Lecture:** Wind erosion and possibilities of erosion control. **Practice:** Practical assignments and case studies related to the lecture.
13th week: **Lecture:** The concept and process of land recultivation (rehabilitation), technical and biological recultivation. **Practice:** Technical and biological recultivation in mining exploitations and landfills.	14th week: **Lecture**: Soil contamination. **Practice:** Remediation of contaminated soils.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at the lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

The course ends in a written exam test.

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Environmental Technologies II (Water Protection)

Code: MK5KVT2K03K117-EN

ECTS Credit Points: 3

Evaluation: exam

Year, Semester: 2nd year/2nd semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

Completing the course, students will be familiar with the actual issues and challenges, as well as programs, laws, and technical solutions concerning qualitative and quantitative water resource protection and environmental damage prevention, particularly for water. Considering water resource protection, the course includes related elements of environmental risk assessment and hydrogeological and transport modelling. In addition, strategies and technical solutions for the protection against flood, drought, excess surface water and contamination. Tools to reduce risk and damage in the environment caused by them will also be detailed.

Completing the practice, students will gain skills on water resource and water balance calculations for both surface and groundwater bodies via individual project work and assessment of case-studies, they will understand and be able to apply modelling and risk assessment methods related to water resource protection and environmental damage prevention related to water.

Literature:

Required:

- Hipel, Keith W.; Fang, Liping; Cullmann, Johannes; Bristow, Michele (2015): Conflict Resolution in Water Resources and Environmental Management. Springer Verlag. ISBN-13: 9783319142142

Recommended:

- Loucks, Daniel P.; van Beek, Eelco; Stedinger, Jery R.; Dijkman, Jozef P.M.; Villars, Monique T. (2005): Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications, Paris: UNESCO, ISBN 9231039989: https://ecommons.cornell.edu/handle/1813/2804.

Schedule

1st week Registration week

2nd week:

Lecture: Vulnerability of water resources, global water balance and related issues.

Practice: Water resource and water balance calculations: individual project.

3rd week:

Lecture: Water resources, water utilization, water balance.

Practice: Hydrogeological modelling: model parametrization.

4th week:

Lecture: Assessment, monitoring and protection of drinking water resources. Water Framework Directive of the European Union.

Practice: Hydrogeological modelling: scenario analyses.

5th week:

Lecture: Methods for qualitative and quantitative protection of surface water bodies and subsurface water bodies.

Practice: Case-study: water body vulnerability, actions for protection – surface water.

6th week:

Lecture: Environmental risk assessment methodology.

Practice: Case-study: water body vulnerability, actions for protection – groundwater water.

7th week:

Lecture: Legal relations of ERA.

Practice: Environmental risk assessment, individual project: hazard identification and quantification.

8th week:

Lecture: Tools of ERA. Drought prevention, risk reduction and mitigation.

Practice: Environmental risk assessment, individual project: applying risk evaluation methods and applicability assessment.

9th week:

Lecture: Hydrogeological and transport processes and modelling. Regional sharing of water.

Practice: Environmental risk assessment, individual project: risk evaluation.

10th week:

Lecture: Flood prevention, risk reduction and mitigation. Rehabilitation of contaminated water bodies.

Practice: Environmental risk assessment, individual project: assessment of risk reduction alternatives.

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

The course ends in a written exam test.

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Environmental Technologies III (Air and Noise Protection)

Code: MK5KVT3K03K117-EN

ECTS Credit Points: 3

Evaluation: mid-term grade

Year, Semester: 2nd year/1st semester

Number of teaching hours/week (lecture + practice): 0+3

Topics:

Within the subject, students learn about the air chemistry basic concepts, the most important air pollutants and their environmental and health effects, atmospheric physical and chemical transformation processes and "Indoor" pollutants, and calculating tasks related to the topics discussed. They also get acquainted with the possibilities of modelling air pollutant emissions and the modelling environmental impacts of urban transport.

The noise protection part covers the following topics: The concept of noise. Basic Concepts. Levels. Frequency distribution. Sound propagation in free space. Indoor propagation. Room acoustics. Sound absorption, reverberation. Sense acoustics. Strategic noise maps.

Literature:

Required:

- Noel de Nevers: Air Pollution Control Engineering, (Third Edition, 2017) ISBN 978-1-4786-2905-4
- Lev S. Ruzer and Naomi H. Harley: Aerosol Handbook: Measurement, Dosimetry, and Health Effects, (Second Edition, 2013) ISBN 978-1-4398-5510-2
- Enda Murphy and Eoin King: Environmental Noise Pollution, 2014, ISBN: 978-0-12-411595-8

- Lawrence K. Wang, Norman C. Pereira, Yung-Tse Hung: Advanced Air and Noise Pollution Control, 2007, ISBN 1-59259-779-3

Recommended:

- M. P. Norton and D. G. Karczub: Fundamentals of Noise and Vibration Analysis for Engineers, 2003

Schedule

1st week Registration week	
2nd week: Practice: Air chemistry basic concepts. The most important air pollutants and their environmental and health effects. Calculations.	3rd week: **Practice:** Atmospheric physical and chemical transformation processes. Acid rain. Calculations.
4th week: **Practice:** "Indoor" pollutants – calculations.	5th week: **Practice:** Air pollution measurements, Emission estimates and calculations.
6th week: **Practice:** Modelling urban transport and environmental impacts.	7th week: **Practice:** Mid-term test.
8th week: 1st drawing week	
9th week: **Practice:** The concept of noise. Basic Concepts. Levels. Operations with levels. Frequency analysis (octave, 1/3 octave bands, FFT. Calculations.	10th week: **Practice:** Free space propagation, modifying terms. Point, line, and surface sound sources. Vibration measurements and instruments.
11th week: **Practice:** Indoor propagation. Sound absorption, reverberation time, energy distribution in enclosed space. Acoustic insulation, noise reduction.	12th week: **Practice:** Effects on humans. Sense acoustics. Phon, Son. Fletcher-Munson curves. Filters. Basic concepts of vibration. Human vibrations. Workplace vibration measurement (instruments, sensors). Modes of vibration reduction.
13th week: **Practice:** Noise mapping.	14th week: **Practice:** Test.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance at **lectures** is recommended, but not compulsory.

Attending practices is compulsory. Students have to attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any

practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date previously discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to submit two **reports** as scheduled minimum at a sufficient level.

During the semester there are two **tests**: a mid-term test around the 8th week and an end-term test in the 15th week. Students have to sit for the tests and earn at least 51% of the maximum points.

B, for a grade:

The grade is determined based on the total points of the two mid-semester tests. The minimum requirement is 51% of the total points. Based on the score of the tests, the grade for the course is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 50, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Environmental Technologies IV (Waste Recycling)

Code: MK5KVT4K03K117-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade

Year, Semester: 2nd year/2nd semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

Legislation and regulation of wastes. Municipal solid waste (MSW), hazardous waste, sewage sludge, other wastes. Life cycling analysis of materials recycling. Green engineering and sustainable design aspects. Integrated waste management strategies. Waste containers, collection systems, transport. The logistics of solid waste collection. Types of collection systems, equipment, and personnel requirements.

European Union waste management policy, waste strategy in the EU. The economics of waste management. Options of waste treatment and disposal. Waste landfill, types of waste landfilled. Waste incineration, incineration technologies. Other waste treatment technologies: pyrolysis, gasification, composting, anaerobic digestion. Composting of municipal solid wastes. Environmental, public, and industrial health considerations. Hazardous waste definition, classification and generation.

Literature:

Required:

- Jerry A. Nathanson, Richard A. Schneider: Basic Environmental Technology: Water Supply, Waste Management and Pollution Control. Prentice Hall (6th Edition, 2015), 456 pages, ISBN-13: 9780132840149
- George Tchobanoglous and Frank Kreith: Handbook of Solid Waste Management. McGraw-Hill Education (2nd edition, 2002), 950 pages, 2002, ISBN-13: 9780071356237

Recommended:

- Paul T. Williams, Waste Treatment and Disposal. John Wiley & sons, Ltd. (2nd edition, 2005), 392 pages, ISBN-13: 9780470849132
- Trevor Letcher, Daniel Vallero: Waste: A Handbook for Management. Academic Press (1st edition, 2011), 604 pages, ISBN 9780123814753
- Alireza Bahadori: Waste Management in the Chemical and Petroleum Industries, Wiley, 2013. ISBN: 978-1-118-73175-8

Schedule

1st week Registration week	
2nd week: Lecture: The current situation and challenges of waste management in the world. Environmental, public, and industrial health considerations. Practice: Progress and challenges to the global waste management system.	3rd week: Lecture: Legislation and regulation of wastes. European Union waste management policy, waste strategies. Practice: Challenges in legislation, recycling system and technical system of waste electrical and electronic equipment in China.
4th week: Lecture: Options of waste treatment and disposal. The economics of waste management. Waste management plans. Practice: Toward the implementation of new regional bio-waste management plans: Environmental assessment of different waste management scenarios in Catalonia.	5th week: Lecture: The logistics of solid waste collection. Waste containers, types of collection systems, equipment, and personal requirements. Practice: Municipal solid waste collection optimization in Singapore.
6th week: Lecture: Waste landfill, types of waste landfilled. Landfills for hazardous waste, for non-hazardous waste, and for inert waste. Practice: Modelling of energy consumption and environmental life cycle assessment for incineration and landfill systems of municipal solid waste	7th week: Lecture: Waste incineration, incineration technologies. Negative effects on the environment caused by the incineration of waste. Operational conditions, technical requirements, and emission limit values for incineration and co-incineration plants.

management - A case study in Tehran Metropolis of Iran.

8th week:

Lecture: Life cycling analysis of materials recycling. Recyclable materials, municipal recycling facilities. Turning waste into a resource and build up a circular economy. Green engineering and sustainable design aspects. Integrated waste management strategies.

Practice: A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems.

10th week:

Lecture: Other waste treatment technologies: pyrolysis, gasification. Shipment of waste around the world. Waste from the chemical industry, their handling and utilization.

Practice: Comparative assessment of municipal sewage sludge incineration, gasification and pyrolysis for a sustainable sludge-to-energy management in Greece.

Practice: Waste to energy – key element for sustainable waste management.

9th week:

Lecture: Composting, anaerobe digestion. Composting of municipal solid wastes. Treatment methods for biodegradable waste. Processing and utilizing plastic and rubber wastes, degradable plastics and their significance in waste management.

Practice: Comparison of the organic waste management systems in the Danish–German border region using life cycle assessment (LCA).

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at the lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

Everybody has to take two mid-term tests during the semester.

The minimum requirement for the mid-term tests is 60%, respectively. Based on the scores of the mid-term tests, the grade for each test is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5). All the two tests have to be performed at least pass (grade 2). Students can make up or improve their grades at the last week of the semester. At the end of the semester everybody will get a final grade on the basis of the average of the grades.

Recovery Systems of Renewable Energy Sources I

Code: MK5MEF1L04KX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 2nd year/1st semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

The energetic situation in Hungary. Factors affecting wind energy. Measuring wind energy. Types of Wind-powered devices. Efficiency, application examples. The structure, operating principle and types of solar collectors. Concept of Efficiency and Coverage Rate. Solar systems: DHW and pool heating applications. Solar cells types. Factors influencing energy production. Elements of a solar system. Application examples. The utilization of biomass in the building engineering. The concept and types of biomass. The process of gasification and firing is a point source. Overview of biomass-based heat producers. Geothermal energy utilization. Specifications of systems utilizing geothermal energy.

Literature:

Required:

- Renewable Energy Engineering Nicholas Jenkins, Janaka Ekanayake Cambridge University Press, 2017.

Schedule

1st week Registration week	
2nd week: **Lecture:** The energetic position of Hungary. **Practice:** Discussing assignment.	**3rd week:** **Lecture:** Examining a Renewable Energy System in Practice. **Practice:** Returns calculation
4th week: **Lecture:** Factors affecting wind energy. Measuring wind energy. **Practice:** Wind energy calculations.	**5th week:** **Lecture:** Types of wind energy utilization. Efficiency, application examples. **Practice:** Wind energy calculations.
6th week: **Lecture:** The utilization of biomass in the building engineering. The concept and types of biomass. The process of gasification and firing of wood, combustion phases, chemical process, emission of pollutants. **Practice:** Sizing the Biomass Storage.	**7th week:** **Lecture:** Overview of biomass-based heat producers: traditional solid-fired heat producers, wood-gasifiers and pellet fireplaces, boilers. **Practice:** Sizing the buffer container.
8th week: 1st drawing week	

9th week: **Lecture:** Harnessing method of the geothermal heat. **Practice:** Lindal diagram editing.	10th week: **Lecture:** Direct geothermal harnessing systems. **Practice:** Design of a direct geothermal harnessing systems.
11th week: **Lecture:** Solar panels. The structure, operating principle and types of solar collectors. The structure, operating principle and types of solar collectors. Concept of Efficiency and Coverage Rate. **Practice:** Dimensional principles. Solar collector system design example for selective level collector and vacuum tube collector.	12th week: **Lecture:** Solar systems: DHW heating, heating and swimming pool heating applications. **Practice:** Sizing the DHW storage
13th week: **Lecture:** Solar cell types. Factors influencing energy production. **Practice:** Dimensional principles. Inverter selection.	14th week: **Lecture:** Parts of a photovoltaic system. Application examples. **Practice:** Efficiency of solar cells, switches, diagrams.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at the lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

The course ends in a written end-term test.

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Recovery Systems of Renewable Energy Sources II

Code: MK5MEF2L03KX17-EN

ECTS Credit Points: 3

Evaluation: exam

Year, Semester: 2nd year/2nd semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

Calculation of wind energy, solar energy, hydropower, geothermal energy potential. Adaptation of renewable energy harnessing devices to buildings. Knowledge of Primary Sizing and Application Limits. Optimizing Primary Energy Use. Small wind power plants, large solar systems, description of a spring water geothermal system.

Literature:

Required:

- Renewable Energy Engineering Nicholas Jenkins, Janaka Ekanayake Cambridge University Press, 2017.

Schedule

1st week Registration week	
2nd week: **Lecture:** The energetic position of Hungary. **Practice:** Examining a Renewable Energy System in Practice.	**3rd week:** **Lecture:** Factors affecting wind energy. Measuring wind energy. **Practice:** Discussion of the task to be addressed.
4th week: **Lecture:** Types of wind energy utilization. Efficiency, application examples. **Practice:** Returns calculation.	**5th week:** **Lecture:** The utilization of biomass in the building engineering. Operation of the construction of biomass fired power plants and heat recovery systems. **Practice:** Wind energy calculations.
6th week: **Lecture:** Overview of biomass-based heat producers: traditional **Practice:** Sizing the Biomass Storage.	**7th week:** **Lecture:** Solid-fired heat producers, wood-gasifiers and pellet fireplaces, boilers. **Practice:** Thermal water heating systems.
8th week: **Lecture:** Solar panels. Operation of large solar collector systems. Handling of idle	**9th week:** **Lecture:** Alternative types of solar collector systems, special applications.

problems
Practice: Operation of heat pumps.

10th week:

Lecture: Impact of solar cells on the national grid.

Practice: Use of solar systems in island mode.

Practice: Operation of heat pumps.

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

The course ends in a written end-term test.

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Near-natural and Cleaner Production Technologies

Code: MK5TKTTK03K117-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade

Year, Semester: 2nd year/1st semester

Number of teaching hours/week (lecture + practice): 1+2

Topics:

Students attending the course can get acquainted with the importance of near natural and cleaner production technologies. They get an overview about an approach, which takes into account impacts on the environment of a product or a service over its entire life cycle (Cleaner Production Options, Cleaner Production and its Relation to Other Similar-Sounding Concepts, Cleaner Production and Environmental Management

Systems,), that is from its design to its final disposal (e. g. Integrated Product Policy, Extended Producer Responsibility, Integrated Pollution Prevention and Control).

Students get knowledge about how to introduce the basic concepts of Clean Production (CP) and how CP can be applied in practice to be the benefit of industry, while they clarify several common misconceptions about CP. The subject also provides an overview of the main obstacles to successful CP policy development and how to mainstream Cleaner Production.

Within the frame of different kind of production technologies (e.g. paper production, biogas production; composting; poultry rearing; eco-farming; slaughterhouses and animal by-products; food, drink and milk industries) students get acquired with the implementation and operation of these technologies.

Literature:

Required:

- Lennart Nilsson, Per Olof Persson Lars Rydén, Siarhei Darozhka, Audrone Zaliauskiene (2005) Cleaner Production Technologies and Tools for Resource Efficient Production. The Baltic University. Environmental Management book series.
- Zainura Zainon Noor (ed.) INTRODUCTION TO CLEANER PRODUCTION Prepared by Universiti Teknologi Malaysia, Skudai, Johor.

Recommended:

- EUROPEAN COMMISSION (2015) Best Available Techniques (BAT) Reference Document for the Production of Pulp, Paper and Board.
- EUROPEAN COMMISSION (2017) Best Available Techniques (BAT) Reference Document for the Intensive Rearing of Poultry or Pigs
- EUROPEAN COMMISSION (2005) Reference Document on Best Available Techniques in the Slaughterhouses and Animal By-products Industries.
- EUROPEAN COMMISSION (2006) Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Food, Drink and Milk Industries
- Pawel Kazmierczyk (UNIDO CP Policy Consultant) (2002) Manual on the Development of Cleaner Production Policies—Approaches and Instruments, Guidelines for National Cleaner Production Centres and Programmes. UNIDO. Vienna.

Schedule

1st week Registration week	
2nd week: Lecture: Introduction into cleaner production. Industrial Impacts on the Environment. Practice: Case study.	3rd week: Lecture: Environmental management systems, environmental management tools, LCA. Practice: Environmental tools in decision support system, LCA in practice.

4th week: **Lecture:** CP policy development cycle **Practice:** Policy tools and instruments. Analyses, planning.	**5th week:** **Lecture:** Recent trends in CP policy. **Practice:** Background regulations.
6th week: **Lecture:** Promoting Cleaner Production **Practice:** Case studies, corporate social responsibility.	**7th week:** **Lecture:** air-water-soil pollution reduction, energy conservation, waste reduction. **Practice:** Case studies - Sustainability reports.
8th week: 1st drawing week	
9th week: **Lecture:** Green engineering, cleaner production practices. **Practice:** Case study, analyses in practice, end of pipe and clean(er) technologies.	**10th week:** **Lecture:** Food industry. **Practice:** Best available techniques, case studies.
11th week: **Lecture:** Intensive rearing of poultry, slaughterhouses and animal by-products industries. **Practice:** BAT technologies.	**12th week:** **Lecture:** Biogas production. **Practice:** BAT for biogas production.
13th week: **Lecture:** Eco-farming. **Practice:** Eco-farming in practice (cop production, animal husbandry).	**14th week:** **Lecture:** Production of paper. **Practice:** Paper production technologies. BAT technologies.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

The course ends in a written end-term test.

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5). If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Complex Environmental Engineer Planning I

Code: MK5KKP1K03KX17-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade

Year, Semester: 2nd year/2nd semester

Number of teaching hours/week (lecture + practice): 0+3

Topics:

Within the framework of this course, students learn about the identification, characterization, assessment and resolution of complex environmental and environmental engineering tasks.

They acquire knowledge of the software needed to solve complex problems. By using the software, they are able to solve concrete practical situations.

Literature:

Recommended:

- Ruth E Weiner, Robin A. Matthews: Environmental Engineering (Fourth Edition), Elsevier, 2003
- Shroder, John F and Sivanpillai, Ramesh: Biological and Environmental Hazards, Risks, and Disasters, Elsevier, 2015
- Software manuals

Schedule

1st week: **Practice:** Fundamentals of financial planning.	**2nd week:** **Practice:** Static methods for evaluating investment projects, managing the time value of money.
3rd week: **Practice:** Decision rules, calculations, sample tasks.	**4th week:** **Practice:** Dynamic Project Evaluation (Sensitivity Testing).
5th week: **Practice:** Dynamic Project Evaluation (Profit Threshold Analysis).	**6th week:** **Practice:** Dynamic Project Evaluation (Monte-Carlo Simulation, Decision Tree Method).

7th week:	8th week:
Practice: Complex tasks.	**Practice:** Complex tasks.
9th week:	10th week:
Practice: Complex tasks.	**Practice:** Test.

Requirements

A, for a signature:

Attending practices is compulsory. Students have to attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date being discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to submit one **home assignment** as scheduled minimum at a sufficient level.

During the semester, there is a **test**: the end-term test on the 10th week. Students have to sit for the tests and earn at least 51% of the maximum points.

B, for a grade:

The grade is determined based on the test points. The minimum requirement is 51% of the total points. Based on the score of the tests, the grade for the course is given according to the following (score/grade): 0-50 = fail (1); 51-62 = pass (2); 63-75 = satisfactory (3); 76-88 = good (4); 89-100 = excellent (5).

If the score of the test is below 50, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Complex Environmental Engineer Planning II

Code: MK5KKP2K03KX17-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade

Year, Semester: 2nd year/2nd semester

Number of teaching hours/week (lecture + practice): 0+3

Topics:

Within the framework of this course students study and practice about the resolution of complex environmental and environmental engineering tasks

They acquire knowledge of the MATLAB software needed to solve complex problems. By using the software, they are able to solve concrete practical situations of the field environmental engineering.

Literature:

Recommended:

- Christie G. Geonkopéis: Transport Processes and Separation Processes Principles (Includes Unit Operations) Forth Edition, 2008. ISBN 0-13-101367-X
- H. Scott Fogler: Elements of Chemical Reacton Engineering. Fourth Edition, 2006. Personal Education International. ISBN 0-13-127839-8
- Waren L.McCabe, Julian C Smith, Peter Harriott: Unit Operations of Chemical Engineering. Seventh Edition, McGraw Hill Higher Edition. 2005. ISBN 007-12-4710-6
- H. F. Hemond, E. J. Fechner-Levy: Chemical Fate and Transport in Environment. Second Edition, 2000. AP. ISBN-13: 978-0-12-340275-2.
- Bruce E. Logan: Environmental Transport Processes. JohnWiley and Son Inc. 1999. ISBN: 0-471-18871-9.
- Ekkehard Holzbecher: Environmental Modeling Using MATLAB, Springer, 2007. ISBN978-3-540-72936-5
- Ruth E Weiner, Robin A. Matthews: Environmental Engineering (Fourth Edition), Elsevier, 2003
- Shroder, John F and Sivanpillai, Ramesh: Biological and Environmental Hazards, Risks, and Disasters, Elsevier, 2015

Schedule

1st week: **Practice:** Field of complex environmental engineering planning.	2nd week: **Practice:** Fundamentals of environmental technique, environmental technology and economics.
3rd week: **Practice:** Environmental remediation.	4th week: **Practice:** Removal of pollutions and contaminants from environmental media.
5th week: **Practice:** Remediation technologies: ex-situ and in-situ methods.	6th week: **Practice:** Ex-situ methods of remediation of soils. Extraction of contaminated groundwater and treatment at the surface.
7th week: **Practice:** In-situ methods of remediation of soils and groundwater. Remediation of oil-contaminated soil or sediments.	8th week: **Practice:** Complex tasks.
9th week:	10th week:

Practice: Complex tasks.	**Practice:** Test.

Requirements

A, for a signature:

Attending practices is compulsory. Students have to attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date being discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to submit one **homework assignment** as scheduled minimum at a sufficient level.

During the semester there is a **test**: the end-term test in the 10th week. Students have to sit for the tests and earn at least 51% of the maximum points.

B, for a grade:

The grade is determined on the basis of the test points. The minimum requirement is 51% of the total points. Based on the score of the tests, the grade for the course is given according to the following (score/grade): 0-50 = fail (1); 51-62 = pass (2); 63-75 = satisfactory (3); 76-88 = good (4); 89-100 = excellent (5).

If the score of the test is below 50, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Subject group "Differentiated Professional Subjects" for
Built Environment Specialization

Urban Climate

Code: MK5VKLTK03K217_EN

ECTS Credit Points: 3

Evaluation: exam

Year, Semester: 2nd year/1st semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

Terminology of urban climatology; spatial and temporal extent and dynamics of urban climate, structure of urban atmosphere; the reasons of the development of urban climate;

the modifications of the composition and pollution of the urban atmosphere are discussed in the frame of the lectures. Energy and water budgets of the urban surfaces, modifications in air humidity and precipitation in build-up areas; the urban heat island, its relationships to settlement size and morphology are examined. The heat island circulation is presented. Anthropogenic heat emissions from buildings with the dynamic balance of the heating season and positive feedbacks of the non-heating season; effects of urban green areas and issues of street comfort are discussed.

Methods of urban climate research, meteorological instruments used for urban climate measurements; tools for urban climate modelling; application of results of urban climate research in spatial planning are discussed in the frame of the practice.

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Literature:

Required:

- T. R. Oke: Boundary Layer Climates. Routledge (1997) ISBN-10: 0415043190
- T. R. Oke, G. Mills, A. Christen, J. A. Voogt: Urban climate Cambridge University Press (2017) ISBN-10: 1107429536

Recommended:

- R. G. Barry, P. D. Blanken: Microclimate and Local Climate Cambridge University Press; (2016) ISBN-10: 1107145627

Schedule

1st week Registration week	
2nd week: Lecture: Terminology of urban climatology. Vertical structure of the urban boundary layer. Practice: Spatial and temporal scales of urban climate research. .	3rd week: Lecture: Diurnal and annual dynamics of urban climate processes. Practice: Urban climate measurement: in situ measurement methods and instruments.
4th week: Lecture: Reasons of the development of urban climate 1, modifications in the urban energy budget. Practice: Urban climate measurement techniques 2: remote sensing techniques.	5th week: Lecture: The reasons of the development of urban climate 2, modifications in the urban water budget. Practice: Methods and instruments for the determination of the sky view factor.
6th week: Lecture: The reasons of the development of urban climate 3: the role of urban geometry. Practice: Tools for urban climate/human bioclimate modelling 1: the RayMan software.	7th week: Modifications of the composition and pollution of the urban atmosphere, urban air quality and its effects on urban climate. Lecture:

	Practice: Tools for urban climate/human bioclimate modelling: the ENVIMET software.
8th week: 1st drawing week	
9th week: **Lecture:** Modifications of the climate parameters in build-up spaces 1: air humidity, precipitation and fog. **Practice:** urban climate models 1: urban radiation, energy and water budget models.	**10th week:** **Lecture:** Modifications of the climate parameters in build-up spaces 2: the spatial and temporal dynamics of the urban heat island. Their relationships to settlement size and morphology. **Practice:** urban climate models 2: urban heat island models.
11th week: **Lecture:** Modifications of the climate parameters in build-up spaces 3: urban winds, heat island circulations. **Practice:** Urban climate models 3: urban air flow and dispersion models.	**12th week:** **Lecture:** Anthropogenic heat emissions from buildings; dynamic energy balance of the heating season and positive feedbacks of the non-heating season. **Practice:** Use of results of urban climate measurements and modelling (case studies) 1.
13th week: **Lecture:** Impacts of green spaces on urban climate, park climates. Effects of urban climate on human comfort and health. **Practice:** Use of results of urban climate measurements and modelling (case studies) 2.	**14th week:** **Lecture:** Opportunities in urban climate mitigation and modification on micro and local scale. **Practice:** Tools, techniques and best practises of urban climate modification.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

The course ends in a written end-term test.

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Urban Hydrology

Code: MK5VHDRK03K217-EN

ECTS Credit Points: 3

Evaluation: exam

Year, Semester: 2nd year/2nd semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

The main aim of this course is to recognize modified effects of urban environment to the elements of hydrological cycle. Students learn the opportunities (tools and technologies), which are ideal to moderate the anthropogenic effects of urban hydrology. Students learn about drinking water and waste water supply and treatment. Students recognize the modern technologies, which provide opportunities to plan the defence of hydrological extremes in urban environment.

The main aim of this practice is to know the calculation options of urban hydrological elements of water balance. Students can use such modern remote sensing data, which provide the more effective examination of urban water cycle.

Literature:

Required:

- Kibler, D. F. (1991): Urban Stormwater Hydrology (Water Resources Monograph). 1st edition. American Geophysical Union. 271 p. (ISBN: 978-087-590-308-8)
- Lyon, J. G. (2002): GIS for Water Resource and Watershed Management. CRC Press. 274 p. (ISBN: 978-041-528-607-7)

Recommended:

- Watershed Management and Socio-Economic Aspects. Springer International Publishing. 370 p. (ISBN: 978-3-319-40194-2)
- Wang, L., (2013): Urban Waste Management. [In. Yao, R. (ed.): Design and Management of Sustainable Built Environments.] Springer London. 141-156 p. (ISBN: 978-144-714-780-0)

Schedule

1st week Registration week	
2nd week:	3rd week:

Lecture: The natural and urban water cycles.

Practice: Calculation of water balance.

Lecture: Climatic conditions in an urban area (Precipitation and Evapotranspiration).

Practice: Preparation of precipitation prediction.

4th week:

Lecture: Climatic conditions in an urban area (Runoff and Infiltration).

Practice: Calculation of evaporation and transpiration. Estimation of surface runoff.

5th week:

Lecture: Urbanization effect to the groundwater and surface water hydrology.

Practice: Watershed characterization.

6th week:

Lecture: Modified effects of urban environment to the elements of hydrological cycle and those moderation opportunities.

Practice: Inland water management in urban areas (estimation of specific discharge of excess water).

7th week:

Lecture: Chronological development of urban hydrology.

Practice: Inland water management in urban areas (planning of open drain system for removing excess surface water).

8th week:

Lecture: Satisfying (national and international) water demands. Waste water treatment (natural technologies and processes).

Practice: Using high spatial resolution LiDAR data in urban hydrology (database management).

9th week:

Lecture: Obtaining, purification, delivery and distribution of drinking water. Remote sensing data in urban hydrology.

Practice: Using high spatial resolution LiDAR data in urban hydrology (digital elevation model – DEM) I.

10th week:

Lecture: Urban drainage and waste water treatment. GIS in urban hydrology (relationship of water sector and urban planning).

Practice: Using high spatial resolution LiDAR data in urban hydrology (digital elevation model – DEM) II.

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to

be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

The course ends in a written exam test.

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Air Pollution Control

Code: MK5LETVK03K217-EN

ECTS Credit Points: 3

Evaluation: exam

Year, Semester: 2nd year/1st semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

Air pollution control. Emission, transport, receptors. Units and standards. Air pollution effects on human health, property and visibility. Air pollution measurements, emission estimates. Meteorology for environmental engineers. Air pollutant concentration models (Fixed-box models, diffusion models, long-term average applying Guassian Plume models etc.). General ideas in air pollution control. The nature of particulate pollutants (Primary and secondary particulates. Settling velocity and drag forces. Particle size distribution functions, Particles in our bodies). The motor vehicles problem. Air pollutants and global climate. Persistent organic compounds. Indoor air pollution. The radon problem. Environmental impact of waste-to-energy. The odour problem.

Literature:

Required:

- Noel de Nevers: Air Pollution Control Engineering, (Third Edition, 2017) ISBN 978-1-4786-2905-4
- Lev S. Ruzer and Naomi H. Harley: Aerosol Handbook: Measurement, Dosimetry, and Health Effects, (Second Edition, 2013) ISBN 978-1-4398-5510-2

Recommended:

- Kalogirou, Efstratios N.: Waste-to-energy technologies and global applications, ISBN 9781315269061.

Schedule

1st week Registration week	
2nd week: **Lecture:** Air pollution control. Emission, transport, receptors. Units and standards. **Practice:** Calculations.	3rd week: **Lecture:** Air pollution effects on human health, property and visibility. Animal experiments. Short-term exposure of human volunteers. Epidemiology. Regulations to protect human health. **Practice:** Calculations.
4th week: **Lecture:** Air pollution control laws and regulations, and air pollution control philosophies. Air quality standards. Regional problems. Emission trading. **Practice:** Problems and examples.	5th week: **Lecture:** Air pollution measurements, emission estimates. Representative sample. Getting the representative sample to the detector. Concentration determination. Averaging. Standard analytical methods. Determining pollutant flow rates. Isokinetic sampling. Emission factors. Visible emissions. **Practice:** Calculations.
6th week: **Lecture:** Meteorology for environmental engineers. Horizontal and vertical motion in the atmosphere. Winds. Temperature inversions. **Practice:** Calculations.	7th week: **Lecture:** Air pollutant concentration models: Fixed-box models. Diffusion models. Long-term average applying Guassian Plume models. Pollutant creation and decay in the atmosphere. Multiple cell multispecies models. Receptor-oriented and source-oriented air pollution models. **Practice:** Examples.
8th week: 1st drawing week	
9th week: **Lecture:** General ideas in air pollution control. Alternatives. Resource recovery. The nature of particulate pollutants: Primary and secondary particulates, Settling velocity and drag forces, Particle size distribution functions, Particles in our bodies **Practice:** Calculations.	10th week: **Lecture:** Environmental impact of Waste-to-Energy. Emissions. Properties and toxicity. Prevention and abatement. Sources and health effects. **Practice:** Problems and examples.
11th week: **Lecture:** The motor vehicles problem. Air pollutants and global climate. **Practice:** Problems and examples.	12th week: **Lecture:** Persistent organic compounds. **Practice:** Calculations.
13th week:	14th week:

Lecture: Indoor air quality. The radon problem. **Practice:** Problems and examples.	**Lecture:** The main odour problems. **Practice:** Problems and examples.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at the lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

The course ends in a written end-term test.

The minimum requirement of the end-term test is 51%. The grade is given according to the following (score/grade): 0-50 = fail (1); 51-62 = pass (2); 63-75 = satisfactory (3); 76-88 = good (4); 89-100 = excellent (5).

If the score of the test is below 50%, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Bridges and Structures

Code: MK5TAR1S3TX17-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade

Year, Semester: 2st year, 1st semester

Number of teaching hours/week (lecture + practice): 2 + 0

Topics:

History of bridges. Bridges classes. Norms and preliminary works. Foundations, substructures and equipment. Dilatations. Structure and building techniques of steel bridges. Steel beam bridges. Steel frame, arch and suspension bridges. Orthotropic plates. Structure and building techniques of concrete bridges. Concrete beam, frame and arch bridges. Prestressing techniques. Precast pretensioned girder bridges. Concrete box girders. Structures and building techniques of cable-stayed bridges. Composite and timber bridges. Test loading, monitoring and maintenance and strengthening techniques. Reservoirs, bunkers water-towers.

Literature:

Required:

- M. J. Ryall, G. A. R. Parke, J. E. Harding (2000): The Manual of Bridge Engineering, Thomas Telford
- H. G. Tyrrell (2008): History of Bridge Engineering; Stubbe Press

Recommended:

- *fib Bulletin* N° 39. Seismic bridge design and retrofit - structural solutions. State-of-art report (300 pages, ISBN 978-2-88394-079-6, May 2007).
- *fib Bulletin* N° 32. Guidelines for the design of footbridges. Guide to good practice (160 pages, ISBN 978-2-88394-072-7, November 2005).
- *fib Bulletin N° 30. Acceptance of stay cable systems using prestressing steels. Recommendation (80 pages, ISBN 978-2-88394-070-3, January 2005)*
- *fib Bulletin* N° 29. Precast concrete bridges. State-of-art report (84 pages, ISBN 978-2-88394-069-7, November 2004).
- *fib Bulletin* N° 9. Guidance for good bridge design. Part 1 – Introduction. Part 2 – Design and construction aspects. Guide to good practice (190 pages, ISBN 978-2-88394-049-9, July 2000).

Schedule

1st week Registration week	
2nd week: **Lecture:** History of bridges. Bridges classes.	3rd week: **Lecture:** Norms and preliminary works.
4th week: **Lecture:** Foundations, substructures and equipment. Dilatations.	5th week: **Lecture:** Structure and building techniques of steel bridges. Steel beam bridges.
6th week: **Lecture:** Steel frame, arch and suspension bridges. Orthotropic plates.	
8th week: **Lecture:** Structure and building techniques of concrete bridges. Concrete beam, frame and arch bridges.	9th week: **Lecture:** Prestressing techniques. Precast pretensioned girder bridges. Concrete box girders. Reservoirs, bunkers water-towers.
10th week: Structures and building techniques of cable-stayed bridges. Composite and timber bridges. Test loading, monitoring and maintenance and strengthening techniques.	

Requirements

Participation at **lectures** is **compulsory**. Students have to attend lectures and may not miss more than three occasions during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Attendance at the lectures will be recorded by the staff of the department. Being late counts as an absence.

In case of further absences, a medical certificate needs to be presented. Students are required to bring calculators and the printed materials of the lectures to each class. Active participation is evaluated by the teacher in every class. Active student participation should be required. Students have to **submit the test and the presentation** as scheduled minimum at a sufficient level.

A, for a signature:

Students have to reach at least 40 points from the 60 points on the test and at least 21 points from the 40 points on presentation. The presentation has to be handed in personally. One will get questions about the presentation.

B, for a mid-semester grade:

The course ends with a mid-semester grade. Based on the summa points of the test and the presentation, the mid-semester grade is defined in the following way:

Test:	Maximum:	**60 points**	Minimum:	**40 points**
Homework:	Maximum:	**40 points**	Minimum:	**21 points**
Summa points:	Maximum:	**100 points**	Minimum:	**61 points**

Score/Grade: 0-60 = fail (1); 61-70 = pass (2); 71-80 = satisfactory (3); 81-90 = good (4); 91-100 = excellent (5).

Noise and Vibration Protection

Code: MK5ZRVDK04K217-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 2nd year/1st semester

Number of teaching hours/week (lecture + practice): 1+3

Topics:

The theoretical part of the subject encompasses the following topics: The concept of noise. Basic Concepts. Levels. Frequency distribution. Sound propagation in the free space. Indoor propagation. Room acoustics. Sound absorption, reverberation. Sense acoustics. Strategic noise maps. Mechanical vibrations. Human vibrations.

Practice: noise and vibration measurements, calculations and noise mapping.

Literature:

Required:

- Enda Murphy and Eoin King: Environmental Noise Pollution, 2014, ISBN: 978-0-12-411595-8
- Lawrence K. Wang, Norman C. Pereira, Yung-Tse Hung: Advanced Air and Noise Pollution Control, 2007, ISBN 1-59259-779-3

Recommended:

- M. P. Norton and D. G. Karczub: Fundamentals of Noise and Vibration Analysis for Engineers, 2003

Schedule

1st week Registration week	
2nd week: **Lecture:** The concept of noise. Basic Concepts. Levels. Operations with levels. **Practice:** Free space calculations.	3rd week: **Lecture:** Frequency analysis (octave, 1/3 octave bands, FFT). **Practice:** Free space calculations.
4th week: **Lecture:** Free space propagation, modifying terms. **Practice:** Indoor propagation calculations.	5th week: **Lecture:** Point, line, and surface sound sources. **Practice:** Indoor propagation calculations.
6th week: **Lecture:** Indoor propagation. Sound absorption, reverberation time, energy distribution in enclosed space. **Practice:** Noise measurements and instruments.	7th week: **Lecture:** Acoustic insulation, noise reduction. **Practice:** Noise measurements and instruments.
8th week: 1st drawing week	
9th week: **Lecture:** Effects on humans. Sense acoustics. Phon, Son. Fletcher-Munson curves. Filters. **Practice:** Test.	10th week: **Lecture:** Noise measurement and instruments. Environmental Noises, measurement backgrounds. **Practice:** Vibration measurements and instruments.
11th week: **Lecture:** Noise maps (strategic, environmental). **Practice:** Vibration measurements and instruments.	12th week: **Lecture:** Basic concepts of vibration. **Practice:** Noise mapping.
13th week: **Lecture:** Human vibrations. **Practice:** Noise mapping.	14th week: **Lecture:** Workplace vibration measurement (instruments, sensors). Modes of vibration reduction. **Practice:** Test.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance at **lectures** is recommended, but not compulsory.

Attending practices is compulsory. Students has to attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date previously discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to submit two **reports** as scheduled minimum at a sufficient level.

During the semester there are two **tests**: a mid-term test around the 8th week and an end-term test in the 15th week. Students have to sit for the tests and earn at least 51% of the maximum points.

B, for a grade:

The grade is determined on the basis of the total points of the two mid-semester tests. The minimum requirement is 51% of the total points. Based on the score of the tests, the grade for the course is given according to the following (score/grade): 0-50 = fail (1); 51-62 = pass (2); 63-75 = satisfactory (3); 76-88 = good (4); 89-100 = excellent (5).

If the score of the test is below 50, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Waste Management

Code: MK5HUGKK03K217-EN

ECTS Credit Points: 3

Evaluation: exam

Year, Semester: 2nd year/2nd semester

Number of teaching hours/week (lecture + practice): 2+1

Topics:

Legislation and regulation of waste types. Municipal solid waste (MSW), hazardous waste, sewage sludge, other waste types. Life cycling analysis of materials recycling. Green engineering and sustainable design aspects. Integrated waste management strategies. Waste containers, collection systems, transport. The logistics of solid waste collection. Types of collection systems, equipment, and personnel requirements.

European Union waste management policy, waste strategy in the EU. The economics of waste management. Options of waste treatment and disposal. Waste landfill, types of waste landfilled. Waste incineration, incineration technologies. Other waste treatment technologies: pyrolysis, gasification, composting, anaerobic digestion. Composting of municipal solid wastes. Environmental, public, and industrial health considerations. Hazardous waste definition, classification and generation.

Literature:

Required:

- Jerry A. Nathanson, Richard A. Schneider: Basic Environmental Technology: Water Supply, Waste Management and Pollution Control. Prentice Hall (6th Edition, 2015), 456 pages, ISBN-13: 9780132840149
- George Tchobanoglous and Frank Kreith: Handbook of Solid Waste Management. McGraw-Hill Education (2nd edition, 2002), 950 pages, 2002, ISBN-13: 9780071356237

Recommended:

- Paul T. Williams, Waste Treatment and Disposal. John Wiley & sons, Ltd. (2nd edition, 2005), 392 pages, ISBN-13: 9780470849132
- Trevor Letcher, Daniel Vallero: Waste: A Handbook for Management. Academic Press (1st edition, 2011), 604 pages, ISBN 9780123814753
- Alireza Bahadori: Waste Management in the Chemical and Petroleum Industries, Wiley, 2013. ISBN: 978-1-118-73175-8

Schedule

1st week Registration week	
2nd week: **Lecture:** The current situation and challenges of waste management in the world. Environmental, public, and industrial health considerations. **Practice:** Progress and challenges to the global waste management system.	3rd week: **Lecture:** Legislation and regulation of types. European Union waste management policy, waste strategies. **Practice:** Challenges in legislation, recycling system and technical system of waste electrical and electronic equipment in China.
4th week: **Lecture:** Options of waste treatment and disposal. The economics of waste management. Waste management plans. **Practice:** Toward the implementation of new regional biowaste management plans: Environmental assessment of different waste management scenarios in Catalonia.	5th week: **Lecture:** The logistics of solid waste collection. Waste containers, types of collection systems, equipment, and personal requirements. **Practice:** Municipal solid waste collection optimization in Singapore.
6th week: **Lecture:** Waste landfill, types of waste landfilled. Landfills for hazardous waste, for non-hazardous waste, and for inert waste. **Practice:** Modelling of energy consumption and environmental life cycle	7th week: **Lecture:** Waste incineration, incineration technologies. Negative effects on the environment caused by the incineration of waste. Operational conditions, technical requirements, and emission

assessment for incineration and landfill systems of municipal solid waste management - A case study in Tehran Metropolis of Iran.

8th week:

Lecture: Life cycling analysis of materials recycling. Recyclable materials, municipal recycling facilities. Turning waste into a resource and build up a circular economy. Green engineering and sustainable design aspects. Integrated waste management strategies.

Practice: A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems.

10th week:

Lecture: Other waste treatment technologies: pyrolysis, gasification. Shipment of waste around the world. Waste from the chemical industry, their handling and utilization.

Practice: Comparative assessment of municipal sewage sludge incineration, gasification and pyrolysis for a sustainable sludge-to-energy management in Greece.

limit values for incineration and co-incineration plants.

Practice: Waste to energy – key element for sustainable waste management.

9th week:

Lecture: Composting, anaerobe digestion. Composting of municipal solid wastes. Treatment methods for biodegradable waste. Processing and utilization of plastic and rubber wastes, degradable plastics and their significance in waste management.

Practice: Comparison of organic waste management systems in the Danish–German border region using life cycle assessment (LCA).

Requirements

A, for a signature:

Attending practices is compulsory. Attendance at lectures is recommended. Students have to attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes have to be made up for at a later date previously discussed with the tutor.

B, for a grade:

The course ends in a written end-term test.

The minimum requirement of the end-term test is 60%. The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

If the score of the test is below 60, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Greenfield Management

Code: MK5KOR1S03TX17-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade

Year, Semester: 2nd year, 2nd semester

Number of teaching hours/week (lecture + practice): 2 + 0

Topics:

The main goal of the course is to introduce the greenfield types and their management as these areas and objects can help to manage the environmental challenges – including climate change induced pressures (e.g. flash floods) and pollution - of urban areas in a sustainable and cost effective way.

Therefore, students get basic knowledge on greenfield systems, their multifunctional values and benefits as well as on anthropogenic impacts on urban green surfaces. By introducing techniques and strategies for improving urban ecological sustainability, along with good practices and weak solutions, students will be able to understand the importance of integrated greenfield, urban and landscape management.

The greenfield management and ecological planning courses side by side provide an integrated approach and knowledge on sustainable urban management.

Literature:

Required:

- John W. Dover, Green infrastructure, *Incorporating plants and enhancing biodiversity in buildings and urban environments*, Routledge Taylor and Francis Group, London and New York, 2015, ISBN 978-0-415-52123-9
- Kimberly Etingoff, Urban Ecology, *Strategies for Green Infrastructure and Land Use*, Apple Academic Press Taylor and Francis Group, Oakville, Canada, 2016, ISBN: 13: 978-1-77188-281-1

Recommended:

- Green space strategies, *a good practice guide*, Commission for the Architecture and Built Environment, UK, London, 2004 pp. 44
- GreenKeys Manual, A Strategy for urban green space (2008), URL: https://www.ioer.de/greenkeys/Greenkeys_Tools/manual.htm
- Harnik, P., Urban Green, *Innovative Parks for Resurgent Cities*, Island Press, Washington DC, 2010, pp. 208
- Palazzo, D. and Steiner, F. R., Urban Ecological Design, *A Process for Regenerative Spaces*, Island Press, Washington DC, 2011, pp. 328

Schedule

1st week Registration week	
2nd week:	3rd week:

Lecture: Introduction to greenfield types and functions.	**Lecture:** Green roofs and green walls.
4th week: **Lecture:** Urban ecosystems and the city as ecosystem.	**5th week:** **Lecture:** Ecosystem services of various greenfield systems.
6th week: **Lecture:** Impacts of green areas on urban climate and air quality.	**7th week:** **Lecture:** Impacts of green areas on the urban hydrological cycle. Green solutions.
8th week: 1st drawing week	Visiting the "passive house" of the university.
9th week: **Lecture:** Impacts of green areas on human health and well-being.	**10th week:** **Lecture:** Anthropogenic pressures and impacts on green fields.
11th week: **Lecture:** Sustainable management and development strategies for greenfield.	**12th week:** **Lecture:** Green Infrastructure Strategy – a new approach.
13th week: **Lecture:** Best practices and weak solutions around the world.	**14th week:** **Lecture:** Visiting Debrecen's different greenfield types.
15th week: 2nd drawing week: TEST	

Requirements

A, for a signature:

Participation at practice is compulsory. Students have to attend practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up a practice with another group. Attendance at practice will be recorded by the practice leader Students write a test at the end of the semester, and present the result of their group work carried out during the course.

Test: maximum: 100 points, minimum: 60 points

B, for grade:

The grade of the test and the presentation defining the mid semester grade.

The grade is given according to the following (score/grade): 0-59 = fail (1); 60-69 = pass (2); 70-79 = satisfactory (3); 80-89 = good (4); 90-100 = excellent (5).

Complex Environmental Engineer Planning I

Code: MK5KKP1K03KX17-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade

Year, Semester: 2nd year/1st semester

Number of teaching hours/week (lecture + practice): 0+3

Topics:

Within the framework of this course, students study and practice the resolution of complex environmental problems and environmental engineering tasks.

Literature:

Required:

- Myer Kutz: Handbook of Environmental Engineering, Third Edition, 2018. Wiley Publisher, ISBN 13:9781119304401

Recommended:

- Christie G. Geonkopéis: Transport Processes and Separation Processes Principles (Includes Unit Operations) Forth Edition, 2008. ISBN 0-13-101367-X
- H. Scott Fogler: Elements of Chemical Reacton Engineering. Forth Edition, 2006. Personal Education International. ISBN 0-13-127839-8
- Waren L.McCabe, Julian C Smith, Peter Harriott: Unit Operations of Chemical Engineering. Seventh Edition, McGraw Hill Higher Edition. 2005. ISBN 007-12-4710-6
- H. F. Hemond, E. J. Fechner-Levy: Chemical Fate and Transport in Environment. Second Edition, 2000. AP. ISBN-13: 978-0-12-340275-2.
- Bruce E. Logan: Environmental Transport Processes. JohnWiley and Son Inc. 1999. ISBN: 0-471-18871-9.
- Ekkehard Holzbecher: Environmental Modeling Using MATLAB, Springer, 2007. ISBN978-3-540-72936-5
- Ruth E Weiner, Robin A. Matthews: Environmental Engineering (Fourth Edition), Elsevier, 2003
- Shroder, John F and Sivanpillai, Ramesh: Biological and Environmental Hazards, Risks, and Disasters, Elsevier, 2015

Schedule

1st week Registration week	
2nd week: **Practice:** Environmental Systems Analysis Methods. Measurements in Environmental Engineering.	3rd week: **Practice:** Climate Modeling. Climate Change Impact Analysis for the Environmental Engineer. Adaptation Design to Sea Level Rise.
4th week: **Lecture:** Soil Physical Properties and Processes.	5th week: **Practice:** In Situ Soil and Sediment Remediation: Electrokinetic and Electrochemical Methods.

6th week: **Practice:** Natural or "Conventional" Water Quality Problems.	7th week: **Practice:** Wastewater Engineering. Wastewater Recycling.
8th week: 1st drawing week	
9th week: **Practice:** Design of Porous Pavements for Improved Water Quality and Reduced Runoff.	10th week: **Practice:** Air Pollution Control Engineering.
11th week: **Practice:** Waste Minimization and Reuse Technologies. Waste Reduction in Metals Manufacturing.	12th week: **Practice:** Industrial Waste Auditing.
13th week: **Practice:** Complex tasks.	14th week: **Practice:** Test
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attending practices is compulsory. Students have to attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date being discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to submit one **homework assignment** as scheduled minimum at a sufficient level.

During the semester there is a **test:** the end-term test in the 14th week. Students have to sit for the tests and earn at least 51% of the maximum points.

B, for a grade:

The grade is determined on the basis of the test points. The minimum requirement is 51% of the total points. Based on the score of the tests, the grade for the course is given according to the following (score/grade):

- 0-50 = fail (1);
- 51-62 = pass (2);
- 63-75 = satisfactory (3);
- 76-88 = good (4);
- 89-100 = excellent (5).

If the score of the test is below 50, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Complex Environmental Engineer Planning II

Code: MK5KKP2K03KX17-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade

Year, Semester: 2nd year/2nd semester

Number of teaching hours/week (lecture + practice): 0+3

Topics:

Within the framework of this course, students study and practice the resolution of complex environmental and environmental engineering tasks.

They acquire knowledge of the MATLAB software needed to solve complex problems. By using the software, they become able to solve concrete practical situations on the field of environmental engineering.

Literature:

Recommended:

- Christie G. Geonkopéis: Transport Processes and Separation Processes Principles (Includes Unit Operations) Forth Edition, 2008. ISBN 0-13-101367-X
- H. Scott Fogler: Elements of Chemical Reacton Engineering. Forth Edition, 2006. Personal Education International. ISBN 0-13-127839-8
- Waren L.McCabe, Julian C Smith, Peter Harriott: Unit Operations of Chemical Engineering. Seventh Edition, McGraw Hill Higher Edition. 2005. ISBN 007-12-4710-6
- H. F. Hemond, E. J. Fechner-Levy: Chemical Fate and Transport in Environment. Second Edition, 2000. AP. ISBN-13: 978-0-12-340275-2.
- Bruce E. Logan: Environmental Transport Processes. JohnWiley and Son Inc. 1999. ISBN: 0-471-18871-9.
- Ekkehard Holzbecher: Environmental Modeling Using MATLAB, Springer, 2007. ISBN978-3-540-72936-5

- Ruth E Weiner, Robin A. Matthews: Environmental Engineering (Fourth Edition), Elsevier, 2003
- Shroder, John F and Sivanpillai, Ramesh: Biological and Environmental Hazards, Risks, and Disasters, Elsevier, 2015

Schedule

1st week: **Practice:** Field of complex environmental engineering planning.	2nd week: **Practice:** Fundamentals of environmental technique, environmental technology and economics.
3rd week: **Practice:** Environmental remediation.	4th week: **Practice:** Removal of pollutions and contaminants from environmental media.
5th week: **Practice:** Remediation technologies: ex-situ and in-situ methods.	6th week: **Practice:** Ex-situ methods of remediation of soils. Extraction of contaminated groundwater and treatment at the surface.
7th week: **Practice:** In-situ methods of remediation of soils and groundwater. Remediation of oil-contaminated soil or sediments.	8th week: **Practice:** Complex tasks.
9th week: **Practice:** Complex tasks.	10th week: **Practice:** Test.

Requirements

A, for a signature:

Attending practices is compulsory. Students have to attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students cannot make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date previously discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to submit one **homework assignment** as scheduled minimum at a sufficient level.

During the semester there is a **test**: the end-term test on the 10th week. Students have to sit for the tests and earn at least 51% of the maximum points.

B, for a grade:

The grade is determined based on the test points. The minimum requirement is 51% of the total points. Based on the score of the tests, the grade for the course is given according to the following (score/grade): 0-50 = fail (1); 51-62 = pass (2); 63-75 = satisfactory (3); 76-88 = good (4); 89-100 = excellent (5).

If the score of the test is below 50, students can retake that test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

DIPLOMA

The diploma shall be issued to the students within thirty days from having successfully passed the final exam at the grandaunt's special request. Otherwise, the diploma shall be awarded to him/her at the graduation ceremony of the Faculty.

The diploma is a public document bearing the coat of arms of the Hungary, certifying that the studies have been successfully completed in the Environmental Engineering master program. The diploma displays the name of the HEI (higher education institution), its institutional identification number, the serial number of diploma, the name and the place and date of birth of its holder, the level of qualification or the degree awarded, the program, the specialization, and its mode of attendance, as well as the place, day, month and year of issue. The diploma shall also contain the signature of the rector (in case of incapacitation the vice-rector), and shall bear the stamp of the University of Debrecen.

At the graduate's special request, a certificate on the completion of studies may be issued. The document does not contain any references to the qualification of the graduate, it merely proves that the he/she has taken a successful final exam. The Faculty shall keep a record of the certificates issued.

The diploma shall be assessed on the basis of the calculation of the grade average as follows:

Outstanding	4,81 – 5,00
Excellent	4,51 – 4,80
Good	3,51 – 4,50
Satisfactory	2,51 – 3,50
Pass	2,00 – 2,50

Honours Degrees/Diplomas

A degree/diploma with honours shall be issued to students who receive and excellent grade in all the subjects of the final exam, excellent grade for the thesis, the grade average of all their exam and seminar grades is 4.00. or better, and who do not have a grade lower than satisfactory (3) among his/her grades.

MODEL CURRICULUM OF ENVIRONMENTAL ENGINEERING MSC

ENVIRONMENTAL TECHNOLOGY, PLANNING, CONSTRUCTIONS SPECIALIZATION

The curriculum of the program is available in excel format on the webpage of the Faculty of Engineering (www.eng.unideb.hu/en)

University of Debrecen Faculty of Engineering

Environmental Engineer Master Program

Full-time training

Curriculum

Environmental Technology, Planning, Constructions Specialization

01/09/2019

Number	Subject Group	Subject' English name	Knowledge Group	Code	1st semester				2nd semester				3rd semester				4th semester				Prerequisite
					lecture	practice	evaluation	credit	lecture	practice	evaluation	credit	lecture	practice	evaluation	credit	lecture	practice	evaluation	credit	
1.	Natural Sciences (22 credits)	Mathematical modelling and optimization	**00**	MK5MMO1A04KX17-EN					2	2	msg	4									
2.		Applied Statistics	**00**	MK5AST1A04KX17-EN	2	1	msg	4													
3.		Environmental Chemistry and Environmental Toxicity		MK5KKTOK04KX17-EN					2	2	e	4									
4.		Environment Biology and Nature Protection		MK5KBTVK04KX17-EN	2	2	e	4													
5.		Ecology for Engineers		MK5MOKLK03KX17-EN					2	1	msg	3									
6.		Geosciences		MK5FDTIS03KX17-EN	2	0	msg	3													
7.	Economics and Humanities (10 credits)	Environmental Law and Economics		MK5KJGDK04KX17-EN	2	2	msg	4													
8.		Environmental and Quality Management		MK5KMMMM03KX17-EN	2	1	msg	3													
9.		Production Management and Life Cycle Analysis		MK5TMEEM03KX17-EN					2	1	e	3									
10.	Professional Knowledge of Environmental Engineering (24 credits)	Environmental Engineering Measurement Techniques, Monitoring		MK5KMMMK04KX17-EN					2	2	msg	4									
11.		Environmental Health		MK5KEGTK03KX17-EN					2	0	e	3									
12.		Environmental Modelling and Environmental Informatics		MK5KMKIK04KX17-EN	2	2	e	4													
13.		Environmental Operations		MK5KVMVK04KX17-EN	2	2	e	4													
14.		Environmental Resource Management		MK5KEGDK03KX17-EN					2	1	e	3									
15.		Environmental State Assessment, Auditing		MK5KAEAK03KX17-EN					2	1	e	3									
16.		Safety and Environmental Risk		MK5BTKKK03KX17-EN	2	0	msg	3													
17.	Specialization skills (28 credits)	Environmental Technologies I (Soil Protection)	**56**	MK5KVT1K03K117-EN									2	1	e	3					
18.		Environmental Technologies II (Water Protection)	**56**	MK5KVT2K03K117-EN													2	1	e	3	

19.		Environmental Technologies III (Air and Noise Protection)	**56**	MK5KVT3K03K117-EN									0	3	msg	3					
20.		Environmental Technologies IV (Waste Recycling)	**56**	MK5KVT4K03K117-EN													2	1	msg	3	
21.		Recovery Systems of Renewable Energy Sources I	**62**	MK5MEF1L04KX17-EN									2	1	e	4					
22.		Recovery Systems of Renewable Energy Sources II	**62**	MK5MEF2L03KX17-EN													2	1	e	3	
23.		Near-natural and Cleaner Production Technologies		MK5TKTTK03K117-EN									1	2	msg	3					
24.		Complex Environmental Engineer Planning I	**59**	MK5KKP1K03KX17-EN									0	3	msg	3					
25.		Complex Environmental Engineer Planning II	**59**	MK5KKP2K03KX17-EN													0	3	msg	3	
26.	Optional subjects (6 credits)	Optional subject I							0	2	msg	3									
27.		Optional subject II															0	2	msg	3	
28.	criteria subject	Physical Education			0	2	s	0													
29.	Thesis (30 credits)	Thesis I		MK5DPT1K15KX17-EN									0	10	msg	15					
30.		Thesis II		MK5DPT2K15KX17-EN													0	10	msg	15	
31.		Environmental Summer Professional Practice		MK5NSGYK00KX17-EN					4 weeks												

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Lecture/Practice	16	10			16	10			5	20			6	18		
Exam (e)			3				4				2				2	
Mid-semester grade (msg)			5				4				4				4	
Number of subjects			8				8				6				6	
Number of contact hours (without criteria subject)	26				26				25				24			
Credits				29				30				31				30
Total credit	**120**															

Final exam topics:

Prerequisites for final exam: Environmental status assessment and modelling; Environmental Protection II.

Specialized knowledge: Environmental Technology, Planning, Constructions

MODEL CURRICULUM OF ENVIRONMENTAL ENGINEERING MSC

BUILT ENVIRONMENT SPECIALIZATION

The curriculum of the program is available in excel format on the webpage of the Faculty of Engineering (www.eng.unideb.hu/en)

University of Debrecen Faculty of Engineering

Environmental Engineer Master Program

Built Environment Specialization

Full-time training

Curriculum

01/09/2019

Number	Subject Group	Subject' English name	Knowledge Group	Code	1st semester				2nd semester				3rd semester				4th semester				Prerequisite
					lecture	practice	evaluation	credit	lecture	practice	evaluation	credit	lecture	practice	evaluation	credit	lecture	practice	evaluation	credit	
1.	Natural Sciences (22 credits)	Mathematical modelling and optimization	**00**	MK5MMO1A04KX17-EN					2	2	msg	4									
2.		Applied Statistics	**00**	MK5AST1A04KX17-EN	2	1	msg	4													
3.		Environmental Chemistry and Environmental Toxicity		MK5KKTOK04KX17-EN					2	2	e	4									
4.		Environment Biology and Nature Protection		MK5KBTVK04KX17-EN	2	2	e	4													
5.		Ecology for Engineers		MK5MOKLK03KX17-EN					2	1	msg	3									
6.		Geosciences		MK5FDTIS03KX17-EN	2	0	msg	3													
7.	Economics and Humanities (10 credits)	Environmental Law and Economics		MK5KJGDK04KX17-EN	2	2	msg	4													
8.		Environmental and Quality Management		MK5KMMMM03KX17-EN	2	1	msg	3													
9.		Production Management and Life Cycle Analysis		MK5TMEEM03KX17-EN					2	1	e	3									
10.	Professional Knowledge of Environmental Engineering (24 credits)	Environmental Engineering Measurement Techniques, Monitoring		MK5KMMMK04KX17-EN					2	2	msg	4									
11.		Environmental Health		MK5KEGTK03KX17-EN					2	0	e	3									
12.		Environmental Modelling and Environmental Informatics		MK5KMKIK04KX17-EN	2	2	e	4													
13.		Environmental Operations		MK5KVMVK04KX17-EN	2	2	e	4													
14.		Environmental Resource Management		MK5KEGDK03KX17-EN					2	1	e	3									
15.		Environmental State Assessment, Auditing		MK5KAEAK03KX17-EN					2	1	e	3									
16.		Safety and Environmental Risk		MK5BTKKK03KX17-EN	2	0	msg	3													
17.	Specialization skills (28 credits)	Urban Climate		MK5VKLTK03K217-EN									2	1	e	3					
18.		Urban Hydrology	**56**	MK5VHDRK03K217-EN													2	1	e	3	
19.		Air Pollution Control	**56**	MK5LETVK03K217-EN									2	1	e	3					

20.		Bridges and Structures		MK5TAR1S03TX17-EN									2	0	msg	3					
21.		Noise and vibration protection	**56**	MK5ZRVDK04K217-EN									1	3	msg	4					
22.		Waste Management	**56**	MK5HUGKK03K217-EN													2	1	e	3	
23.		Greenfield Management		MK5KOR1S03TX17-EN													2	0	msg	3	
24.		Complex Environmental Engineer Planning I	**59**	MK5KKP1K03KX17-EN									0	3	msg	3					
25.		Complex Environmental Engineer Planning II	**59**	MK5KKP2K03KX17-EN													0	3	msg	3	
26.	Optional subjects (6 credits)	Optional subject I.							0	2	msg	3									
27.		Optional subject II.															0	2	msg	3	
28.	Criteria subject	Physical Education			0	2	s	0													
29.	Thesis (30 credits)	Thesis I		MK5DPT1K15KX17-EN									0	10	msg	15					
30.		Thesis II		MK5DPT2K15KX17-EN													0	10	msg	15	
31.		Environmental Summer Professional Practice		MK5NSGYK00KX17-EN					4 weeks												

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Lecture/Practice	16	10			16	10			7	18			6	17		
Exam (e)			3				4				2				6	
Mid-semester grade (msg)			5				4				4				4	
Number of subjects			8				8				6				6	
Number of contact hours (without criteria subject)	26				26				25				23			
Credits				29				30				31				30
Total credit	**120**															

Final exam topics:	
Prerequisites for final exam: Environmental status assessment and modelling; Environmental Protection II.	
Specialized knowledge: Built Environment	