University of Debrecen

Faculty of Engineering

Environmental Engineering BSc Program

2024

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 (for fee paying students)	Ádám Losonczi Norbert Balogh
Administrative Assistant (for scholarship students)	Ms. Noémi Tóth Mr. Norbert Tanki

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 Civil Engineering
Department of Engineering Management and Enterprise
Department of Environmental Engineering
Department of Mechanical Engineering
Department of Mechatronics
Department of Vehicle Engineering
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 2024/2025

Opening ceremony of the academic year	8 September, 2024 (Sunday)
Registration week	2 – 8 September, 2024
Revision week (exams in Exam courses may be scheduled during this week)	2 – 6 September, 2024
1st semester study period in MSc and BSc programs	9 September - 13 December, 2024 (14 weeks) In case of finalist courses: 9 September - 8 November, 2024 (9 weeks)
Reporting period I (Drawing week I)	21 - 25 October, 2024 (4 working days without scheduled lessons, consultation schedule announced previously)
Conferences, Career Days	
"New Trends and Challenges in Management – Management of Global Business Processes" Conference – Event of the Mechanical Engineering Department	17 – 18 October, 2024

"Problem-based Learning in Engineering Education" Conference - organised by the Department of Basic Technical Studies	24 October, 2024
Professional exhibition and ISCAME – International Scientific Conference on Advance in Mechanical Engineering - organized by Department of Mechanical Engineering	7 – 8 November, 2024
Faculty Conference of Scientific Students' Association	22 November, 2024
Reporting period II (Drawing week II)	9-13 December, 2024 (5 working days without scheduled lessons, consultation schedule announced previously)
1st semester examination period	16 – 20 December, 2024 (1 week) 6 January – 14 February, 2025 (6 weeks) In case of finalist courses: 11 November - 13 December, 2024 (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 16 December, 2024 and 26 January 2025.
Registration week	10 - 16 February, 2025
2nd semester study period in MSc and BSc programs	17 February - 23 May, 2025 (14 weeks) In case of finalist courses: 17 February - 8 April, 2025 (9 weeks)
Reporting period I (Drawing week I)	31 March - 4 April, 2025 (5 working days without scheduled lessons, consultation schedule announced previously)
Conferences, Career Days	
Career Days – "Industry Days in Debrecen 2024"	26 - 27 March, 2025

National Scientific Students' Associations Conference (OTDK)	23 – 25 April, 2025
Professional Days and Exhibition in the Field of Building Services, event organized by the Department of Building Services and Building Engineering	6 - 7 March, 2025
Reporting period II (Drawing week II)	19 - 23 May, 2025 (5 working days without scheduled lessons, consultation schedule announced previously).
2nd semester examination period	26 May – 11 July, 2025 (7 weeks) In case of finalist courses: 21 April - 23 May, 2025 (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 26 May and 26 June, 2025.

THE ENVIRONMENTAL ENGINEERING UNDERGRADUATE PROGRAM

INFORMATION ABOUT THE PROGRAM

Name of undergraduate program:	Environmental Engineering BSc
Specialization available:	Environmental Technology
Field, branch:	Engineering, environmental engineering
Level:	undergraduate (BSc)
Qualification:	Environmental Engineer
Mode of attendance:	Full-time
Faculty:	Faculty of Engineering
Program coordinator:	Dénes Kocsis, PhD Associate Professor
Person in charge of the specialization:	*Environmental Technology:* Dénes Kocsis, PhD Associate Professor
Program length:	7 semesters
Credits total:	210 (thesis: 15, optional subjects: 10)

Objectives of the undergraduate program and professional competencies

The aim of the programme is to train environmental engineers with up-to-date, applied knowledge of science, ecology, engineering, economics and management. They are able to identify environmental hazards in different areas and, with professional experience, to manage prevention and remediation activities economically and efficiently. With their professional knowledge, they are able to contribute to the prevention, reduction and elimination of environmental damage and harm, to the rational use of natural resources, and to the operation of low-waste and energy-efficient technologies. Students will be prepared to continue their studies at Master's level.

Professional competencies to be acquired

An environmental engineer's

a) knowledge

He/She

- possesses knowledge and applies scientific and technical theories and principles aimed at enhancing the environment and sustainability. This includes meeting the need for clean habitats for people and living organisms (air, water, soil, etc.), restoring the environment in case of pollution, developing sustainable energy sources, and employing advanced waste management and waste reduction methods.
- understands pollution prevention processes, including precautions related to pollution, procedures and associated equipment for combating pollution, and potential measures for environmental protection.
- knows environmental examination methods: performs environmental assessments as needed, monitoring regulatory processes, potential legal actions, or other types of complaints.
- is familiar with major laboratory and field testing methods and the conditions for their application.
- has knowledge of data analysis, transformation, and modeling relevant to the field to uncover useful information and support decision-making.
- understands environmental policies, laws, standards, guidelines, and other strategic documents applicable within the field.
- is knowledgeable about environmental technologies that help reduce the polluting impact of emissions and waste.
- has an overview of the principles of renewable energy technologies and their potential applications.
- is familiar with the principles of the circular economy and opportunities for its application.

b) abilities

He/She

- uses equipment to measure various environmental parameters to identify environmental issues and examines potential solutions. Conducts inspections to ensure compliance with environmental legislation.
- carries out surveys to collect information within an organization or a broader context for analyzing and managing environmental risks.
- monitors activities to ensure compliance with standards that include environmental protection and sustainability, performing necessary tasks to this end; adjusts activities if environmental regulations change. Ensures processes meet environmental standards and best practices.
- tracks environmental impacts and conducts assessments to identify and mitigate the organization's environmental risks, considering costs.
- manages the environmental impact of corporate activities. Identifies and evaluates the environmental impacts of production processes and related services, regulating the reduction of impacts on the environment and people. Organizes action plans and monitors indicators for improvement.

- assesses requirements and provides advice on environmental risk management systems. Ensures that clients take all possible measures to prevent or limit harmful environmental effects through technology use. Secures necessary permits.
- is capable of organizing and integrating all environmental efforts of a company, including pollution control, recycling, waste management, environmental health, conservation, and renewable energy.
- develops strategies for removing pollutants and contaminants from soil, groundwater, surface water, or sediment, considering environmental rehabilitation standards and available technologies.
- advises on the development and implementation of measures aimed at eliminating pollution sources and removing pollution.
- carries out activities that ensure the elimination of pollution and contaminants, following rules for environmental damage restoration.

c) attitude

He/She

- identifies the strengths and weaknesses of various options, sound concepts, such as questions, opinions, and approaches, to develop solutions and alternative methods for handling specific problem situations.
- responds to unexpected situations quickly, calmly, and safely, offering solutions that resolve the problem or reduce its impact.
- collaborates with colleagues to ensure the effective execution of operations.
- regularly participates in training workshops, reads professional publications, and actively engages in professional communities.
- provides guidance or instruction to others by sharing relevant knowledge and support.

d) autonomy and responsibility

He/She

- keeps up-to-date with the latest research, regulations, and other changes in the field that are relevant to the labor market or other industry developments.
- communicates with engineers, designers, survey technicians, and representatives involved in surveying projects.
- promotes sustainability based on the carbon footprint of business processes and other practices, raising awareness of the environmental impact of human and industrial activities.
- applies principles, policies, and regulations aimed at environmental sustainability in the workplace.
- uses a specific work method to carry out activities with minimal supervision or independently.

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, subject-related subjects and differentiated field-specific subjects.

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

- Natural Sciences [Mathematics, Engineering Physics, Chemistry, Applied Biology, Ecology] 40-50 credit points;
- Economics and Humanities (Studies of Law and Business, Microeconomics, Macroeconomics, Fundamentals of Quality and Engineering Management) 14-30 credit points;
- Field-specific professional skills for environmental engineers (Engineering Informatics, Basics of Engineering, Technical Drawing and Basics of CAD, Materials Engineering, Environmental Operations, Environmental Energetics, Environmental Law and Administration, Environment, Health and Safety, Ergonomics (Basics of EHS), Radiation Protection and Environmental Radioactivity, Nature, Landscape and Water Environment Protection, Environmental Impact Assessment, Noise and Vibration Control, Waste Management, Air Pollution Control, Soil Management, Analytical Methods for Environmental Monitoring, Water Management and Water Quality Protection) 70-105 credit points.

The specialization offered by the institution is worth at least 40 credit points.

Minimum of credit points assigned to optional subjects: 10

Credit points assigned to thesis: 15

Credits total: 210

During the program students have to complete a total amount of 210 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 subjects which taking into account the prerequisite(s) of each subject. You can find the recommended list of subjects in chapter “Guideline”.

The total number of credit points (210) 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 to follow the suggested order because some subjects can only be taken after the completion of prerequisite subject(s), and/or can be the prerequisites for other subjects.

The list of subjects you have to complete in the semesters according to the model curriculum of Environmental Engineering BSc programme **Environmental Technology Specialisation**:

1st semester	**2nd semester**
Mathematics I Engineering Physics Chemistry I Applied Biology Engineering Informatics I Engineering Science	Mathematics II Chemistry II Ecology Technical Drawing and Basics of CAD Environment, Health and Safety, Ergonomics (Basics of EHS) Optional Subject I
3rd semester	**4th semester**
Chemistry III Studies of Law and Business Microeconomics Environmental Operations Waste Management Air Pollution Control Optional Subject II	Macroeconomics Fundamentals of Quality- and Engineering Management Environmental Energetics Noise and Vibration Control Soil Management I Analytical Methods for Environmental Monitoring I Optional Subject III
5th semester	**6th semester**
Materials Engineering Environmental Law and Administration Radiation Protection and Environmental Radioactivity	Water Management and Water Quality Protection Environmental Management Food Production and Land Use

Nature, Landscape and Water Environment Protection Environmental Impact Assessment Soil Management II Analytical Methods for Environmental Monitoring II Optional Subject IV.	Environmental Geographical Information System I Complex Environmental Engineering Planning I. Internship Thesis I
7th semester	
Environmental Economics Project- and Environmental Management Environmental Geographical Information System II Complex Environmental Engineering Planning II Optional Subject V Thesis II	

About the prerequisites of each subject please read the chapter "Course Descriptions"!

Work and Fire Safety Course

According to the Rules and Regulations of University of Debrecen, students must complete the online course for work and fire safety in the first semester of their studies. Registration for the course and completion are necessary for graduation.

Registration in the Neptun system by the subject: MUNKAVEDELEM

Students have to read an online material until the end to get the signature on Neptun for the completion of the course. The link of the online course is available on the webpage of the Faculty.

Internship

Internship is a mandatory and integral part of the course of studies and strongly related to thesis writing. It covers 6 weeks after the 6th semester.

Credit points: 0

Aim of internship, competencies

To obtain specific practical skills from the field of environmental engineering and environmental technology, which form the basis for the final semester of the training program, the efficiency of preparing thesis and the period after graduation.

The aim of the internship is to familiarize students with the professional work done at a selected company (the profile of which is in accordance with the requirements for internship), involve them in the daily routine of the company, solve tasks individually assigned by the supervisor, gain experience which makes it easier for them to enter the labour market later. During the internship, both general and professional competencies can be acquired and improved.

General competencies: work to a deadline precisely depending on the task type (individually or in a team showing cooperation), use language for academic purposes.

Professional competencies: practical application of professional skills gained during studies, acquiring new skills and gaining proficiency (depending on the selected specialisation).

Completion of internship

Students are expected to prepare a 15-page long report relating to the work done during internship. The topic should be negotiated with the employer and closely related to the work done during internship and the practical tasks students get acquainted with.

Physical Education

According to the Rules and Regulations of University of Debrecen, students must complete Physical Education courses at least in two semesters during their Bachelor 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 University of Debrecen, student must complete optional courses during their studies.

Students of the Faculty may register for any courses announced by the Faculty without the approval of the Faculty Education Committee, in which case these will be counted as optional courses in the amount of credits indicated in the study plan of the given major or specialisation.

During your training you can complete elective subjects in any semester. In the Environmental Engineering BSc programme, you have to gain at least 10 credits by completing elective subjects.

Pre-degree Certificate

A pre-degree certificate verifies in the Neptun system that the student has successfully completed the study and exam requirements as set out in the curriculum, namely gained the necessary credit points (210), completed all the required subjects and the criteria subjects (Physical Education, Internship, Work and Fire Safety course). Submitting thesis is not a requirement for the pre-degree certificate. Student status ends at the end of the semester in which the pre-degree certificate is obtained.

Students who obtained the pre-degree certificate can take the final exam. Final exam can be taken both at the beginning of January and at the end of June.

It is possible to sit for the final exam in any examination period within two years after the termination of the student status, according to the effective academic requirements. If the final exam is taken more than two years after obtaining the pre-degree certificate the conditions of taking the exam are stipulated by the Faculty. No final exam can be taken later than five years after the termination of the student status.

Thesis

A thesis is the creative elaboration of a professional task (scientific, engineering, design, development, research or research development) in a written form as defined in the requirements of the training program. By solving the task, the student relies on his/her studies using national and international literature under the guidance of an internal supervisor previously approved by the Department of Environmental Engineering or depending on the topic of the thesis with the assistance of an external supervisor as well, also previously approved by the Department. By writing and successfully defending a thesis, students of the Environmental Engineering undergraduate programme 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.

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 are free to come up with their own thesis topics as well, however, the Head of the Department of Environmental Engineering decides on the acceptance of the topic. 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 are announced in writing by the Department of Environmental Engineering.

The latest that thesis can be submitted to the department is the date provided in the Thesis Topic Announcement Form.

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 is evaluated by the reviewer and the department separately, 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 and the department unanimously evaluate the thesis as fail, the student may not take the final exam and must create a new or a modified 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 specialisation.

Final exam

Students having obtained the pre-degree certificate will finish their studies by taking the final exam. Final exam can be taken in active student status in the forthcoming exam period after gaining the pre-degree certificate then after termination of student status in any exam period within two years according to the valid education requirements. If the final exam is taken more than two years after obtaining the pre-degree certificate (and termination of the student status) the conditions of taking the exam are stipulated by the Faculty. After the fifth year of the termination of student status the candidate is not allowed to take the final exam.

The final exam shall be taken in front of a board in the examination period following the award of the pre-degree certificate. Final exam can be taken both in the beginning of January and at the end of June.

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').

All candidates (independent from the order of candidates taking the final exam) are expected to arrive at the venue 15 minutes before the start of the final exam and the presentation of thesis. The order of the candidates taking the final exam and the expected end of the final exam will be announced by the committee chair at the beginning of the final exam. Dress code: Candidates are expected to wear something smart which reflects that this is a special and more formal occasion.

Final exam consists of two parts:

- thesis defence
- oral examination:
  topics of the following subject groups "Control/Protection of Environmental Elements"
  "Environmental Technology"

1. Thesis defence:

The candidate presents his/her thesis in 10 minutes in front of the final exam board. Presentation is mandatory, the examination room will be provided with computer and slide projector. In the presentation the candidate is supposed to highlight his/her own work and the research results. Taking into account the thesis review report and the questions of the referee and the members of the committee ask questions about thesis. Candidates are expected to answer without any preparation time.

2. Oral exam:

The members of the board ask questions about the topic of the thesis. Candidates are expected to answer without any preparation time. Topics of the oral exam covering the following subject groups:

"Control/Protection of Environmental Elements"
"Environmental Technology"

Final exam subjects of the Environmental Technology specialisation:
Environmental Operations, Environmental Energetics, Environmental Impact Assessment, Air Pollution Control, Soil Management, Noise and Vibration Control, Water Management and Water Quality Protection, Waste Management, Environmental Economics, Project and Environmental Management

The thesis defence and the oral exam are evaluated on a five-point scale by the members of the final examination board. Final exam results will be announced by the chair of the board. Results of the final exam and thesis defence will be announced at the end of the given exam day (when all candidates finished final exam and thesis defence on the given day). A note of the final exam will be taken.

The final exam grade (x) is calculated as follows:

$$x = (A+B+C)/3$$

where **A** is the cumulative grade point average (CGPA)
B is the average of the final exam subjects
C is the thesis defence grade given by the committee

Improving failed final exam

Final exam can be retaken if any of its part is a fail. The retake of the final exam may be attempted in the following examination period at the earliest. Final exam can be retaken twice.

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

Subject group "Basic Natural Sciences"

Mathematics I

Code: MK3MAT1A08KX25-EN
ECTS Credit Points: 8
Evaluation: mid-semester grade
Semester: 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 4+4

Topics:

Analysis. Set theory: set operations, relations, functions. Axioms for the Real Number System. Infimum, minimum, supremum, maximum. The set of the complex numbers, operations, cardinality. Topology of the Reals. Real and complex sequences and series, convergence tests. Real functions: continuity, limit. Sequences and series of real functions, power series, elementary functions. Differentiation of real functions: linear approximation, rules of the differentiation, derivative functions of elementary functions. Tangent line, osculating circle. Mean Value Theorems. Taylor polynomials, investigation of differentiable functions. Primitive functions, indefinite integrals: integration b parts, integral with substitutions. Riemann integral, Newton-Leibniz rule. Applications: area, volume and surface area of bodies of revolution, arc length of plane curves determined by real functions Applications in Engineering. Improper integral. Calculations with mathematical software.

Linear Algebra. Vector geometry: addition and scalar multiplication, inner product, cross product, mixed product. Applications in geometry and physics: area, volume, angles, work done by a constant force. Equations of lines and planes. Matrices: determinants (Sarrus' rule, Gaussian elimination, Laplace expansion), inverse matrix. Vector spaces: linearly independent and dependent vector systems, basis, dimensions. Change of basis. Ranks of vector systems and matrices. Systems of linear equations: Cramer's rule, Inverse Matrix Method, Gaussian elimination. Applications in Engineering.

Literature:

Compulsory:

- Adrienn Varga, Mathematical Analysis for Engineers, Debrecen, Hungary: Dupress (2019) , 118 pp. ISBN: 9789633188156
- Lajos, Hajdu; Adrienn, Varga, Engineering Mathematics: part I. Debrecen, Hungary: Dupress (2021) , 154 p. ISBN: 9789633189030

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
- Szíki Gusztáv Áron, Nagy Kondor Rita, Kézi Csaba, Differential and integral calculus for Engineering and Economists Debrecen, Magyarország: Dupress (2019), 225 p. ISBN: 9789633187418

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture: Real numbers - Axiom system. Boundary, inf, sup, min, max. Dedekind-complete, real line. Distance, neighbourhood, interior point, accumulation point. Intervals. The sets $\mathbb{R}$, $\mathbb{R}^2$, $\mathbb{R}^3$ and their geometric interpretations. Natural numbers, integer numbers, rational numbers. Real functions - Definitions: domain, range, restriction, composition, inverse, zero set. Properties: monotonicity, convexity, parity, period. Exponential and logarithm functions, and their properties. Trigonometric and hyperbolic functions and their inverses.	Lecture: Polynomials, interpolation Factoring polynomials, Euclidean division, rational fractions. Lagrange interpolation. Real sequences monotonicity, bounded sequences. Convergence, famous sequences, limits and operations. Squeeze theorem.
Practice: Real numbers Operations of sets, Boole- algebra. Cartesian product, 2-tuple, n-tuple. Cardinality. Illustrations of sets on the plane and in the space. Real functions Illustration of transformed functions, Determination of the inverse function, the largest possible domain, the zero set. Proof of parity.	Practice: Polynomials, interpolation Roots of polynomials, polynomial factorization, sign, tendency of the values at infinity. Solutions of Polynomial equations. Interpolation. Real sequences Investigation of convergence
4th week:	5th week:
Lecture: Real series Criteria of convergence. Power series, convergence domain, radius of convergence. Complex numbers Rectangular form, trigonometric form, exponential form and operations. Solutions of polynomial	Lecture: Limits of real functions Continuity, namely limits, limits and operations. Left- and right-limits. Differentiability Differentiability and continuity, rules of differentiation of real

equations on the set of the complex numbers. The sum of complex series.

Practice: Real series Determination of sums of series, investigation of convergence domains of real series. Complex numbers Operations, equations. Factorization of polynomials

6th week:

Lecture: Mean value theorems: Cauchy, Lagrange Roll. Investigation of differentiable functions.

L'Hospital's rule, Taylor polynomials.

Practice: Investigation of differentiable functions. Applications in Physics.

functions. Linear approximation, tangent line.

Practice: Limits of real functions Determinations of function limits.

Differentiability applications of the rules of the differentiation

7th week:

Lecture: Summary, sample test.

Practice: Applications of differentiation in Physics. Searching of Maximum and minimum values on a closed bounded interval.

8th week: 1st drawing week, Test1

9th week:

Lecture: Primitive function (antiderivative), indefinite integral integration by parts, integral with substitution. Riemann integral Newton-Leibniz formula

Practice: Determinations of primitive functions

10th week:

Lecture: Improper integral. Applications of the integration in physics and geometry. Numerical integration.

Practice: Applications of Newton- Leibniz formula, calculations of improper integrals. Trapezoidal rule, Simpson's rule, errors

11th week:

Lecture: Vectorgeomety, vectoralgebra Unit vector in the direction of a vector, projections.

Geometric applications: lines and planes in the space. The area of a triangle, the volume of a tetrahedron. The distance between a point and a line, or between a point and a plane

Matrices The arithmetic of matrices, determinants and their properties: operations, the notions of symmetrical matrix, skew-symmetrical matrix, determinant, the inverse matrix

Practice: Vector geometry, vector algebra The algebra of vectors in 2 and 3

12th week:

Lecture: Vectorspaces

The notion of linear (or vector) space, linear combinations of vectors, linearly dependent and independent systems, basis, dimension, coordinates. Ranks of vector systems, ranks of matrices

Systems of linear equations Gauss elimination (addition method) and Cramer's rule, by the inverse matrix method. Applications: Calculations for direct current using Kirchhoff's current and voltage laws.

Practice: Vector spaces Linearly independent and dependent systems,

dimensions: operations, coordinate systems. The algebraic definition of the cross product. Geometric interpretations of the scalar product and the cross product. The mixed product. Applications: Mechanical work, moment of a force with respect to a point, moment of a force with respect to an axis. Matrices Operations, determinants and inverses with adjoint matrices	bases. Ranks of vector systems, ranks of matrices Systems of linear equations Gauss elimination (addition method) and Cramer's rule, inverse matrix method
13th week: Lecture: Linear functions The notion of the linear function, the matrices of linear functions. Bases transformation. Eigenvalues, eigenvectors	14th week: Lecture: Summary, sample test.
Practice: Descriptions of reflections, orthogonal projections, rotations on the plane and in the space.	Practice: Determination of eigenvalues, eigenvectors. Applications of a mathematical software.
15th week: 2nd drawing week, Test2	

Requirements

A, for a signature and mid-semester grade:

Participation at practice classes is compulsory. Students must 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 can't take part in 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. The final grade can be obtained in the following way:

- students write a mid-term test (Test I) from the linear algebra part of the material in the first drawing week; maximum 50 points can be achieved
- students write a mid-term test (Test I) from the differential and integral calculus part of the material in the first drawing week; maximum 50 points can be achieved
- students write an end-term test (Test II) from the linear algebra part of the material in the second drawing week; maximum 50 points can be achieved
- students write an end-term test (Test II) from the differential and integral calculus part of the material in the second drawing week; maximum 50 points can be

Mark ranges after the four tests:

- 175-200 points: excellent (5)
- 150-174 points: good (4)
- 125-149 points: satisfactory (3)

- 100-124 points: sufficient (2)
- 0-99 points: insufficient (1)

Those who fail, or do not accept their marks, can write a Test in any of the first three weeks of the exam period. This Test is a combination of the previous four tests, maximum 50 points can be achieved, and the mark ranges are proportional to the above table. For exam dates see Neptun. If someone does not accept her/his mark, it is possible to get any mark (better, the same, or worse) than the original mark by writing this Test.

Mathematics II

Code: MK3MAT2A06KX25-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Semester: 2nd semester

Its prerequisite(s): Mathematics I

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+4

Topics:

Differentiation and integration of multivariable and vector-valued functions, differential equations.

Part A: Differentiation and integration of multivariable vector-valued functions (2 hours lecture+2 hours practise/week): Metric, topology, sequences in the space. Linear functions. Parametric curves. Notions of differentiation, linear approximation, curvature, torsion. Parametric surfaces, tangent plane, linear approximation. Surfaces of revolution, ruled surfaces. Scalar field, gradient. Young's theorem. Directional derivative. Local and global extrema. Vector fields. Derivatives. Divergence and curl. Potential function. The notion of double and triple integrals on 2 and 3 dimensional intervals. The extensions of the integrals. Integrals over general regions. The arc length of curves, surface area. Line and surface integrals. The theorems of Gauss and Stokes, Green’s formulae. Applications in physics.

Part B: Differential equations (2 hours practise/week): Notions of differential equations, classification of differential equations, initial value problem. Problems leading to differential equations. First order linear differential equations (homogeneous and inhomogeneous, method of variation). Determination of solutions of inhomogeneous first order linear differential equations. Higher order linear differential equations. Solution of linear homogeneous differential equations of order two having constant coefficients. Method of undetermined coefficients. Special second order differential equations. The Laplace transform and its applications. Slope fields, numerical methods. (Euler, Runge-Kutta).

Literature:

Compulsory: -

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:** Part A: Metric, topology, sequences in $\mathbb{R}^n$. **Practice:** Part A: Limits of vector sequences Part B: Notions of differential equations	**3rd week:** **Lecture:** Part A: Parametric curves I. **Practice:** Part A: Differentiation. Part B: Problems leading to differential equations.
4th week: **Lecture:** Part A: Parametric curves II. **Practice:** Part A: Curvature, torsion Part B: First-order linear differential equations	**5th week:** **Lecture:** Part A: Differentiable functions of type $\mathbb{R}^n \to \mathbb{R}^m$. **Practice:** Part A: Derivatives of functions of type $\mathbb{R}^n \to \mathbb{R}^m$. Part B: Higher-order linear differential equations.
6th week: **Lecture:** Part A: Parametric surfaces **Practice:** Part A: Surfaces of revolution Part B: Solution of linear homogeneous differential equations of order two having constant coefficients	**7th week:** **Lecture:** Part A: Scalar field, gradient. Young's theorem. Directional derivative. **Practice:** Part A: The domains of functions of type $\mathbb{R}^2 \to \mathbb{R}$. Directional derivative and gradient. Part B: Summary, sample test
8th week: Test 1	
9th week: **Lecture:** Part A: Local and global extrema **Practice:** Part A: Local extremas of functions of type $\mathbb{R}^2 \to \mathbb{R}$, $\mathbb{R}^3 \to \mathbb{R}$. Part B: Method of undetermined coefficients	**10th week:** **Lecture:** Part A: Vector fields **Practice:** Part A: Vector fields Part B: Special second order differential equations.
11th week: **Lecture:** Part A: Double and triple integrals	**12th week:** **Lecture:** Part A: Integrals over general regions

Practice: Part A: Integrals on 2 and 3 dimensional intervals Part B: Laplace transform	**Practice:** Part A: Applications Part B: Slope fields, numerical methods.
13th week:	**14th week:**
Lecture: Part A: Line and surface integrals.	**Lecture:** Part A: Mathematical software
Practice: Part A: arc length of curves, surface area. Line and surface integrals Part B: Potential functions	**Practice:** Part A: Summary, sample test Part B: Summary, sample test
15th week: Test 2	

Requirements

A, for a signature and mid-semester grade:

Participation at practice classes is compulsory. Students must 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 can't take part in 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.

The final grade can be obtained in the following way:

- students write a mid-term test (Test I) from differential equation part of the material in the first drawing week; maximum 30 points can be achieved
- students write a mid-term test (Test I) from the differential and integral calculus part of the material in the first drawing week; maximum 50 points can be achieved
- students write an end-term test (Test II) from the differential equation part of the material in the second drawing week; maximum 30 points can be achieved
- students write an end-term test (Test II) from the differential and integral calculus part of the material in the second drawing week; maximum 50 points can be achieved

Mark ranges after the four tests:

144-160 points: excellent (5)

128-143 points: good (4)

104-127 points: satisfactory (3)

80-103 points: sufficient (2)

0-79 points: insufficient (1)

Those who fail, or do not accept their marks, can write a Test in any of the first three weeks of the exam period. This Test is a combination of the previous four tests, maximum 80 points can be achieved, and the mark ranges are proportional to the above table.

For exam dates see Neptun. If someone does not accept her/his mark, it is possible to get any mark (better, the same, or worse) than the original mark by writing this Test.

Chemistry I

Code: MK3KEM1K04KX25-EN
ECTS Credit Points: 4
Evaluation: exam
Semester: 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:

LECTURE:
Evolution of chemistry: fundamental elements of Aristotle, atomic theory of Democritus, basic principles of iatrochemistry and alchemy. Phlogiston theory. Law of conservation of mass. Law of definite proportions. Law of multiple proportions. Atomic theory of Dalton. Basic concepts of elements, compounds and mixtures.
Periodic table Mendeleev's periodic table. Discovery and basic properties of subatomic particles (electron, proton, neutron). Atomic theories (Thomson, Rutherford, Bohr, quantum mechanical model). Periodically changing properties (radius, ionization energy, electronegativity).
Primary and secondary chemical bonds.
Radiochemistry and nuclear chemistry. Types of radiation and radioactive decay. Isotopes. Decay law. Natural decay series. Natural and anthropogenic sources of radioactivity. Application of radioactive isotopes. Nuclear reactions. Binding energy of a nucleus. Nuclear fission and fusion.
States of matter and phase changes. Gas laws, viscosity, surface tension. Types of crystalline solids. Some non-classic states of matter: plasma, supercritical fluid. Phase changes, vapor pressure, phase diagrams.
Solutions: steps of physical dissolution, heat of solvation. Solubility of gases: Henry's law and its consequences. Electrolytic dissociation in aqueous solutions. Colligative properties: lowering of vapor pressure, freezing point depression, boiling point elevation, osmosis
Chemical equilibrium: reversible and irreversible processes. Law of mass action. Equilibrium constant. Le Chatelier's principle. Factors affecting the equilibrium composition and the equilibrium constant.
Acid base theories: Theories of Arrhenius, Bronsted-Lowry and Lewis. pH, indicators, principles of acid base titration, buffers, super acids.
Redox reactions: reduction and oxidation. Oxidation numbers. Basics of electrochemistry, galvanic and electrolytic cells. Batteries. Practical examples of electrolysis. Faraday's law.
Basics of reaction kinetics: rates of reactions, catalysis, inhibition, enzymes, half time, explosions, reactive radicals and intermediates. Temperature dependence of the reaction rate.
Basics of thermochemistry: work, energy, heat, enthalpy, Hess' law, entropy, Gibbs energy. 1st and 2nd law of thermodynamics.
PRACTICE: General chemistry calculation practice.

Literature:

- Darrell Ebbing, Steven D. Gammon - General Chemistry; 11th Edition, Cengage Learning, 2019, ISBN: 978-1305580343
- Jason Overby, Raymond Chang - Chemistry, 14th Edition, McGraw-Hill Education, 2021, ISBN: 978-1260784473

Practice:
• The calculation problems are available in e-learning system.

Schedule

1st week Registration week	
2nd week: Lecture: Milestones in the evolution of chemistry. Practice: Conversion of measurement units, significant figures, molar mass, relative atomic mass, Avogadro's constant.	3rd week: Lecture: Periodic table and atomic theories. Practice: Preparation of solutions from solid salts. Composition: w/w%, mass concentration, molarity
4th week: Lecture: Primary and secondary chemical bonds. Practice: Preparing solutions from hydrated salts, mixing, dilution.	5th week: Lecture: Radiochemistry and nuclear chemistry. Practice: Gas laws.
6th week: Lecture: States of matter Practice: Solubility of gases, Henry's law, colligative properties.	7th week: Lecture: Phase changes Practice: mid-term calculation test.
8th week: 1st drawing week	
9th week: Lecture: Solutions. Practice: Balancing equations using the chain rule. Calculations based on chemical reactions.	10th week: Lecture: Redox reactions and electrochemistry Practice: Oxidation numbers. Balancing redox equations. Electrochemical calculations.
13th week: Lecture: Basics of thermochemistry Practice: Thermochemical calculations.	14th week: Lecture: Basics of reaction kinetics Practice: end-term calculation test.
15th week: 2nd drawing week	

Requirements

A, for a signature:
The calculation grade is prerequisite of the signature and contributes to the final grade.
Participation at the practical classes is compulsory. Students must attend all practical sessions and may not miss any practice class during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. In case of absence due to health issues, a medical certification needs to be presented.

There are two calculation tests during the semester. Grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent) calculated as an average of the tests' results. The minimum requirement for the tests is 50%.

B, for a grade:
The final grade is based on both parts: 1/3 of the total score comes from the calculation practice, and 2/3 from the theoretical part.
From the theory, students take an oral exam in the exam period. Exam grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent).
In case of failure, students can take retake exam(s) in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Chemistry II

Code: MK3KEM2K06KX25-EN
ECTS Credit Points: 6
Evaluation: exam
Semester: 2nd semester
Its prerequisite(s): Chemistry I
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+4

Topics:
LECTURE:
Inorganic chemistry: electronic structure, occurrence, production, physical and chemical properties, application of hydrogen, noble gases, halogens, oxygen group elements, nitrogen group elements, carbon group elements and boron.
Genaral properties of metals: conductivity of electricity and heat, melleability, ductility, melting point, boiling point, color, density. Electronic structure, occurrence, production, physical and chemical properties, application of alkali metals, alkaline earth metals, p block metals (Al, Pb, Sn) and transition metals (Sc group, Ti group, V group, Cr group, Mn group, Cu group, Zn group, Fe group, Pt group.
Corrosion: rusting and other examples. Corrosion protection: active (coating, cathodic protection) and passive (coating, anodizing) protections.
Organic chemistry. Basic definitions: functional group, homologous group, isomers, constitution, conformation, configuration. Molecular structure, occurrence, production, physical and chemical properties, application of alkanes, cycloalkenes, alkenes, alkines, aromatic hydrocarbons, alcohols, ethers, aldehydes and ketons, carbonic acids, halogenated hydrocarbons, amines, and N-heterocycles

PRACTICE: General chemistry laboratory practice.

Literature:

- Inorganic Chemistry, Mark Weller, Tina Overton, Jonathan Rourke, Fraser Armstrong, 6th Edition, Oxford University Press, 2015, ISBN: 978-0198757177

- Foundations of Inorganic Chemistry, Gary Wulfsberg, University Science Books, 2017, ISBN: 978-1891389955
- Organic Chemistry, Janice Gorzynski Smith, 6th Edition, McGraw Hill Education, 2020, ISBN: 9781260119107
- Organic Chemistry, Leroy G. Wade, Jan W. Simek, 9th Edition, Pearson, 2020, ISBN: 9780135213728

Practice:

• The laboratory manual is available in e-learning system.

Schedule

1st week Registration week	
2nd week: **Lecture:** Hydrogen. Properties and classification of hydrides. **Practice:** Detailed information on laboratory practical's. Laboratory work and safety training	3rd week: **Lecture:** Noble gases. Halogens and their compounds. **Practice:** Presentation of laboratory equipment. Demonstration of mass measurement. Performing a laboratory exercise related to mass measurement
4th week: **Lecture:** The oxygen group and their compounds: oxygen, ozone, water, and hydrogen peroxide; sulfur and its oxides, sulfuric acid and sulfates, hydrogen sulfide. **Practice:** Presentation of volumetric instruments. Volume measurement, solution preparation	5th week: **Lecture:** The nitrogen group and their compounds: nitrogen and its oxides, ammonia, nitric acid and nitrates; phosphorus and its oxides, phosphoric acid. Non-metallic elements of the carbon and boron groups. **Practice:** Density measurement
6th week: **Lecture:** General characterization of metals. Corrosion and corrosion protection. **Practice:** Calibration of laboratory volumetric equipment.	7th week: **Lecture**: The metals of the s- and p-block. **Practice:** Determination of the mass percentage composition of sand-salt mixtures
8th week: 1st drawing week	
9th week: **Lecture:** Transition metals. The scandium, titanium, vanadium, and chromium groups and their compounds. The manganese, iron, platinum, copper, and zinc groups and their compounds. **Practice:** Purification of alumina or copper sulphate by crystallisation	10th week: **Lecture:** Saturated and unsaturated hydrocarbons: alkanes, alkenes, alkynes. **Practice:** Gravimetry - mass analysis: determination of sulphate ions in the form of barium sulphate

11th week: **Lecture:** Aromatic hydrocarbons. Alcohols and phenols. Ethers. **Practice:** Production of colloids, Testing buffer solutions	**12th week:** **Lecture:** Aldehydes and ketones. Carboxylic acids. Carboxylic acid derivatives. **Practice:** Investigation of factors affecting the rate of reactions; investigation of quantitative relationships of reactions involving precipitation
13th week: **Lecture:** Halogen containing hydrocarbons. **Practice:** Investigation of complex formation using the ColorMeter application	**14th week:** **Lecture:** Nitrogen-containing organic compounds: amines and amides. Heterocyclic compounds. **Practice:** Possibility to make up for absence.
15th week: 2nd drawing week	

Requirements

A, for a signature:

The lab grade is prerequisite of the signature and contributes to the final grade.

Participation at practice classes is compulsory. Students must attend practice classes and may not miss any practice class during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Being late is equivalent with an absence. In case of absence due to health issues, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor. The weekly syllabus covers the particular topics and gives a full description of the experiments.

Each week the laboratory session begins or closes with a short test (no more than 20 minutes) based exclusively on the preparatory material of that week of the experiments carried out.

There are ten short tests during the semester. Lab grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent) calculated as an average of the tests' results and measurement reports. The minimum requirement for the short tests is 50%.

B, for a grade:

The final grade is based on both parts: 50 % of the total score comes from the laboratory practice, and 50 % from the theoretical part.

From the theory, students take an oral exam in the exam period. Exam grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent).

In case of failure, students can take retake exam(s) in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Chemistry III (Basics of Analytical Chemistry)

Code: MK3KEM3K04KX25-EN

ECTS Credit Points: 4
Evaluation: mid-semester grade
Semester: 3rd semester
Its prerequisite(s): Chemistry II
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:

LECTURE: The importance of chemical analysis, directions of its development. Preparation of the test material: sampling, sample preparation methods. Basics of qualitative analysis. Quantitative description of equilibria in solution (aqueous) phase: acid-base equilibria, complex formation, precipitation reactions, redox equilibria. Evaluation of experimental results: statistical analysis. Errors (systematic, random) in chemical analysis.
Basics of classical analytical methods: titrimetry: acid-base, redox, precipitation and potentiometric titrations. Heterogeneous equilibria (separation techniques) in analytical chemistry: gravimetry. Instrumental analytical methods: electrochemistry, thermal analysis, optical methods, chromatographic separation.

PRACTICE: Classical quantitative analytical methods: volumetric titrations based on acid-base equilibria, complex formation, precipitation reactions and redox equilibria; gravimetric analyses.

Literature:

- Dr. Mahmood M. Barbooti (2015) Environmental Applications of Instrumental Chemical Analysis, CRC Press, Boca Raton, ISBN 978-1-4822-6264-3
- Roger N. Reeve: Introduction to Environmental analysis, John Wiley & Sons Ltd. 2002. ISBNs: 0-471-49294-9 (Hardback); 0-470-84578-3 (Electronic)
- David Harvey: Modern Analytical Chemistry, McGraw-Hill Higher Education, 2000. USA, ISBN 0–07–237547–7
- C. N. HEWITT: INSTRUMENTAL ANALYSIS OF POLLUTANTS, ELSEVIER APPLIED SCIENCE, 1991, ISBN 1-85166-548-X

Schedule

1st week Registration week	
2nd week: Lecture: The importance of chemical analysis, directions of its development. Preparation of the test material. Practice: Block practices	3rd week: Lecture: Chemical equilibria in aqueous solutions. Gravimetry. Practice: Block practices
4th week: Lecture: Titrimetry Practice: Block practices	5th week: Lecture: Titrimetry Practice: Block practices
6th week: Lecture: Electrochemistry. Instrumental analytical methods based on electrochemical principles.	7th week: Lecture: Thermal methods, thermal analysis.

Practice: Block practices	**Practice:** -
8th week: 1st drawing week	1st Theoretical test
9th week: **Lecture:** Basics of optical testing methods. Emission spectrum analysis **Practice:** -	**10th week:** **Lecture:** Optical testing methods: Flame spectrometry. **Practice:** -
11th week: **Lecture:** Atomic absorption spectrophotometry. **Practice:** -	**12th week:** **Lecture:** Photometric methods based on molecular absorption. **Practice:** -
13th week: **Lecture:** Basics of chromatographic separation methods. **Practice:** -	**14th week:** **Lecture:** 2nd Theoretical test **Practice:** -
15th week: 2nd drawing week	**Retake of the Theoretical tests**

Practices are held in blocks!

1. General rules of laboratory work and using of laboratory equipment:

1.1. Laboratory work and safety training

1.2. Introduction to laboratory equipment

Schedule of Laboratory Practice:

1. Calibration of volumetric instruments. Determination of the exact concentration of hydrochloric acid measuring solution (factoring for solid $KHCO_3$).
2. Preparation of sodium hydroxide measuring solution and determination of its concentration with hydrochloric acid. Determining the concentration of household vinegar.
3. Preparation of silver nitrate measuring solution and determination of its exact concentration. Measurement of halide ions argentometrically.
4. Determination of the exact concentration of potassium permanganate solution by redox titration. Measurement of Fe(II) ions by permanganometry.
5. Preparation of EDTA measuring solution and determination of its exact concentration. Determination of Ca^{2+} and Mg^{2+} ions side by side by complexometry.

Requirements

A, for a signature:

The lab grade is prerequisite of the signature and the mid-semester grade, too!

Participation at practice classes is compulsory. Students must attend practice classes and may not miss any practice class during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Being late is equivalent with an absence. In case of absence due to health issues, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor. The weekly syllabus covers the particular topics and gives a full description of the experiments.

Each week the laboratory session begins or closes with a short test (no more than 20 minutes) based exclusively on the preparatory material of that week of the experiments carried out.
There are five short tests during the semester. Lab grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent) calculated as an average of the tests' results and measurement reports. The minimum requirement for the short tests is 50%.

B, for a mid-semester grade:
The course ends in mid-semester grade, the theoretical part ends in a written end-term test at the abovementioned weeks. The minimum requirement for the written test is 50%. Based on the total score, the grade is given according to the following table:
Score Grade
0-49 fail (1)
50-62 pass (2)
63-75 satisfactory (3)
76-87 good (4)
88-100 excellent (5)
If the case of failure, students can take retake written tests in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. In the mid-term grade, the score for the theoretical part counts is 60% and the lab grade counts is 40%. (Satisfactory level is the criterion in both parts).

Engineering Physics

Code: MK3MFIZA06KX25-EN
ECTS Credit Points: 4
Evaluation: exam
Semester: 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
Geometrical optics, kinematics and dynamics of particles, concept of mechanical work, kinetic and potential energy, electrostatics, electric fields around conductors, transport processes, steady-state transport of electric charge, steady-state heat transfer (conduction, convection and radiation)

Literature:
Compulsory:

- Alvin Halpern: 3,000 Solved Problems in Physics, SCHAUM'S SOLVED PROBLEM SERIES (2011), ISBN-13: 978-0071763462
- Jerry S. Faughn, Raymond A. Serway, Chris Vuille, Charles A. Bennett: Serway's College Physics, Published 2005 by Brooks Cole Print, ISBN 0-534-99723-6

Schedule

1st week Registration week	
2nd week: **Lecture:** Concept of geometrical optics, law of reflection and refraction (Snell's law), Brewster's angle, Optics of prisms and lenses, imaging properties and magnification, aberrations, compound lenses **Practice:** Solving problems for the reflection and refraction of light beams and for the imaging of lenses and compound lenses.	3rd week: **Lecture:** Description of the motion by scalar quantities: Scalar position, velocity and acceleration. Example: uniform and uniformly varying motion **Practice:** Solving problems for uniform and uniformly varying motions.
4th week: **Lecture:** Description of the motion by vector quantities: Position vector, vector velocity and acceleration. Example: throwing problems, circular motion. **Practice:** Solving throwing and circular motion problems.	5th week: **Lecture: Kinetics of a particles I** Inertial frame of reference, Newton's Laws, force formulas. Application of Newton's Laws in static and dynamic problems. **Practice:** Application of Newton's laws in kinetic problems.
6th week: **Lecture: Kinetics of a particles II** Concept of work and kinetic energy, work-energy theorem. Application of work-energy theorem in dynamic problems. **Practice:** Application of Newton's laws and the work energy theorem in kinetic problems.	7th week: **Lecture: Electrostatics I** Electric field strength and flux, Gauss's law for electricity (Maxwell's first equation), potential energy in electric fields. **Practice:** Calculation of the electric field strength and its flux in the electrostatic fields of different charge arrangements.
8th week: 1st midterm test	
9th week: **Lecture: Electrostatics II** Electric voltage and potential, capacitance, capacitance of planar, cylindrical and spherical capacitors, the energy of capacitors, capacitor circuits **Practice:** Calculating the capacitance and stored energy of different types of capacitors and capacitor connections	10th week: **Lecture:** Concept of physical system, current intensity and source strength, extensive and intensive physical properties, conduction and convection current. Equation for steady-state conduction. Thermal conductivity and conductive resistance. Conductive resistance circuits. **Practice:** Application of the equation of balance and steady-state conduction in different physical problems.

11th week:	12th week:
Lecture: Steady state transport of electric charge (Direct electric current)	Lecture: Steady-state heat transfer I - Thermal conduction
Electric current intensity, electrical conductivity and resistance, Ohm's law, electric work and power, characteristics of DC sources, Kirchhoff's circuit laws, solution of electric circuits	Concept of heat current and thermal conduction, equation of steady-state thermal conduction, thermal conductivity and resistance, steady state temperature distribution in a one dimensional wall of thermal conductivity
Practice: Solution of DC circuits	Practice: Solving thermal conduction problems
13th week:	14th week:
Lecture: Steady-state heat transfer II - Thermal convection	Lecture: Steady-state heat transfer III - Thermal radiation
Concept of thermal convection and heat transfer, equation of steady-state heat transfer, heat transfer coefficient and resistance, overall heat transfer coefficient and resistance	Thermal radiation characteristics, concept of black body radiation, fundamental laws of thermal radiation (Planck distribution, Wien displacement law, Stefan-Boltzmann and Kirchhoff's law), gray body radiation
Practice: Calculating the steady state temperature distribution in a one dimensional wall of thermal conductivity	Practice: Solving thermal radiation problems
15th week: 2nd midterm test	

Requirements

A, for a signature:

Participation at lectures is compulsory. Students must 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 must be made up for at a later date, being discussed with the tutor.

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. At the end of the semester everybody will get a seminar grade on the basis of the table below:

0-39 points = Fail (1); 40-50 points = Close fail (2); 51-60 points = Improvement needed (3) = 61-70 points = Very good (4); 71-80 points =Excellent (5)

If somebody fails, then he has 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. If somebody has to repeat his midterm tests, then his seminar grade cannot be better than (2).

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.

B, for a grade:

For their exam, everybody will get an exam grade. The final grade will be the average of the seminar and exam grade. If it is for example (3.5) then the lecturer decides if it is (3) or (4).

Applied Biology

Code: MK3ALKBK04KX25-EN
ECTS Credit Points: 4
Evaluation: exam
Semester: 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+1

Topics:

LECTURE: Students learn about the relationship between living organisms and their habitats. They will gain insight into how living organisms, including humans, affect the environment and how environmental changes affect living organisms. They learn about the taxonomic classification of organisms and the importance of conserving biodiversity. Through a better understanding of the process of genetic information transfer, students will gain a comprehensive understanding of the background to genetic disorders, diseases, genetic modification and biotechnological processes, including the benefits and risks of producing and using genetically modified organisms. They will learn about the basics of production, manufacture and processing of food raw materials of plant and animal origin, and about healthy nutrition and nutrition-related diseases. They understand the role of microbes in our environment, in the cycles of elements, in environmental processes, in industrial processes e.g. in pharmaceuticals, food industry. This is completed with a brief overview of disease-causing microbes, the spread of infectious diseases and how to control them.

PRACTICE: Student research on cases and issues of applied biology, reported in student presentations.

Literature:

- Bhargava, R, N. et al. Ecology and Environment. Taylor & Francis, 2019.
- Vaccari, David, A. et al. Environmental Biology for Engineers and Scientists. Wiley-Interscience, 2005.
- James, Philip. The Biology of Urban Environments. Oxford University Press Academic UK, 2018.
- Gilbert, Scott, F. and David Epel. Ecological Developmental Biology. (2nd edition). Oxford University Press Academic US, 2015.
- Aswathanarayana, U. (ed.): Food and Water Security. Taylor & Francis, 2007.

Schedule

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

Lecture: Subject and areas of biology. The concept of living matter, life phenomena, life criteria. Levels of organisation of living matter. **Practice:** Biodiversity.	**Lecture**: General features of metabolism. Transport processes in the plasma membrane. **Practice:** Structure and function of enzymes.
4th week: **Lecture:** Metabolism of cells to break down and build up. **Practice:** The relationship between a living organism and its environment.	**5th week:** **Lecture:** How genes work, how gene function is regulated. Types of cell division. **Practice:** The latest results from cell research.
6th week: **Lecture**: Organising living things. Artificial and natural systems. **Practice:** Biosphere evolution.	**7th week:** **Lecture**: General characterization and classification of viruses, their place in the living world. **Practice:** Viral pathogenesis.
8th week: 1st drawing week	**Theoretical test**
9th week: **Lecture:** The world of unicellular organisms. Prokaryotic and eukaryotic unicellular organisms. **Practice:** Useful and harmful bacteria.	**10th week:** **Lecture:** An overview of the fungi system. The role of fungi in metabolism. **Practice:** The practical importance of fungi.
11th week: **Lecture:** An overview of the flora. Water uptake and water balance in plants, and the function of gas channels. **Practice:** Nutrient uptake by plants.	**12th week:** **Lecture:** The flora of Hungary, our endangered and protected plants. **Practice:** Crop farming and use.
13th week: **Lecture:** An overview of the kingdom Animalia. Organs and organ systems of animals. **Practice:** The regulation of animal life processes.	**14th week:** **Lecture:** The fauna of Hungary, our endangered and protected animals. **Practice:** Breeding and use of domestic animals.
15th week: 2nd drawing week	**Theoretical test**

Requirements

A, for a signature:

The practice grade is prerequisite of the signature and the mid-semester grade.

Participation at practice classes is compulsory.

B, for a mid-semester grade:

The course ends in an exam, for which the tests of the theoretical part can provide an offered grade. The minimum requirement for a written test is 50%. Based on the total score, the grade is given according to the following table:
Score Grade
0-49 fail (1)
50-62 pass (2)
63-75 satisfactory (3)
76-87 good (4)
88-100 excellent (5)
If the case of failure, students can take retake written tests in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Ecology

Code: MK3OKOLS04KX25-EN
ECTS Credit Points: 4
Evaluation: exam
Semester: 2nd semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:

The concepts and history of ecology, the characterisation of living systems, the dialectics of biological levels of organisation, and a comprehensive characterisation of supraindividual levels of organisation. Introduction to population structure and dynamics, the concepts and disciplines of synbiology, ecological factors, the multiplural environmental principle, the limitation principle, niche theory. The main components of the metabolism of living organisms, the metabolism of matter and energy in living organisms, the cycling of biogenic elements. The characteristics and typology of terrestrial, aquatic and wetland habitats, the main life form types and the evolution of the biosphere. Synbiological indicators, ecological status assessment and classification. The biological indicators of environmental pressures, indicator and measuring organisms, biological monitoring systems. The biological and social determinants of the specific relationship between humans and the biosphere, the relationship between ecology and economics. Ecological, evolutionary and socio-ecological concepts that are essential for understanding and interpreting natural and environmental problems. Practical exercises related to the lectures in an integrated approach to the present and the future, both individually and in groups. Comparative-analytical group work, the practical focusing on the integration of ecological knowledge into the students' engineering approach.

Literature:

Compulsory:

- Environment and Ecology 2021. G.K PUBLICATIONS PVT.LTD

- Ecology for students in the Fourth Year of the Scientific Humanities 2021. Our Knowledge Publishing.
- Ecology and Ecosystems Analysis 2024. Springer, Berlin.
- Ecology Book 2019. Dorling Kindersley Ltd.

Recommended:

- Global Change Biology. Erica Bree Rosenblum 2021.
- Introduction to Ecology 2022. Callisto Reference
- Environment & Ecology for Civil Services Examination 6ed by Majid Husain 2022. CL Educate Limited.
- Wetland Ecology Principles and Conservation. 3rd edition. Cambridge University Press.
- Essentials of Ecology Michael Begon 2014. John Wiley & Sons Inc.

Schedule

1st week: Registration week	
2nd week:	**3rd week:**
Lecture: Introduction. Objectives of ecological studies. Classification of ecology. Types of ecology levels.	**Lecture:** Global ecology. Climate crisis. Interconnected crises of climate change, biodiversity loss and pollution.
Practice: Engineering and Ecological approach. Global laws. Ecological trends in the 21th century.	**Practice:** Saving the world by ecological design. Biodiversity loss. Economy and environment.
4th week:	**5th week:**
Lecture: Community ecology. Interspecific Interaction. Positive and negative interactions.	**Lecture**: Material and energy flows at the community level, trophic structures. Biogeochemical cycles (carbon, nitrogen, water, phosphorus, sulphur, biogenic elements).
Practice: Indicators of the state of ecosystems, the characteristics of communities of organisms understood as systems. Creation and use of built environment. Areas of environmental sustainability in the built environment. Ecological aspects of the built environment, effects of urbanisation.	**Practice:** Operational environmental factors. Environment and tolerance. Analysis of tolerance curves. Types of adaptation. Aspects of ecological impact assessment and their practical implications.
6th week:	**7th week:**
Lecture: The main characteristics of biocoenoses. Types of biocoenoses and their structure. Trophodynamic and production biology of ecosystems. Ecological and biogeographical divisions of the biosphere. Biomes. Ecosystem dynamics.	**Lecture:** Accelerated cycling of materials in response to natural and anthropogenic forcings.

Practice: The relationship between the ecosystem and the economy. Externalities, economic impacts, environmental governance needs. The relationship between engineering and environmental problems.	**Practice:** Life-cycle environmental impact analysis of buildings. Chemicals in building materials that are harmful to the environment or human health. Life cycle assessment applications for a sustainable built environment.
8th week: 1st drawing week	
9th week:	**10th week:**
Lecture: Ecotoxicology, bioindicators.	**Lecture:** Ecological consequences of global environmental change. State of the environment - assessment.
Practice: Objectives, options and main steps of ecological restoration. Basic concepts and tasks of nature conservation. Main international conventions on nature conservation and ecology.	**Practice:** Design, development, maintenance and operation of a monitoring system.
11th week:	**12th week:**
Lecture: Terrestrial and aquatic ecosystems and the impacts of human activities. Ecosystem assessment.	**Lecture:** Toxic substances in environmental systems: bioindication, bioaccumulation, bioconcentration and biomagnification. Ecotoxicology and risk assessment, types of early warning systems.
Practice: Specific water quality problems in watercourses. Eutrophication processes, consequences and regulation/intervention options (Case study)	**Practice:** Ecological effects of cyanide pollution in the Tisza, monitoring studies, status assessment. Analysis of ecological limit values (taking bioaccumulation effects into account).
13th week:	**14th week:**
Lecture: Urban ecological challenges in the 21st century. Possibilities for assessing environmental consistency in "zones" with different built-up and use characteristics. Characteristics of a sustainable city.	**Lecture:** Urban ecology - problems and solutions today
Practice: Urban ecology - problems and solutions today	**Practice:** The ecological role of urban green spaces. Environmental and health impacts of green spaces.
15th week: 2nd drawing week	

Requirements

Participation at lectures and practice classes are compulsory. Students must attend lectures and may not miss more than three lectures during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students have to submit all the two tests and the homework tasks as scheduled minimum at a sufficient level. The course ends with oral exam.

Tests:

1. Test Maximum: 50 points Minimum: 30 points
2. Test Maximum: 50 points Minimum: 30 points

Summa points Maximum: 100 points Minimum: 61 points

Based on the summa points of the tests, the grade is defined according to the following calculation:

Score		Grade
0-60 points	fail	no sign
61-70 points	pass	(2)
71-80 points	satisfactory	(3)
81-90 points	good	(4)
91-100 points	excellent	(5)

Studies of Law and Business

Code: MK3JVISM04KX25-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: 2nd year, 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:

The course will equip students with an understanding of the fundamental principles of contract, consumer, and company law. The incorporation of real-world business scenarios will facilitate students' comprehension of the significance and implications of legal matters in business contexts. Students will be required to identify ethical questions that arise in a business context, consider potential resolutions, and select and justify a course of action. A comprehension of the rights and obligations of organizations is a fundamental prerequisite for the study of business operations, both domestically and in the context of international business transactions and trade.
The objective of this unit is to familiarize the student with the study of law in the context of business. The course introduces students to the sources of law and legal methodology, business organizations and legal relationships, contracts (including the supply of goods and services), agency agreements and civil wrongs in the business environment (including negligence). By the end of the course, students should be able to use some basic analytical tools of finance and apply them in the valuation of financial assets. The curriculum encompasses an array of financial concepts, including an examination of firms and the financial market, an analysis of financial statements, an investigation of taxation, an evaluation of cash flows, a study of financial analysis, and an exploration of the time value of money.

Literature:

Compulsory:

- Study materials provided by the lecturer and other possible mini cases, hand-outs.
- Robert W. Emerson: Business Law – Fifth Edition, Business Review Books, 2010. ISBN-13: 978-0764142406
- Titman, Sharidan- Keown, A. J., Martin J. D. (2020): Financial Management. Principles and Applications – 13th edition- ISBN – 13: 978-0-13-217422-0
- Robert B. Cooter, Thomas Ulen, (2014): Law and Economics: Pearson New International Edition, 6th, Pearson, ISBN. 9781292021843.

Recommended

- Brealey, R. A. - Myers, S. C. - Allen, F.: Principles of Corporate Finance, 2008. (ISBN: 8601200473155)

- Mishkin, Frederic S. (2013): The economics of money, banking, and financial markets) 10th edition, (The Addison-Wesley series in economics), ISBN 0-321-12235-6
- Kenji Uchino, Entrepreneurship for Engineers (2009) ISBN-13: 9781439800638
- Mellor R., Entrepreneurship for Everyone (2010) Student textbook ISBN-13: 9781412047756

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture: The basic legal principles and guidelines. The sources of law, the actors of legal relationships. Practice: The working and development of the law system and sources of law in practice.	Lecture: The most important features and legal rules of the legal person. The founding documents, the common rules of legal persons (entrepreneurships), the organization of legal persons. Practice: Practical questions of legal persons in Hungarian and EU Law.
4th week:	5th week:
Lecture: The most important features and rules of contracts in Hungarian and EU Law. The rules of the freedom of the contracts. Practice: The freedom of contracts and the breaching of a contract in practice, while examining examples	Lecture: The modifying of the contract, the expiry of contracts, the breaching of a contract. Practice: Practice: Introducing special cases of contract modifying and expiring
6th week:	7th week:
Lecture: Most important individual contracts in Hungarian and EU Law, especially sales contract, entrepreneurship contract, employment contract, designing, engineering contract Practice: The practical introduction of the individual contracts, explaining the common rules and the differences.	Lecture: The rules of tort law, introducing the main legal solutions for compensation. Practice: Mini Cases. Midterm test A (50%)
8th week: 1st drawing week	
9th week:	10th week:
Lecture: Introduction to Financial Management Practice: Firms and the Financial Market Application of the lecture's topic of Book No. [1] Chapter [1 and 2].	Lecture: Financial Statements, Taxes, Cash Flows Practice: Application of the lecture's topic of Book No. [1] Chapter [3].
11th week:	12th week:
Lecture: Sizing Up Firm Performance I. Practice: Application of the lecture's topic of Book No. [1] Chapter [4].	Lecture: Sizing Up Firm Performance II. Practice: Application of the lecture's topic of Book No. [1] Chapter [4].

13th week:	14th week:
Lecture: Time Value of Money (FV, PV) Practice: Application of the lecture's topic of Book No. [1] Chapter [5] and [6].	Midterm test B (50%)
15th week: 2nd drawing week	

Requirements
A, for a signature: Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three occasions during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. During the semester there are two tests: the mid-term test on the 6th week and the end-term test on the 13th week.
B, for a grade: Marks offered based on both midterm test (A+B) and team tasks, otherwise written exam at examination period

Microeconomics

Code: MK3MIOKM04KX25-EN
ECTS Credit Points: 4
Evaluation: Exam
Year, Semester: 2nd year, 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 1+2

Topics:
This course aims to make students familiar with the basic concepts of microeconomic analysis. In particular, the course will focus on the analysis of how economic actors, consumers, and firms choose between different alternatives. By the end of the course, the student should be able to use the basic tools and models of microeconomics and apply them to solve problems. The course focuses on the theory and application of the following: Microeconomic processes and the basics of supply and demand. Market equilibrium. The elasticity of demand (supply). Consumer behaviour - Households' choices (Marginal utility theory, indifference (curve) analysis. Firm's production (factors), costs of production, profit-maximizing behaviour. Market structures (perfect competition, imperfect competition: monopoly, oligopoly). Profit maximizing under perfect competition and monopoly. Pricing rules. The value of money.

Literature:
Compulsory::

- Judit T. Kiss (2015): Introduction to Microeconomics for Engineers and Technical Managers. Debrecen University Press. ISBN: 978-963-318-469-1.

Recommended literature:

- Besanko, David – Breautigam, Ronald R. (2020): Microeconomics. Sixth Edition (International Student version). John Wiley and Sons, Inc., New York, ISBN13: 978-1119554844.

- Besanko, David – Breautigam, Ronald R.: Microeconomics. Study Guide. Fourth Edition. John Wiley and Sons, Inc., New York, 2011. ISBN: 9781118027059.
- Samuelson P.A., Nordhaus W.D.: Economics, 18th edition, Academic Internet Publishers Inc., 2006. ISBN: 0072872055
- Gregory Mankiw (2017): Principles of Microeconomics – Cengage Learning. ISBN13: 978-1305971493

Schedule

1st week Registration week	
2nd week: Lecture: *Basic Concepts of Economics and Microeconomics* Introduction to Microeconomics and Macroeconomics. Key analytical tools (Comparative statics, equilibrium analysis, and constrained optimization). Efficiency, scarcity, environment and use of resources. Practice: Case study examination	3rd week: Lecture: *Demand and supply* Demand curves, Supply curves; Market equilibrium. Equilibrium price and quantity; market demand and individual demand; shifts versus movements along the demand curve (supply curve); market supply and individual supply; shifts versus movements along the supply curve. Practice: Calculation exercises: equilibrium price and quantity; market demand and individual demand; shifts versus movements along the demand curve (supply curve).
4th week: Lecture: *Consumer Behaviour* Cardinal and ordinal approach. Total utility function, marginal utility function and calculation method. Principle of diminishing marginal utility. Relationship between individual and market demand functions. Consumer surplus. Practice: Calculation/team problems: marginal utility, relationship between total utility and marginal utility. Principle of diminishing marginal utility.	5th week: Lecture: *Types of elasticity of demand* Demand and supply together, market equilibrium. Price elasticity of demand, cross price elasticity of demand, income elasticity of demand. The elasticity of supply. Total revenue and the price elasticity of demand. Increase in total revenue. Taxes and elasticity. Practice: Case study examination and calculation/team problems: Application of elasticity of demand. Energy and price elasticity. Types of goods (substitutes, complements, independents).
6th week: Lecture: *Production* Factors of production. Inputs, outputs and production function. Total product function. Technically efficient and inefficient. The marginal product of labour and average product of labour. Law of diminishing marginal returns to labour (capital). Practice: Calculation/team problems (average product of labour (capital), marginal product of	7th week: Lecture: *Costs of production* Costs of production. (Total, fixed and variable costs, marginal and variable cost). The relationship between marginal and average cost. Total revenue, total profit curves. Calculating problems (types of cost, relationship between cost and profit. opportunity cost). Practice: Midterm test I

labour (capital), relationship between marginal product and average product.	
8th week: 1st drawing week	
9th week: Lecture: *Condition of profit maximization* Main condition of profit maximization under a competitive market. Main characteristics of the competitive market. Marginal cost, average costs of production, profit-maximizing output, shut down and breakeven point, profit and loss. The competitive firm's supply curve. **Practice:** Calculation/team problems: types of cost, relationship between cost and profit. The opportunity cost.	**10th week:** Lecture: *Firm Behaviour* Firms objectives. Stakeholder and shareholders of the firm. Key Performance Indicators. Models of the firm's pricing decisions, cost estimation and decision. Sources of Cost Efficiency. Economical analysis of investments. **Practice:** Calculation/team problems: marginal cost, total, variable and fixed cost, average costs. Determination of the shutdown and breakeven point.
11th week: Lecture: *Perfect and Imperfect competition* Monopoly (the profit-maximization condition; average revenue, marginal revenue, total revenue curves). Profit-maximization. Relationship between marginal revenue and linear demand curve). **Practice:** Calculation/team problems_ marginal average revenue, total revenue, average and marginal profit, profit-maximizing output, marginal cost curve and supply curve. Determination of the shutdown and breakeven point.	**12th week:** Lecture: *Monopoly* Monopoly, perfect and monopolistic competition. Pricing decision - Price discrimination. The welfare cost of monopoly. Consumer and producer surplus. Deadweight loss. Monopsony. **Practice:** Calculation/team problems: Profit maximization condition (Monopoly), consumer and producer surplus. Relationship between marginal revenue and linear demand curve.
13th week: Lecture: *Imperfect competition* Strategic behaviour, market barriers. Main characteristics of oligopoly. The main characteristics of cartels are welfare and oligopoly. Products differentiation. **Practice:** Calculation/team problems: The monopoly equilibrium versus the perfectly competitive equilibrium.	**14th week:** **Lecture:** The markets for the factors of production. Taxes and efficiency. Earnings and discrimination. **Practice:** Test II.
15th week: 2nd drawing week	

Requirements

A, for a signature:

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

During the semester, there are two tests: the mid-term test on the 7th week and the end-term test on the 14th week. Students must sit for the tests.

B, for a grade (ESE):

The course ends in an examination.

The minimum requirement for the mid-term, the end-term test and the teamwork is 50% separately. Based on the scores of the tests separately, the grade for the tests and the examination is given according to the following table:

The grade is given according to the following table:

%	Grade
0-49	fail (1)
50-62	pass (2)
63-75	satisfactory (3)
76-89	good (4)
90-100	excellent (5)

If the score of any test is below 50%, the student once can take a retake test of the whole semester material.

Macroeconomics

Code: MK3MAOKM04XX25-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: 2nd year, 2nd semester
Its prerequisite(s): Microeconomics
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 1+2

Topics:

This course is intended to help students understand important macroeconomic issues such as macroeconomic processes, national income, fiscal policy, monetary policy, and main labour and money market characteristics. To introduce students to the fundamental context and terminology of the economy at the macro level, to introduce the main concepts and theories about economic science so that they become able to realize economic processes and relationships.
This course focuses on the theory and application of the following:
Measuring macroeconomic output (real vs. nominal Gross Domestic Product, Gross output, the problem of double counting). Consumption and Investment. Household and firm sector. Investment multiplier. IS model. Economic role of government (externalities). Fiscal policy and output determination. The role of money in the economy, the evolution of money, central bank, commercial banking. Monetary policy. Aggregate demand and supply. Labour market. Unemployment and inflation. Economic growth and environmental awareness, energy efficiency and sustainable development.

Literature:

Compulsory:

- Mankiw, Gregory (2023): Brief Principles of Macroeconomics. Cengage Learning, USA, 2023. ISBN: 0357723066
- Judit T. Kiss (2014): Introduction to Macroeconomics for Engineers and Technical Managers. Debrecen University Press. ISBN: 978-963-318-416-5.

Recommended literature:

- K. E. Case – R. C. Fair – S. M. Oster (2012): Principles of Macroeconomics, Tenth Edition. Prentice Hall, ISBN 13: 978-0-13-139140-6.
- Samuelson P.A., Nordhaus W.D.: Economics, 19th edition, Academic Internet Publishers Inc., 2009. ISBN-13. 978-0073511290.
- N. Gregory Mankiw - Mark P. Taylor (2023): Macroeconomics, Cengage Learning . ISBN-10: 1473787122 ISBN-13: 9781473787124.

Schedule

1st week Registration week	
2nd week: Lecture: *The Scope and Method of Macroeconomics* The scope and method of macroeconomics. The difference between Microeconomics and Macroeconomics. Main macroeconomic problems. Models in Macroeconomics. The components of the Macroeconomics. The circular flow Diagram. Market sectors – commodity, money and labour market. Practice: Calculation/team problems: Circular flow of income. Case study examination.	3rd week: Lecture: *Measuring Macroeconomic Output* Circular flow – market sectors. Output and Income. Price level, Consumer price index. Measuring macroeconomic output (Gross Output, Gross Domestic Product, calculating GDP, real versus nominal GDP, the components of the GDP, GDP deflator and Produce price index). Practice: Calculation/team problems: measuring macroeconomic income and output.
4th week: Lecture: *The Keynesian Theory – Aggregate demand* Consumption function, marginal propensity to consume. Saving function, marginal propensity to saving. Economic role of investment, Mathematical and geometrical derivation of the equilibrium output. Investment multiplier is the main influencing factor of investment. Derivation of investment–saving curve. IS curve. Practice: Calculation/team problems: consumption and saving function, Investment multiplier.	5th week: Lecture: *Government in the economy* Government expenditures and revenues. Types of taxes, disposable income, government budget, determination of equilibrium output, fiscal policy, the government spending multiplier, and the tax multiplier. Average tax rate, tax wedge, and marginal tax rate. Practice: Calculation/team problems: the role of the government. Tax burden and tax multiplier.
6th week: Lecture: *Open Economy* Balance payments. International sector and aggregate planned expenditure. Equilibrium output in an Open Economy, net exports (exports and imports). Price Feedback and Trade Feedback	7th week: Lecture: *Money market* The meaning of money, the functions of money, measuring the supply of money. The creation of money, required reserve ratio. Banking system, Commercial banking. The money multiplier. Open

effect. Openness of an economy. International trades. **Practice:** Calculation/team problems: measuring openness of an economy. Case study examination.	market operations. Fisher effect (nominal and real interest rate). **Practice:** Mid-term test I.
8th week: 1st drawing week	
9th week: **Lecture:** *Money market* The demand for money. Supply and demand in the money market. The equilibrium interest rate. Mathematical and geometrical derivation of the LM curve. The equilibrium output and price-level. **Practice:** Calculation/team problems: The equilibrium output and price-level. Case study examination.	**10th week:** **Lecture:** *The aggregate demand and aggregate supply* Aggregate demand curve and aggregate supply curve. Movements along the demand and supply curve, shift in aggregate demand, the Equilibrium. Changes in Fiscal and Monetary policy. **Practice:** Calculation/team problems: Equilibrium analysis.
11th week: **Lecture:** *The labour market* The demand for labour, the supply of labour. The labour force, working-age population, active and inactive population, labour participation rate. Supply curve and demand curve, equilibrium. Employed population. **Practice:** Calculation/team problems: Supply of labour function and demand for labour function, equilibrium analysis.	**12th week:** **Lecture:** *Main macroeconomic problems - Unemployment* Measurement of unemployment, the unemployment rate, and the employment and activity rate. Types of unemployment (voluntarily and involuntarily unemployment; structural, frictional and cyclical unemployment), Okun law. **Practice:** Calculation/team problems: measurement of unemployment. Case study examination.
13th week: **Lecture:** *Main macroeconomic problems - Inflation* Inflation; (Price level, inflation rate, definition and measuring of inflation, types and causes of inflation, moderate, galloping and hyperinflation, demand side and supply side inflation, The relationship between unemployment rate and inflation rate – Philips curve). **Practice:** Test II.	**14th week:** **Lecture:** Growth (sources of economic growth, human capital, investment in human capital), Economic growth, Welfare and Sustainable development. Population and poverty. **Practice:** Calculation/team problems
15th week: 2nd drawing week	

Requirements

A, for a signature:

Participation in practice classes is compulsory. Students must 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 can't take part in any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent to an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor.

During the semester, there are two tests: the mid-term test on the 7th week and the end-term test on the 14th week. Students must sit for the tests.

B, for a grade (ESE):

The course ends in an examination.

The minimum requirement of the mid-term, the end-term test and the teamwork is 50% separately. Based on the scores of the tests separately, the grade for the tests and the examination is given according to the following table:

The grade is given according to the following table:

%	Grade
0-49	fail (1)
50-62	pass (2)
63-75	satisfactory (3)
76-89	good (4)
90-100	excellent (5)

If the score of any test is below 50%, the student once can take a retake test of the whole semester material.

Fundamentals of Quality- and Engineering Management

Code: MK3MIMMM04KX25-EN
ECTS Credit Points: 4 credits
Evaluation: exam
Prerequisites: -
Year, Semester: 2nd year 2nd semester
Number of teaching hours/week (lecture + practice): 2 + 2

Topics:

Quality and engineering management history, concepts and functions. The place and role of quality management in the management system of companies and institutions. Quality philosophies, quality schools. Evolution of quality management and applied quality tools. Characteristics of modern production systems, basic engineering tools for the design and development of production processes. The role of engineers in lean management systems.

Literature:

Compulsory:

- Total Quality Management: Key Concepts and Case Studies (Kiran D. R., 2016)
- The Toyota Way, Second Edition: 14 Management Principles from the World's Greatest Manufacturer (Jeffrey K. Liker, 2020)

Recommended:

- Strategic KAIZEN™: Using Flow, Synchronization, and Leveling [FSL™] Assessment to Measure and Strengthen Operational Performance (Masaaki Imai, 2021)

Schedule

1st week Registration week	
2nd week: **Lecture:** Evolution of manufacturing paradigms and industrial systems. History and basic concepts of quality management. **Practice:** Introductory exercises: tests for a clear understanding of the objectives.	3rd week: **Lecture:** The place and role of quality management in the management system of companies and institutions. Quality philosophies, quality schools. **Practice:** Case study and presentation related to the lecture material.
4th week: **Lecture:** The integrating role of quality management in the activities of organisations. The evolution of quality improvement approaches and techniques. **Practice:** Case study and presentation related to the lecture material.	5th week: **Lecture:** The philosophy and tools of Total Quality Management (TQM). Fundamentals of self-assessment models and their application. **Practice:** Case study and presentation related to the lecture material.
6th week: **Lecture:** The 7 Basic Quality Tools for continuous improvement. **Practice:** Case study and presentation related to the lecture material.	7th week: **Lecture:** Quality tools for engineers: QFD, FMEA, 8D. **Practice:** Graded exercise.
8th week: 1st drawing week	
9th week: **Lecture:** History and basic concepts of engineering management. Characteristics of modern production systems. **Practice:** Case study and presentation related to the lecture material.	10th week: **Lecture:** Lean management system. The TPS structure, JIT and JIDOKA concepts. Push vs. Pull systems. The role of engineers in lean management systems. **Practice:** Lean Lab Practice.
11th week: **Lecture:** Value Stream Management. Value Stream Mapping (VSM) – Value Stream Design (VSD). Developing Lean action plan. **Practice:** Lean Lab practice.	12th week: **Lecture**: Flow, synchronization, leveling. Creating continuous flow, takt time / cycle time balancing. **Practice:** Lean Lab practice
13th week: **Lecture:** Managing the change. Continuous improvement (CI) systems, types of Kaizen in an organization. Basic engineering tools for the design and development of production processes. **Practice:** Lean Lab Practice.	14th week: **Lecture:** From strategy to action. Vision, mission, values, strategy. Strategy deployment, Hoshin management. **Practice:** Graded exercise.

15th week: 2nd drawing week

Requirements

A, for a signature:

Participation in exercises, solving the assigned team tasks.

B, for a grade:

Mark offered on the basis of the graded exercise and team assignments (presentation), otherwise - written exam

Engineering Informatics

Code: MK3INF1A04KX25-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

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

Topics:

Number systems, number representations, and character codes (ASCII, UNICODE). Database models (hierarchical, network, ER, relational, object-oriented), normalization (1st, 2nd, 3rd, Boyce-Codd, 4th, 5th normal forms). Databases (hierarchical, network, relational, object-oriented, OLTP, OLAP) The Structured Query Language. Data structures (set, array, list, record, tree, file). Searching algorithms (full, linear, binary). Sorting algorithms (selection, bubble, insertion, quick). Computer programing (basic concepts, pseudo-code, flowchart, development models, data types, variable declarations, control structures, loops ...). Data compression (lossless and lossy compression algorithms). Data security (symmetric and asymmetric cyphers)
Practice:
We are implementing a real-world project, from data acquisition through the process of data to graphical results.
LabVIEW – for data acquisition and data storing
Excel and VBA Macros – for data process and graphical display

Literature:

Recommended:

- Microsoft Excel 2016 Bible: The Comprehensive Tutorial Resource
- Microsoft VBA 2016 Bible: The Comprehensive Tutorial Resource
- Jennings Richard: LabVIEW Graphical Programming, Fifth Edition

Schedule

1st week Registration week	
2nd week:	**3rd week: Excel 2.**
Lecture: Number systems, number representations, character codes	**Lecture:** Database models

Practice: Introduction to the course project

- Measurement System for electric motors
- LabVIEW simulated signal generating

Practice: LabVIEW DAQmx

- Signal processing
- Storing data in a measurement file

4th week: Excel 3.

Lecture: Database model normalization, databases

Practice: Importing data into Excel

- import from file (.txt, .csv, .lvm)

5th week: Excel 4.

Lecture: SQL

Practice: Excel data processing

Analyzing data:

- Ordering, summarizing, a range.
- Filter a range.
- Summarize data with subtotals.

6th week: Excel 5.

Lecture: Data structures (set, array, list, record)

Practice: Excel data processing

Formulas:

- Building Formulas.
- Move or copy a Formula.
- Reference Range or Sheet

Conditional and database functions:

- IF, SUMIF
- CHOOSE
- VLOOKUP, HLOOKUP, INDEX, MATCH

7th week: Excel 6.

Lecture: Data structures (graph, tree, file)

Practice: Excel data representation

Graphical representation in Excel:

- Creating Charts.
- Chart types.
- Chart Elements.
- Format and customize Excel Charts

Practicing for the Midterm test

8th week: 1st drawing week: Midterm test

9th week: VBA 1.

Lecture: Searching algorithms

Practice: Automation of data processing with VBA

Visual Basic for Applications (VBA) basics

- Variables.
- Data-Types
- Constants

10th week: VBA 2.

Lecture: Sorting algorithms

Practice: Automation of data processing with VBA

- Arithmetic Operators
- Logical Operators.
- Comparison Operators
- String Operators

11th week: VBA 3.

Lecture: Computer programing (basic concepts, pseudo-code, flowchart, development models)

Practice: Automation of data processing with VBA

- Arrays

12th week: VBA 4.

Lecture: Computer programming (datatypes, variable declarations, control structures, loops ...)

Practice: Automation of data processing with VBA

- Range Object
- Cell Property

	• Offset property
13th week: VBA 5. **Lecture:** Data compression (examples of lossless and lossy compression algorithms) **Practice:** Automation of data processing with VBA • Subroutine • Function • Return • Call	**14th week: VBA 6.** **Lecture:** Data security (examples of symmetric and asymmetric cyphers) **Practice:** Practicing for the End-term test
15th week: 2nd drawing week: End-term test	

Requirements

A, for a signature:

Regular attendance (Minimum 70 %). Successful accomplishment of homework.

B. Requirements for the grade:

Grades will be calculated as the average of midterm and end-term tests. Minimum requirements to pass the semester: Minimum 50% on both tests.

Basics of Engineering

Code: MK3MEISK04KX25-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Semester: 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week: 2+2

Topics:

Topics: SI units, basic and derived quantities, prefixes. Translational and rotational motion, moment of inertia, torque, work, power. Conservation of energy, viscous friction, dry friction, rolling resistance. Efficiency, power loss of machines. Bernoulli's equation, law of continuity, Venturi tube, water jet force. Entropy, specific heat capacity, latent heat, temperature-entropy diagram for steam. Classification of machines, power drives. Drive gears, flywheels, breaks, springs, bearings. Otto engines, Diesel engines. Positive displacement pumps, centrifugal pumps and gear pumps. Fans, compressors. Steam boilers, steam turbines, steam power plants, water turbines, wind power plants. Adaptation of prime movers and driven machines.

Literature:

Compulsory:

- Mechanical Engineers' Handbook, Volume 4 John Willey & Sons, 2006. ISBN: 9780471719885
- M. R. Lindeburg: Mechanical Engineering Reference Manual 13th. Professional Publications Inc., 2006. ISBN-13: 978-1591264149 ISBN-10: 1591264146

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture: SI units, basic and derived quantities, prefixes.	Lecture: Translational and rotational motion, moment of inertia, torque, work, power
Practice: Overview of The International System of Units (SI). Elaboration of kinetic and kinematic exercises.	Practice: Elaborating exercises in the following topics: losses of machines, efficiency, specific consumption, economical efficiency.
4th week:	5th week:
Lecture: Efficiency, power loss of machines.	Lecture: Bernoulli's equation, law of continuity, Venturi tube, water jet force.
Practice: Elaborating exercises in the topic of flywheels and hydrostatics. Utilization of Bernoulli's principle.	Practice: Elaborating calculation exercises in the field of hydrodynamics.
6th week:	7th week:
Lecture: Entropy, specific heat capacity, latent heat, temperature-entropy diagram for steam.	Lecture: Classification of machines, power drives. Drive gears, flywheels, breaks, springs,
Practice: Elaborating calculation exercises: the air as energy source.	Practice: Elaborating calculation exercises: machines transmitting fluid and the water vapour as energy source.
8th week: 1st drawing week	
9th week:	10th week:
Lecture: Otto engines, Diesel engines.	Lecture: Positive displacement pumps, centrifugal pumps and gear pumps.
Practice: Elaborating calculation exercises in connection with water vapour.	Practice: Elaborating calculation exercises: machines transmitting gas.
11th week:	12th week:
Lecture: Fans, compressors	Lecture: Steam boilers, steam turbines, steam power plants.
Practice: Elaborating calculation exercises: steam-engines, steam-boilers.	Practice: Elaborating calculation exercises: internal combustion engines.

13th week:	14th week:
Lecture: Water turbines, wind power plants.	**Lecture:** Adaptation of prime movers and driven machines
Practice: Elaborating calculation exercises: water turbines, topics of hydraulic and pneumatic machines.	**Practice:** Elaborating calculation exercises in the field of machine groups.

15th week: 2nd drawing week

Requirements

A, for a signature:

A, for a signature: Attendance at lectures is recommended, but not compulsory. Attending practices is compulsory. A student must attend the practices 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. A student cannot make up a 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 practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't 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: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for grade:

The course ends in an exam grade. The grade for the test is given according to the following table: Score Grade 0-59 % = fail (1); 60-69 % = pass (2); 70-79 % = satisfactory (3); 80-89 % = good (4); 90-100 % = excellent (5)

Technical Drawing and Basics of CAD

Code: MK3GEPRG05KX25-EN

ECTS Credit Points: 5

Evaluation: exam

Semester: 2nd semester

Its prerequisite(s): Engineering Informatics

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+3

Topics:

Students get acquainted with basic rules of preparation of technical documentation. They acquire the specifications and get routine in preparation and application of technical drawings. They get acquainted with CAD systems, and get routine in the use of AutoCAD software.

Drawing standards, formal requirements of machine drawings. Drawing sheet dimensions, line types and thickness groups. Projection views, sections and sectional views, revolved- and removed sections. Drawings of standardized machine elements: threads and thread symbols, bolted joint, gears, sprocket-wheel, splined shaft, bearings. Representation of welded joints. General prescriptions for dimensioning. Conventional dimensioning methods. Tolerance system. Defining fits: clearance, transition and interference fit. ISO Tolerance system. Form and position tolerances. Defining the surface roughness.

General properties of AutoCAD. Utilization of commands, menu bar options and icons. The layer-system of the AutoCAD, operations with layers. Use of outer references and blocks. Dimensioning possibilities, building up dimensional chains, representation of tolerances.

Literature:

Compulsory:

- Tiba Zsolt, Machine drawing, Debreceni Egyetemi Kiadó – Debrecen University Press, 2013
- Learning AutoCAD 2010, Autodesk Official Training Guide Edition, 2010

Recommended:

- Flender, Technical Handbook

Schedule

1st week Registration week	
2nd week: **Lecture:** Drawing standards, formal requirements of machine drawings. Drawing sheet dimensions, title block, defining the line types and thickness groups. Standardized letter and figure shape and sizes, scales, full size, reduction scales, enlarged scales. **Practice:** issuing task 1: Lettering	3rd week: **Lecture:** Defining the surfaces of a part. Views, auxiliary view, local view, sectional views and sections. Complex sectional views, removed sections, specific sectional views and sections. **Practice:** issuing task 2: Drawing Machine Parts. Practicing the presentation methods. Introduction of CAD systems, general properties of AutoCAD.
4th week: **Lecture:** General prescriptions for dimensioning, choosing basis surfaces. Conventional dimensioning methods. Specific dimensioning, defining and giving conical taper and flat taper	5th week: **Lecture:** ISO Tolerance system. Basic size, actual size, limits, deviations, fundamental deviation. Defining the tolerance IT grades.

Practice: submitting 1 and 2, issuing task 3: Shaft drawing. Practicing the presentation methods.
User interface of AutoCAD. Utilization of commands, menu bar options and icons.

6th week:

Lecture: Hole-base system, shaft base system. Defining fits: clearance, transition and interference fit.

Practice: submitting task 3, issuing task 4: Designing Fitting Pieces. Applying the cutting plane and the cutting sphere method to construct the intersection lines of interpenetrating surfaces.
The layer-system of the AutoCAD, operations with layers.

8th week: 1st drawing week

9th week:

Mid-term test

Lecture: Defining the surface roughness. Feasible roughness with different processing methods. Correlation between the surface roughness and the IT grade of dimension.

Practice: elaborating the shop drawing of pattern development of fitting pieces. Hatching, loading of styles, indication of areas to hatch in AutoCAD.

11th week:

Lecture: springs: the standardized representation of helical spring, Belleville spring, buffer spring, annular spring, multi-leaf spring. Keyed joints with saddle keys, sunk keys, parallel keys and woodruff keys. Splined shaft joint.

Practice: elaborating on task 5, Drawing threaded joints in section and on view.
Dimensioning possibilities in AutoCAD, building up dimensional chains, representation of tolerances.

13th week:

Practice: Applying the dimensioning methods to dimensioning parts.
"Modify" commands in AutoCAD. Effect of constructional commands on efficiency.

7th week:

Lecture: ISO Tolerance system. Form and position tolerances. Free dimensional tolerance.

Practice: Designing Fitting Pieces. Applying the triangulation and parallel line methods to develop fitting pieces. Representing tolerances and calculating its dimensions.
Insertion of texts in AutoCAD. Loading and modification of letter types.

10th week:

Lecture: Standardized Thread forms and its main features. Threads and thread symbols in drawing. Threaded joints: bolted joint, studded joint, screw fastening.

Practice: submitting task 4, issuing task 5: Screw Fastening and Joints. Presentation of tolerances and fits in drawing. Presentation of surface roughness in drawing. Use of outer references and blocks in AutoCAD.

12th week:

Lecture: Gears and toothed parts. Spur and helical gears, bevel gears, worms, rack and pinion gears, sprockets.

Practice: issuing task 6: Gearing. Drawing keyed joints and splined shaft joint in section and on view. Drawing in AutoCAD.

14th week:

Lecture: rolling bearings: ball and roller bearings. Riveted joints. Welding symbols and welded joints: butt joint, lap joint, tee joint, corner joint. **Practice:** submitting task 5, elaborating on task 6. Drawing in AutoCAD.	**Lecture: End-term test** **Practice:** submitting task 6. Drawing bearings, riveted and welded joints in section and on view. Drawing in AutoCAD.
15th week: 2nd drawing week	

A, for a signature:

Attendance on the **lectures** is recommended, but not compulsory.

Participation at **practice** is compulsory. Student must attend the practices and my not miss more than three practice during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Student cannot make up a practice with another group. The attendance on practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments for the course with them to each practice. Active participation is evaluated by the teacher in every class. If student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence due to the lack of active participation in class.

Students have to **submit all the six drawing tasks** made manually as well as with AutoCAD as scheduled minimum on a sufficient level.

During the semester there are two tests: the mid-term test is in the 9th week and the end-term test in the 14th week. Students have to sit for the tests.

B, for grade:

The course ends in **mid-semester grade**. Based on the average of the marks of the drawings and the average of the test results, the mid-semester grade is calculated as an average of them:

- average grade of the six drawing tasks
- average grade of the two tests

The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following:

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 covering the whole semester material.

Materials Engineering

Code: MK3ANISG05KX25-EN

Evaluation: exam

ECTS Credit Points: 5

Semester: 5th semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

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

Topics:

The structure and composition of a material, including the types of atoms and their arrangement, as viewed over a range of length scales (nano-, micro-, meso-, and macro-scale). The crystalline structure of metals, crystal defects. Solid solutions, compounds, alloys. Equilibrium conditions of systems, binary systems, phase diagrams. The iron-carbon phase diagram. Austenite transformations, principles of transformation diagrams (isothermal, continuous cooling). Ferrous and non-ferrous metals, basic micro-structures. Polymers, ceramics, composites. Material properties (physical, mechanical, electrical, optical, and magnetic). Calculation tasks for crystalline systems, phase diagrams, transformation diagrams.

Literature:

Compulsory:

- William D. Callister, David G. Rethwisch: Fundamentals of materials science and engineering: SI version, John Wiley and Sons, 2013., ISBN 978 1 118 32269 7

Recommended:

- ASM Handbook, Vol. 3: Alloy Phase Diagrams, ASM International, 1992., ISBN-10: 0871703815

Schedule

1st week Registration week	
2nd week:	**3rd week:**
Lecture: Introduction to material science. The classes and functions of materials and their properties.	**Lecture:** Production of metals. Chemical reactions during the production of iron. Steel, aluminium and copper production.
Practice: Overview of periodic system.	**Practice:** Classification of steels and cast iron.
4th week:	**5th week:**
Lecture: Crystal structures. Crystalline and noncrystalline materials. Imperfections in solids. Defects type: point, line, bulk, surface.	**Lecture**: Mechanical properties of metals. Concepts of stress and strain. Elastic, plastic deformation.

Practice: Crystallographic points, directions, and planes	**Practice:** Tension Tests. Computation of Load to produce specified diameter change.
6th week:	7th week:
Lecture: Dislocations and strengthening mechanisms. Mechanisms of strengthening in metals **Practice:** Failure: fracture, fatigue, creeps.	**Lecture:** Phase diagrams. Basic concepts, binary and multi-component systems, the Gibbs phase rule. Development of microstructure in isomorphous alloys. **Practice:** Determination of phase amounts, Lever rules, types of phase diagrams
8th week: 1st drawing week	
9th week:	10th week:
Lecture: Development of microstructure in iron–carbon alloys. **Practice:** Determination of iron – iron carbide phase diagram.	**Lecture:** Types of metal alloys. Classification scheme for the various ferrous alloys and alloying elements. **Practice:** Structure of alloyed steels
11th week:	12th week:
Lecture: Phase transformations: Microstructural and Property Changes in Iron–Carbon alloys. **Practice:** TTT diagrams - Microstructural Determinations for Isothermal Heat Treatments	**Lecture:** Structures, characteristics, applications and processing of polymers. **Practice:** Production and design of ceramics
13th week:	14th week:
Lecture: Structures, characteristics, applications and processing of polymers. **Practice:** Production and design of polymers.	**Lecture:** The classes and functions of composite materials and their properties. **Practice:** Production and design of composites
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance on the lectures is recommended, but not compulsory. Participation at practice is compulsory. Student must attend the practices and not miss more than three practice during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Student cannot make up a practice with another group. The attendance on practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor.

During the semester there are two tests: the mid-term test is in the first drawing week and the end-term test in the 2nd drawing week. Students have to sit for the tests. If the score of any test is below 60%, the student once can take a retake test covering the whole semester material.

B, for grade:

The course ends in a final exam, the grade is calculated as:

- 60% from the exam
- 20%-20% from the two tests

The minimum requirement for passing is 60%, the grade for the final mark is given according to the following:

0-59 % = fail (1); 60-69 % = pass (2); 70-79 % = satisfactory (3); 80-89 % = good (4); 90-100 % = excellent (5)

Environmental Operations

Code: MK3KVMVK06KX25-EN
ECTS Credit Points: 6
Evaluation: exam
Semester: 3rd semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 3+3

Topics:

LECTURE: The substance of environmental engineering science. Unit Operations of Environmental Engineering. Basis of environmental engineering thermodynamics of unit operations. Quantities describing the operational unit. Measurement, units and dimensions in the environmental engineering. Conversion of units. Conditions of equilibriums. Transport processes. Component, heat and momentum streams. The Benedek-László's 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, fluidization and mixing of liquid.
General characterization of transfer processes. Classification of transfer processes.
Heat transfer. General characterization of heat transfer. Heat transfer by convection, conduction and radiation. Unsteady- and steady state transfer of heat. The logarithmic mean temperature difference. Heat exchangers. Evaporation and crystallization. Evaporators and crystallizers.
Mass transfer processes. Mass transfer across a phase boundary, the two-film theory. Common interpretation of the operating line and the equilibrium curve. Mass transfer in the columns, the transfer units. Mass transfer in the cascades, the equilibrium units.
Mass transfer processes. Absorption. Evaporation. Distillation. Rectification. Extraction. Adsorption. Draying. Crystallization.
Chemical reaction engineering. Chemical reactors. Classification of reactors and choice of reactor type in the industry.
Mechanical operations. Size reduction of solids. Methods of operating crushers: coarse-, intermediate-, fine crushers and colloid mills. Classification of solid particles and settling. Blending of solid particles

PRACTICE: Problem-solving technique. Examples- and problems-solving in Environmental Techniqeus.

Literature:

Compulsory:

- Louis Theodore, R. Ryan Dupont, Kumar Ganesan: Unit Operations in Environmental Engineering. 2017. ISBN 9781119283638
- Waren L. McCabe; Julian C. Smith; Peter Harriott: Unit Operation of Chemical Engineering. Seventh Edition, McGraw Hill Higher Education. 2021. ISBN 007-124710-6

Recommended:

- 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 Fundamantals and Applications. Second Edition. McGraw Hill Higher Education, 2010, ISBN 978-0-07-352926-4
- H. Scott Fogler: Elements of Chemicel Reaction Engineering. Forth Edition, 2006.Personal Education International 2006. ISBN 0-13-127839-8
- 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: The importance of environmental techniques. Quantities describing the operational unit. Measurement, units and dimensions in the environmental engineering. Practice: Unit and unit conversion	3rd week: Lecture: The classification of operational units. processes. Component, heat and momentum streams. Practice: Examples- and problems-solving related to the topic of lecture.
4th week: Lecture: The Benedek-László's equation. Flow of fluids, energy and momentum relationships. Practice: Examples- and problems-solving related to the topic of lecture.	5th week: Lecture: Separation of heterogeneous systems: Sedimentation, centrifugation, fluidization. Practice: Examples- and problems-solving related to the topic of lecture.
6th week: Lecture: Separation of heterogeneous systems: filtration and mixing of liquid. General characterization of transfer processes. Classification of transfer processes. Practice: Examples- and problems-solving related to the topic of lecture.	7th week: Lecture: Mechanical operations. Size reduction of solids. Methods of operating crushers: coarse-, intermediate-, fine crushers and colloid mills. Classification of solid particles and settling. Blending of solid particles Practice: 1st calculation test
8th week: 1st drawing week	
9th week:	10th week:

Lecture: Heat transfer. General characterization of heat transfer. Heat transfer by convection, conduction and radiation. Unsteady- and steady state transfer of heat. The logarithmic mean temperature difference. Heat exchangers. **Practice:** Examples- and problems-solving related to the topic of lecture.	**Lecture:** Mass transfer processes. Mass transfer across a phase boundary, the two-film theory. Common interpretation of the operating line and the equilibrium curve. Mass transfer in the columns, the transfer units. Mass transfer in the cascades, the equilibrium units. **Practice:** Examples- and problems-solving related to the topic of lecture.
11th week: **Lecture:** Mass transfer processes. Absorption. Distillation. Rectification. Adsorption. Crystallization. **Practice:** Examples- and problems-solving related to the topic of lecture.	**12th week:** **Lecture:** Mass transfer processes. Evaporation. Extraction. Ion exchange. **Practice:** Examples- and problems-solving related to the topic of lecture.
13th week: **Lecture:** non-equilibrium component separation operations: membrane separation process **Practice:** Examples- and problems-solving related to the topic of lecture.	**14th week:** **Lecture:** Chemical reaction engineering. Chemical reactors. Classification of reactors and choice of reactor type in the industry. **Practice:** 2nd calculation test
15th week: 2nd drawing week	**Retake of the Practice tests**

Requirements

A, for a signature:

Attendance at lectures is recommended, but not compulsory.

Participation at practice classes is compulsory. A student must 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. A student can't make up a practice class with another group. Attendance at practices 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 practices should be made up for at a later date, being discussed with the tutor.

During the semester there are two tests: the mid-term test in the 7th week and the closing test in the 14th week. Practice grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (average), 4 (good), 5 (excellent) calculated from as an average of the midterm test and closing test. Minimum requirement for the tests is 50%. Students have to sit for the tests.

B, for a grade:

For their exam everybody will get an exam grade. The final grade will be the average of the practice grade and exam grade. If it is for example (3.5) then the lecturer decides if it is (3) or (4).

Sample exam test questions provided on the e-learning in the beginning of December. All lecture materials are posted at least one day after the lecture.

The grade for each test is given according to the following table:

Score Grade

0-49 fail (1)

50-64 pass (2)
65-79 satisfactory (3)
80-89 good (4)
90-100 excellent (5)

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

Environmental Energetics

Code: MK3KENGK06KX25-EN
ECTS Credit Points: 6
Evaluation: mid-semester grade
Semester: 4th semester
Its prerequisite(s): Environmental Operations
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 3+2

Topics:

LECTURE: Introduction and basic concepts: Energy and thermodynamics. Importance of Dimensions and units. Systems and control volumes. Properties of a system. State and equilibrium. Process and cycles. Temperature and the zeroth law of thermodynamics.

Energy, energy transfer, and general energy analysis: Forms of energy. Energy transfer by heat and energy transfer by work. Mechanical forms of work. The first law of thermodynamics. Energy conversion efficiencies. Energy and environment.

Properties of pure substances: Phases and pure substances. Phase-change processes of pure substances. Property diagrams for phase-change processes. Property tables. The ideal-gas equation of state. Compressibility factor. Other equations of state.

Energy analysis of closed systems: Moving boundary work. Energy balance for closed systems. Specific heat. Internal energy, enthalpy and specific heats of ideal gases, solids, and liquids. Flow work and the energy of a flowing fluid.

The second law of thermodynamics. Thermal energy reservoirs. Heat engines. Refrigerators and heat pumps. Perpetual-motion Machines. Reversible and irreversible processes. The Carnot cycle and principles. The Carnot heat engine, refrigerator, and heat pump. Entropy: The increase of entropy principle. Entropy change of pure substances. Isentropic processes. Entropy change of liquid, solids, and ideal gases. Reversible steady-flow work. Isentropic efficiencies of steady-flow devices. Entropy balance.

Gas power cycles: Otto cycle, the ideal cycle for spark-ignition engines. Diesel cycle, the ideal cycle for compression-ignition engines. Brayton cycle, the ideal cycle for gas-turbine engines. Vapor and combined power cycle: The Carnot vapor cycle. Rankine cycle, the ideal cycle for vapour power cycle. Refrigeration cycle. Refrigerators and heat pumps. Power station: Fossil-fuel power station: Natural gas-fired plants and coal-fired power station. Nuclear power plants. Geothermal power stations. Biomass-fuelled power plants. Hydroelectricity. Solar thermal electric plants. Wind power electric plants.

SEMINARS: Problem-solving technique. Examples- and problems-solving in themes of Environmental Energetics.

Literature:

Compulsory:

- Richard T. Wright Dorothy F. Boorse: Environmental Science toward a sustainable future (13th edition), 2016. ISBN-10: 0134312872
- Jean-Philippe Anserment and Sylvain D. Brechet: Principles of Thermodynamics. Cambridge University Press. 2019. ISBN 978-1-108-42609-1
- Comprehensive Engineering Thermodynamics. LAP LAMBERT Academic Publishing. 2022. ISBN 6205488507
- Dirk Assmann: Renewable Energy. Taylor & Franic Ltd. 2016. ISBN 9781138985124

Recommended:

- Yanus A. Cengel: Introduction to thermodynamics and heat transfer. International Edition, Boston, 2007. ISBN: 0-07-122660-5
- Yunus A. Cengel and John N. Cimbala: Fluid Mechanics, Fundamentals and Applications. Second Editions. McGraw-Hill Higher edition, Boston, 2010. ISBN: 978-0-07-352926-4
- David M. Himmelblau and James B. Riggs: Basic Principles and Calculations in Chemical Engineering. Second Edition. Prentice Hall International Series in the Physical and Chemical Engineering Sciences. 2004. ISBN: 0-13-140634-5
- 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:** Introduction and basic concepts: Energy and thermodynamics. Importance of Dimensions and units. Systems and control volumes. Properties of a system. State and equilibrium. Process and cycles. Temperature and the zeroth law of thermodynamics. **Practice:** Examples- and problems-solving related to the topic of lecture.	3rd week: **Lecture:** Energy, energy transfer, and general energy analysis: Forms of energy. Energy transfer by heat and energy transfer by work. Mechanical forms of work. The first law of thermodynamics. Energy conversion efficiencies. Energy and environment. **Practice:** Examples- and problems-solving related to the topic of lecture.
4th week: **Lecture:** Properties of pure substances: Phases and pure substances. Phase-change processes of pure substances. Property diagrams for phase-change processes. Property tables. The ideal-gas equation of state. Compressibility factor. Other equations of state. Energy analysis of closed systems. **Practice:** Examples- and problems-solving related to the topic of lecture.	5th week: **Lecture:** The second law of thermodynamics. Thermal energy reservoirs. Entropy: The increase of entropy principle. Entropy change of pure substances. Isentropic processes. Entropy change of liquid, solids, and ideal gases. Reversible steady-flow work. Isentropic efficiencies of steady-flow devices. Entropy balance. **Practice:** Examples- and problems-solving related to the topic of lecture.
6th week:	7th week: **Lecture**: 1st Theoretical test

Lecture: Vapor and combined power cycle: The Carnot vapor cycle. Rankine cycle, the ideal cycle for vapour power cycle. **Practice:** 1st calculation test	**Practice:** Examples- and problems-solving related to the topic of 6th lecture.
8th week: 1st drawing week	-
9th week: **Lecture:** Power station: Fossil-fuel power station: Natural gas-fired plants and coal-fired power station. Nuclear power plants. **Practice:** Examples- and problems-solving related to the topic of lecture.	**10th week:** **Lecture:** Gas power cycles: Otto cycle, the ideal cycle for spark-ignition engines. Diesel cycle, the ideal cycle for compression-ignition engines. Brayton cycle, the ideal cycle for gas-turbine engines. **Practice:** Examples- and problems-solving related to the topic of lecture.
11th week: **Lecture:** Refrigeration cycle. Refrigerators and heat pumps. Introduction to renewable energy sources (determination, potential). **Practice:** Examples- and problems-solving related to the topic of lecture.	**12th week:** **Lecture:** Geothermal power stations. Biomass-fuelled power plants. **Practice:** Examples- and problems-solving related to the topic of lecture.
13th week: **Lecture:** Hydroelectricity. Solar thermal electric plants. Wind power electric plants. **Practice:** 2nd calculation test	**14th week:** **Lecture:** 2nd Theoretical test **Practice:** Retake of the calculation tests
15th week: 2nd drawing week	**Retake of the Theoretical tests**

Requirements

A, for a signature:

Attendance at lectures is recommended, but not compulsory.

Participation at practice classes is compulsory. A student must 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. A student can't make up a practice class with another group. Attendance at practices 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 practices should be made up for at a later date, being discussed with the tutor.

During the semester there are **two calculation tests**. the mid-term test in the 6th week and the closing test in the 13th week. Practice grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (average), 4 (good), 5 (excellent) calculated from as an average of the midterm test and closing test. Minimum requirement for the tests is 50%. Students have to sit for the tests.

During the semester there are **two theoretical part tests**: the mid-term test in the 7th week and the closing test in the 14th week. Practice grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (average), 4 (good), 5 (excellent) calculated from as an average of the midterm test and closing test. Minimum requirement for the tests is 50%. Students have to sit for the tests.

B, for a mid-semester grade:
The course ends in mid-semester grade based on the average grade of the four tests. The minimum requirement for the mid-term and end-term tests is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

Score Grade
0-49 fail (1)
50-62 pass (2)
63-75 satisfactory (3)
76-87 good (4)
88-100 excellent (5)

If the score of any test is below 50, the student once can take a retake test covering the whole semester material.

Environmental Law and Administration

Code: MK3KOJGK03KX25-EN
ECTS Credit Points: 3
Evaluation: mid-semester grade
Semester: 5th semester
Its prerequisite(s): Studies of Law and Business
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice):

Topics:
The class includes the following topics. Basic legal and administration terms and principles, legal resources, validity and effects of legal resources, different legal systems, indigenous laws and traditions, legal hierarchy and different ways of legal interpretation. Basic terms and principles of environmental law, the methodology and classification of environmental law. Environmental authorization procedures, types environmental permits, environmental authorities. Basics of EU and international environmental law.
Practice: improving ability to find the appropriate legislation, case studies to improve legal interpretation and problem solving, practices on how environmental permits/declarations should look like and how they can be interpreted.

Literature

Compulsory
Stuart Bell, Donald McGillivray, Ole Pedersen, Emma Lees, and Elen Stokes: Environmental Law (Ninth Edition). Published: 01 June 2017, Oxford University Press, 872 Pages ISBN: 9780198748328.

Recommended
Herwig - Hofmann (ed.) et al. Specialized Administrative Law of the European Union: A Sectoral Review. Oxford University Press, 2018.

Schedule

1st week Registration week	
2nd week: **Lecture:** The current situation and challenges of environmental protection in	3rd week: **Lecture:** What is law? How does it function?

the world. The role of law in environmental protection. **Practice:** Watching a relevant movie.	**Practice:** Overview of different legal and environmental policy documents to learn distinguish between them.
4th week: **Lecture:** Legal resources, validity and different legal effects. **Practice:** Case studies.	**5th week:** **Lecture:** Different legal systems, indigenous laws and traditions. **Practice:** Case studies.
6th week: **Lecture:** What is environmental law and administration? The general system of environmental regulation. **Practice:** Case studies.	**7th week:** **Lecture**: Methodology of environmental regulation **Practice:** Case studies.
8th week: 1st drawing week	
9th week: **Lecture:** Environmental authorization procedures. **Practice:** Cases studies.	**10th week:** **Lecture:** Environmental permits. **Practice:** Case studies.
11th week: **Lecture:** Environmental authorities. **Practice:** Case studies.	**12th week:** **Lecture:** EU environmental law in a nutshell **Practice:** Case studies.
13th week: **Lecture:** International environmental law in a nutshell. **Practice:** Case Studies	**14th week:** **Lecture:** Summary **Practice:** Test
15th week: 2nd drawing week	

Requirements

Students are obliged to attend classes regularly. 3 misses are possible. Active participation is requested and evaluated by the teacher in every class.
The course ends in a written exam covering the whole semester material and the students get grade on the base of its result.

Environment, Health and Safety, Ergonomics (Basics of EHS)

Code: MK3EHSAK04KX25-EN
ECTS Credit Points: 4
Evaluation: exam
Semester: 1st semester

Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
Environment (E): In connection with environment protection the most important topics are introduced to the students. The subject includes air quality, noise protection, water protection, soil protection, and waste management side topics.
Health (H): Basics of labor and health are discussed. The impact of work on health and the health impact on working ability is also a side topic. The fundamentals of occupational health and work hygiene are also involved.
Safety (S): It involves the basics of labor safety and fire protection. The lectures discuss the personal, material and organizational requirements for safe work, ergonomic fundamentals, personal protective equipment, work safety reviews, employer checks, and workplace risk assessment. Industrial safety and security is also a side topic.
The lectures introduce the most important aspects and the practices focus on examples and plant visits.

Literature:
Compulsory:

- Gilbert M. Masters, Wendell P. Ela: Introduction to Environmental Engineering and Science, Pearson New International Edition, 3/E, Pearson, 2013, ISBN: 9781292025759
- David L. Goetsch, Occupational Safety and Health for Technologists, Engineers, and Managers, 8th Edition, Pearson, 2015, ISBN: 9780133484175
- Lon H. Ferguson, Christopher A. Janicak, Fundamentals of Fire Protection for the Safety Professional, 2nd Edition, Bernan Press, 2015, ISBN: 9781598887112

Recommended:

- Richard T. Wright, Environmental Science, Pearson, 2017, Isbn: 9780134011271

Schedule

1st week Registration week	
2nd week: Lecture: The development and basic concepts of environmental protection and management. **Practice:** Practice in connection with environmental management (plant visit)	3rd week: Lecture: Basics of air quality protection, air pollutants, greenhouse gases, ozone layer problem, smogs, acid rain. **Practice:** Practice in connection with air quality protection (plant visit)
4th week: Lecture: Fundamentals and issues of protection against environmental noise. **Practice:** Practice in connection with noise protection (plant visit)	5th week: Lecture: Water quality and water management issues and technologies. **Practice:** Practice in connection with water quality protection (plant visit)
6th week: Lecture: Preserving and protecting soil quality.	7th week: Lecture: Waste treatment, disposal options, equipment, hazardous waste.

Practice: Practice in connection with soil quality protection (plant visit)	**Practice:** Practice in connection with waste management (plant visit)
8th week: 1st drawing week	
9th week: **Lecture:** Personal, material and organizational requirements for safe work, ergonomic fundamentals. **Practice:** Practice in connection with labor safety I. (plant visit)	10th week: **Lecture:** The impact of work on health and the health impact on working ability. **Practice:** Practice in connection with labor safety II. (plant visit)
11th week: **Lecture:** The impact of work on health and the health impact on working ability. **Practice:** Practice in connection with occupational health I.	12th week: **Lecture:** Fundamentals of occupational health and work hygiene. **Practice:** Practice in connection with occupational health I-II.
13th week: **Lecture:** Main goals of industrial safety and security. **Practice:** Practice in connection with industrial safety and security.	14th week: **Lecture:** Test **Practice:** -
15th week: 2nd drawing week	Retake of the Theoretical tests

Requirements

A, for a signature:

Attendance to the practices (absence up to the permissible level)

B, for a grade:

The final grade will be the average of the tests. Each test hast to be at least 50%.

Radiation Protection and Environmental Radioactivity

Code: MK3SGROK03KX25-EN

ECTS Credit Points: 3

Evaluation: exam

Semester: 5th semester

Its prerequisite(s): Engineering Physics

Further courses are built on it: Yes/No

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

Topics:

The course covers the following topics: the structure of matter, the laws of radioactive decay, particle radiation, the interaction of radiation with matter and the different measurement methods. The dosimetry

of ionising radiation and the principles of radiation protection and its legal background. The phenomenon of natural environmental radioactivity, with a special emphasis on the significance of radon and radiocarbon in particular. The effects of artificial radioactivity and nuclear reactors, their operational and accidental releases, especially in case of Paks Nuclear Power Plant.

Students will also learn about radioactive waste disposal methods and their environmental impact, as well as the radiation protection aspect of radioactive emissions and waste from coal-fired power plants. They will be given an overview of the therapeutic applications of nuclear medicine, radiotherapy and radiopharmaceuticals and their radiation protection implications.

Literature:

Compulsory:

- Henriksen, Thormod, and David Maillie. (2002) 2002. Radiation and Health. 1st ed. CRC Press.

Schedule

1st week Registration week	
2nd week: **Lecture:** The structure of the material. Radioactive decay laws. Particle radiation. **Practice:** block practice visiting Paks Nuclear Power Plant	3rd week: **Lecture:** The interaction of radiation with matter. Methods for measuring radiation. **Practice:** block practice
4th week: **Lecture:** Dosimetry of ionizing radiation. The principles of radiation protection. Legislative background. **Practice:** block practice	5th week: **Lecture:** Natural sources of radiation **Practice:** block practice
6th week: **Lecture:** Radon in the environment. Testing and mitigation. **Practice:** block practice	7th week: **Lecture:** Radiocarbon and its applications in environmental studies **Practice:** block practice
8th week: 1st drawing week	
9th week: **Lecture:** Artificial radioactivity. Nuclear power plants. Radioactive releases. **Practice:** block practice visiting HUN-REN Institute for Nuclear Research	10th week: **Lecture:** Nuclear and radioactive accidents, their ecological impacts **Practice:** block practice

11th week: **Lecture:** The environmental activities of Paks nuclear power plant and their social perception. **Practice:** block practice	12th week: **Lecture:** Radioactive waste disposal methods and their environmental impact. **Practice:** block practice
13th week: **Lecture: Radioactive releases of coal power plants.** TENORM materials **Practice:** block practice	14th week: **Lecture:** Nuclear medicine. Radiation therapy. Therapeutic applications of radiopharmaceuticals. **Practice:** block practice
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance on the **lectures** is recommended, participation at the block **practices** is compulsory.

B, for grade:

Students must submit a written home-assignment based on which they will get their final grade.

Nature, Landscape and Water Environment Protection

Code: MK3TTVKK04KX25-EN
ECTS Credit Points: 4
Evaluation: mid-semester grade
Semester: 5th semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
The concept, object, characteristics, Hungarian and international history of nature conservation. Presentation of the types and hierarchy of nature conservation areas in Hungary. Presentation of World Heritage Sites, protected areas of Europe. Learning the forms of landscape conservation, nature conservation (types of protected natural values, international, national and local protection categories) and active and passive nature conservation. General landscape protection tasks, landscape management practices in urban, recreational and agricultural landscapes. Application of knowledge in landscape planning tasks related to the presentation of protected landscapes.

Literature:

- Voloscuk I. (ed).: The National Parks and Biosphere Reserves in Carpathians-The last nature paradise, ACANAP, Tatranská Lominca, Slovak Republic, ISBN: 80-88680-31-X, 1999
- Otero C., Bailey C.: Europe's Natural and Cultural Heritage, Friends of the countryside, ISBN: 84-607-9790-2, 2003
- Tucker G, ed. Nature Conservation in Europe: Approaches and Lessons. Cambridge University Press; 2023.

Schedule

1st week Registration week	
2nd week: **Lecture:** Ecological bases of nature conservation, background sciences. The relationship between nature protection, landscape and environmental protection, the connections of the specialized fields. **Practice:** Presentation of Hungarian national parks. I. (Hortobágyi, Kiskunsági, Körös - Maros, Aggteleki, Duna - Dráva)	**3rd week:** **Lecture:** The development, history, and place of conservation ecology among the biological sciences. The structure of the biosphere. Hierarchy and characteristics of supra-individual systems. Spatial and temporal patterns. **Practice:** Presentation of Hunagrian national parks. I. ((Duna – Ipoly, Balatonfelvidéki, Bükki, Őrségi, Fertő – Hanság)
4th week: **Lecture:** Laws of pattern formation, conservation consequences. Organism-centeredness, complementarity, causality.	**5th week:** **Lecture:** Ecological methods in nature conservation, landscape and water environmental protection. The principle of limitation and indication. Niche theory as a

Practice: Interpretation of the concept of landscape. The scientific background of landscape protection, its relationship with the environment and nature conservation. Natural landscape hierarchy levels.	tool for interpreting ecological processes taking place in the landscape. **Practice:** Landscape-forming factors, the landscape as a system. Natural and cultural landscape. Impact points of human activities. Presentation of landscape types. Landscape classification.
6th week: **Lecture:** Population biology considerations for the protection of natural systems. Temporal and spatial representation of populations. Effects affecting population size, carrying capacity, competition. Natural selection.	7th week: **Lecture**: The development of nature conservation. Early period - preservation of natural assets. From the idea of nature conservation to the first national park. The development of nature conservation in Hungary, from the first forest law to the first nature conservation area.
Practice: Definition of landscape protection, points of impact of protection. Landscape potential, unique landscape values. Landscape protection relations of land use.	**Practice:** Landscape ecology. Landscape assessment, impact assessments, ecological risk analysis. Applied landscape ecology, landscape care, landscape conservation, nature conservation. Landscape management, sustainability of landscape potential. The role of landscape protection and landscape ecology in economic planning.
8th week: 1st drawing week	
9th week: **Lecture:** The independence of nature conservation. The establishment of the National Nature Conservation Council. The role of science, forestry and social movements (ornithology) in the development of nature conservation. The the first national park **Practice:** Water as the medium and condition of life. The importance of water in the biosphere. Physical and chemical characteristics of the aquatic environment. Aquatic and wetland habitats. General characterization of aquatic habitats and types of life forms, types of life forms of aquatic organisms, their characterization.	10th week: **Lecture:** The development of modern nature conservation. A period of extensive development of nature conservation. The establishment of the national park network. The international background of development. The role of green movements. **Practice:** Types of traffic, surface and underground waters. Comparative presentation of water quality systems. Presentation of the most important elements of water circulation and their biogeochemical cycles.
11th week: **Lecture:** The development of the legal regulation of nature conservation. International contracts. The change in the	12th week: **Lecture:** The EU's nature conservation strategy. Bird Protection and Habitat Protection Directives. Natura 2000 system and its regulation in Hungary. Pannonian

structure of nature protection after the integration with environmental protection. **Practice:** The conceptual system and significance of biological water qualification. (Halobicity, trophicity, saprocity, toxicity.) Concepts of ecological water qualification, saprobiological water classification systems.	biogeographical region. Fragmentation, mosaicing. **Practice:** Quality and quantity protection of waters. Development of water management. The importance of protecting wetlands.
13th week: **Lecture:** The professional practice of nature conservation management. (Preservation, conservation, rehabilitation, reconstruction, creation) The role of natural disturbance processes in the maintenance of biological diversity. **Practice:** Water management issues related to climate change	**14th week:** **Lecture:** The role of a landscape-scale approach in modern nature conservation. Conflicts between farming and nature conservation. Nature conservation issues related to the economic landscape. **Practice:** The EU's water protection and water management guidelines. (Water Framework Directive) Water catchment management planning. Our tasks, a change of attitude in water management.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Active participation in lectures and exercises is a successful fulfilment of the tasks defined by the lecturer

B, for a grade:

The course ends in mid-semester grade, the course ends in a written end-term test at the above mentioned weeks. The minimum requirement for the written test is 50%. Based on the total score, the grade is given according to the following table:

Score Grade
0-49 fail (1)
50-62 pass (2)
63-75 satisfactory (3)
76-87 good (4)
88-100 excellent (5)

If the case of failure, students can take retake written tests in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Environmental Impact Assessment

Code: MK3KAHVK04KX25-EN
ECTS Credit Points: 4
Evaluation: exam
Semester: 5th semester

Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
Environmental assessment and sustainable development. Place of environmental assessment in environmental management, Environmental management models, International outlook of environmental assessment. Environmental assessment in the European Union, Hungarian regulation of environmental state assessment, provisions of Act LIII of 1995. The concept and types of environmental assessment. Environmental assessment methods, Evaluation criteria. Analysis of risks. Information needs and methodological development opportunities of environmental assessment. General basics of environmental impact assessments. Environmental impact assessment process and methodology. Monitoring.

Literature:

- Bastmeijer, K., Koivurova, T.: Theory and Practice of Transboundary Environmental Impact Assessment. Martinus Nijhoff Publishers, 2008.
- Ravi Jain, Lloyd Urban, Harold Balbach and M. Diana Webb (editors) Handbook of Environmental Engineering Assessment, Butterworth-Heinemann, Boston, 2012
- Colombo, A. G.: Environmental Impact Assessment. Springer Verlag, 2012
- Wathern, P.: Environmental Impact Assessment. Theory and Practice. Routledge (Taylor and Francis Group), 2013
- Arjun Kumar A. Rathi: Handbook of Environmental Impact Assessment, Cambridge Scholars Publishing, 2021

Schedule

1st week Registration week	
2nd week: Lecture: Environmental assessment and sustainable development Practice: Examination of documents, practical tasks	3rd week: Lecture: Place of environmental assessment in environmental management, Environmental management models, International outlook of environmental assessment Practice: Examination of documents, practical tasks
4th week: Lecture: Environmental assessment in the European Union, Hungarian regulation of environmental state assessment Practice: Examination of documents, practical tasks	5th week: Lecture: Regulation of environmental state assessment in Hungary, provisions of Act LIII of 1995. Practice: Examination of documents, practical tasks.
6th week: Lecture: The concept and types of environmental assessment.	7th week: Lecture: Environmental assessment methods, Evaluation criteria

Practice: Examination of documents, practical tasks.	**Practice:** Examination of documents, practical tasks.
8th week: 1st drawing week	
9th week: **Lecture:** Analysis of risks **Practice:** Examination of documents, practical tasks.	**10th week:** **Lecture:** Information needs and methodological development opportunities of environmental assessment **Practice:** Examination of documents, practical tasks.
11th week: **Lecture:** General basics of environmental impact assessments **Practice:** Examination of documents, practical tasks.	**12th week:** **Lecture:** Environmental impact assessment process and methodology **Practice:** Examination of documents, practical tasks.
13th week: **Lecture:** Environmental impact identification methodology. **Practice:** Examination of documents, practical tasks	**14th week:** **Lecture:** Monitoring **Practice:** Examination of documents, practical tasks.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Active participation in lectures and exercises is a successful fulfillment of the tasks defined by the lecturer

B, for a grade:

The course ends in a **written examination**. The minimum requirement for the written examination is 50%. Based on the total score, the grade is given according to the following table:

Score Grade
0-49 fail (1)
50-62 pass (2)
63-75 satisfactory (3)
76-87 good (4)
88-100 excellent (5)

Noise and Vibration Control

Code: MK3ZRVDK05KX25-EN

Evaluation: mid-semester grade

ECTS Credit Points: 5

Semester: 4th semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+3

Topics:

The theoretical part of the course covers the following topics: the concept of noise, fundamental concepts, levels, operations with levels, octave and third-octave frequency analysis, sound propagation in open space, point, line, and surface sound sources, propagation in enclosed spaces, sound absorption, reverberation time, energy distribution in enclosed spaces, sound insulation, effects of noise on humans, perceptual acoustics, the concepts of phon and sone, Fletcher-Munson curves, noise measurement and instruments, environmental noise (industrial, road, rail, and air traffic noise), methods for reducing environmental noise, strategic noise mapping, basic concepts of vibration, workplace vibrations affecting humans, vibration measurement (instruments, sensors), and methods of vibration reduction.

In the practical part, students conduct noise measurements in road, rail, industrial, and workplace settings and document their findings in reports. Additionally, they perform calculations and solve tasks related to the course topics.

Literature:

Compulsory:

- David A. Bies, Colin Hansen, Carl Q. Howard, Kristy L. Hansen: Engineering Noise Control, 6th Edition, 2023, ISBN 9780367414788
- Enda Murphy, Eoin A King: Environmental Noise Pollution - Noise Mapping, Public Health, and Policy, 2nd Edition, 2022, ISBN: 9780128201015

Schedule

1st week, Registration week	
2nd week: **Lecture:** The concept of noise. Basic concepts. **Practice:** Background of workplace noise measurement.	3rd week: **Lecture:** Levels. Operations with levels. Octave and third-octave frequency analysis. **Practice:** Workplace noise measurement.
4th week: **Lecture:** Sound propagation outdoor. Point, line, and surface sound sources. **Practice:** Preparation of workplace noise measurement reports.	5th week: **Lecture:** Sound propagation indoor. Sound absorption, reverberation time, energy distribution. Sound insulation. **Practice:** Background of road traffic noise measurement.
6th week:	7th week: **Lecture:** Noise measurement and instruments. Environmental noises.

Lecture: Effects of noise on humans. Perceptual acoustics. The concepts of phon and sone. Fletcher-Munson curves. **Practice:** Road traffic noise measurement.	**Practice:** Preparation of road traffic noise measurement reports.
8th week: Mid-term Test	
9th week: **Lecture:** Calculations and problem-solving. **Practice:** Background of railway noise measurement.	10th week: **Lecture:** Environmental noises (industrial, road, rail, aviation noise). **Practice:** Railway noise measurement.
11th week: **Lecture:** Possibilities for reducing environmental noise. Strategic noise mapping. **Practice:** Preparation of railway noise measurement reports.	12th week: **Lecture: Basic concepts of vibration.** **Practice:** Background of industrial noise measurement.
13th week: **Lecture:** Workplace vibrations affecting humans. **Practice:** Industrial noise measurement.	14th week: **Lecture:** Vibration measurement (instruments, sensors). Methods of vibration reduction. **Practice:** Preparation of industrial noise measurement reports.
15th week: End-term Test	

Requirements

A, for a signature:

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

Participation at **practice classes** is compulsory. A student must 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. A student can't make up a practice class with another group. Attendance at practices 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.

Students have to **submit all the four noise measurement reports (workplace, road traffic, railway and industrial noise)** as scheduled minimum on a sufficient level.

B, for a grade:

During the semester there are **two tests**. Students have to sit for the tests and reach at least 50%.

The mid-semester grade is calculated as the average of the theoretical part (evaluated based on the two tests: 0-49% fail (1), 50-62% pass (2), 63-75% satisfactory (3), 76-87% good (4), 88-100% excellent (5)) and the practical part (average of the four reports).

Waste Management

Code: MK3HUGKK05KX25-EN
ECTS Credit Points: 5
Evaluation: exam
Semester: 3rd semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 4+1

Topics:

This subject aims to cover different areas of waste management. Legislation and regulation of wastes. European Union waste management policy, waste strategy in the EU. Municipal solid waste (MSW), hazardous waste, sewage sludge, and other wastes. Life cycling analysis of materials recycling. Waste containers, collection systems, transport. The logistics of solid waste collection. Types of collection systems, equipment, and personnel requirements. 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. Green engineering and sustainable design aspects. Integrated waste management strategies.
Seminars/Practice: developing a composting program, studying different composting technologies used in practice, determination of advantages and disadvantages

Literature:

Compulsory:

- 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. **Practice:** Environmental, public, and industrial health considerations.	3rd week: **Lecture:** Legislation and regulation of wastes. European Union waste management policy, waste strategies. **Practice:** Overview of the Sustainable Development Goals
4th week: **Lecture:** Options of waste treatment and disposal. The economics of waste management. Waste management plans. **Practice:** Waste management plans.	5th week: **Lecture:** Waste containers, types of collection systems, equipment, and personal requirements. **Practice:** The logistics of solid waste collection.
6th week: **Lecture:** Waste landfill, types of waste landfilled. **Practice:** Landfills for hazardous waste, for non-hazardous waste, and for inert waste.	7th week: **Lecture**: Waste incineration, incineration technologies. Negative effects on the environment caused by the incineration of waste. **Practice:** Operational conditions, technical requirements, and emission limit values for incineration and co-incineration plants.
8th week: 1st drawing week	
9th week: **Lecture:** Life cycling analysis of materials recycling. Recyclable materials, municipal recycling facilities. **Practice:** Turning waste into a resource and build up a circular economy.	10th week: **Lecture:** Composting, anaerob digestion. Composting of municipal solid wastes. **Practice:** Treatment methods for biodegradable waste.
11th week: **Lecture:** Other waste treatment technologies: pyrolysis, gasification. **Practice:** Shipment of waste around the world.	12th week: **Lecture:** Green engineering and sustainable design aspects. **Practice:** Integrated waste management strategies.
13th week: **Lecture:** Processing and utilization of plastic and rubber wastes. **Practice:** Degradable plastics and their significance in waste management	14th week: **Lecture:** Waste from the chemical industry, their handling and utilization **Practice:** Field trip - E-waste recycling Ltd. (Karcag)
15th week: 2nd drawing week	

Requirements

A, for a signature:
Attendance at lectures is recommended, but not compulsory. Active participation is requested and evaluated by the teacher in every class. There are no tests during the semester.

B, for a grade:
The course ends in a written exam covering the whole semester material and the students get grade on the base of its result.

Air Pollution Control

Code: MK3LETVK05KX25-EN
ECTS Credit Points: 5
Evaluation: exam
Semester: 3rd semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 4+1

Topics:
LECTURE:
Earth's atmosphere: roles, basic characteristics, evolution. Constituents. Changes of pressure, density, temperature, average molar mass with altitude.
Air pollution: primary and secondary pollutants, natural and anthropogenic sources.
Monitor network: stations, background monitoring sites, criteria pollutants and their measurements.
Sampling: online and offline methods.
Aerosols: formation, classification, distribution, physiological and climatic effects.
Atmospheric chemistry: thermal and photochemical processes. Chapman model of ozone formation and decomposition. Chemical reactions of the photochemical smog. Chemical reactions of carbon, nitrogen and sulphur species in the atmosphere
Basics of emission control: primary and secondary measures. Adsorption and absorption techniques. Biological gas purification and condensation techniques. Emission control of particulate matter: filters, wall collection devices, scrubbers. Desulfurisation and DeNOx processes.

PRACTICE: Calculation problems and field practice

Literature:

- John H. Seinfeld, Spyros N. Pandis - Atmospheric Chemistry And Physics From Air Pollution to Climate Change, 2nd edition, 2006, John Wiley & Sons, Inc., ISBN: 978-0-471-72018-8
- Noel de Nevers - Air Pollution Control Engineering, 2nd edition, 2010 by Waveland Press, Inc., ISBN 978-1-57766-674-5
- Zhongchao Tan - Air Pollution and Greenhouse Gases From Basic Concepts to Engineering Applications for Air Emission Control, 2014, Springer, ISBN 978-981-287-211-1

Schedule

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

Lecture: Earth's atmosphere **Practice:** Calculation: average molar mass of the atmosphere. Concepts of ppm, ppb. Weight concentration	**Lecture:** Basic concepts of air pollution. **Practice:** Calculation: basics concepts of box model. Stock, fluxes, residence time.
4th week: **Lecture:** Monitoring networks **Practice:** Calculations of PM sampling	**5th week:** **Lecture:** Sampling **Practice:** Calculations of emissions of points sources
6th week: **Lecture:** Aerosols **Practice:** Carbon footprint of vehicles	**7th week:** **Lecture**: Atmospheric chemistry **Practice:** Calculation related to photochemical processes
8th week: 1st drawing week	
9th week: **Lecture:** Basics of emission control **Practice:** Stoke's law for particle settling	**10th week:** **Lecture:** Adsorption and absorption techniques **Practice:** Field practice: site visit
11th week: **Lecture:** Biological gas purification and condensation techniques **Practice:** Field practice: site visit	**12th week:** **Lecture:** Emission control of particulate matter **Practice:** Field practice: site visit
13th week: **Lecture:** Desulfurisation processes **Practice:** Field practice: site visit	**14th week:** **Lecture:** DeNOx processes **Practice:** end-term calculation test.
15th week: 2nd drawing week	

Requirements

A, for a signature:

The calculation grade is prerequisite of the signature and contributes to the final grade.

Participation at the practical classes is compulsory. Students must attend all practical sessions and may not miss any practice class during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. In case of absence due to health issues, a medical certification needs to be presented.

There is one end-term calculation test during the semester. Grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent) calculated as an average of the tests' results. The minimum requirement for the tests is 50%.

B, for a grade:

The final grade is based on both parts: 1/4 of the total score comes from the calculation practice, and 3/4 from the theoretical part.

From the theory, students take an oral exam in the exam period. Exam grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent).

In case of failure, students can take retake exam(s) in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Soil Management I

Code: MK3TAV1K06KX25-EN
ECTS Credit Points: 6
Evaluation: mid-semester grade
Semester: 4th semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 4+2

Topics:
LECTURE: During the course, students will learn the basics of mineralogy and petrology, the fundamentals of soil science, the importance of soil and its relationship with other environmental elements. They will also learn about the composition of inorganic and organic matter in soils, and the evolution and changes in soil properties. After the factors that influence soil formation, students will learn about soil formation processes. In addition to an overview of the organisms in the soil, they will also learn about the role of these organisms in the cycling of chemical elements and nutrients. The course will also cover the characteristics of colloids in soil and their role in binding different ions, molecules and possible contaminants. Students learn about the soil types found in Hungary, their basic characteristics and their utilisation as well.

PRACTICE: Physical and chemical analysis of different soils using soil test methods.

Literature:

- Ray R. Weil, Nyle C. Brady: Elements of the Nature and Properties of Soils, 4th edition. Pearson, 2019.
- Edward Plaster: Soil Science and Management. 6th edition. Cengage Learning, 2014.
- Kim H. Tan: Environmental Soil Science. CRC Press, 2009.

Practice:
• The labmanual is available in e-learning system.

Schedule

1st week Registration week	
2nd week: **Lecture:** The concept of soil, its functions, its relationship with other environmental elements, soil structure. **Practice:** Block practice	**3rd week:** **Lecture:** Soil formation, soil-forming factors. The main processes determining soil formation. **Practice:** Block practice
4th week: **Lecture:** Mineral components of soil, classification of soil minerals, their characterisation. Physical properties of soil, classification of soils according to particle	**5th week:** **Lecture:** Soil organic matter, classification of humic substances, role of humus in soil. Colloids in soil.

composition. Soil structure, bulk density, density. **Practice:** Block practice	**Practice:** Block practice
6th week: **Lecture:** Living organisms in the soil, decomposition and transformation of organic matter in the soil. The role of higher plants and animals. Soil microorganisms and their activities. **Practice:** Block practice	**7th week:** **Lecture**: Soil water management, soil water capacity, moisture forms (pF). Soil air and heat management. **Practice:** -
8th week: 1st drawing week	
9th week: **Lecture:** Soil nutrient supply, nutrient uptake from soil, characteristics of nitrogen cycling. Soil phosphorus and potassium cycling, phosphorus and potassium supply to plants. **Practice:** -	**10th week:** **Lecture:** Soil formation processes, changes in soil properties over time. **Practice:** -
11th week: **Lecture:** Classification of soils, main types of soil classification system in Hungary. **Practice:** -	**12th week:** **Lecture:** The purpose and soil science of soil water balance regulation, the impact of irrigation on soil. **Practice:** -
13th week: **Lecture:** The importance of soil tillage in crop production. Soil utilisation and farming systems. **Practice:** -	**14th week:** **Lecture:** The purpose and function of fertilisation. Crop rotation. Soil management systems. Soil conservation tillage. **Practice:** -
15th week: 2nd drawing week	

Practices are held in blocks!

1. General rules of laboratory work and using of laboratory equipment:
   1.1. Laboratory work and safety training
   1.2. Introduction to laboratory equipment

Schedule of Laboratory Practice:

1. Sampling rules, on-site measurements for soil classification
2. Preparation of soil samples for physical and chemical analysis. measuring moisture content, determining soil colour etc.
3. Physical properties of soils: mechanical composition (soil particle size classification), electrical conductivity, water retention and permeability tests of soils, testing of the soil's ability to absorb or retain water
4. Chemical properties of soils: soil reaction (pH), Measurement of buffer capacity, measurement of phenol-thalidine alkalinity
5. Chemical properties of soils: determination of calcium carbonate content

6. Chemical properties of soils: Measurement of hydrolytic acidity, Determination of humus content, Instrumental analytical tests

Requirements
A, for a signature:
The lab grade is prerequisite of the signature and the mid-semester grade, too!
Participation at practice classes is compulsory. Students must attend practice classes and may not miss any practice class during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Being late is equivalent with an absence. In case of absence due to health issues, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor. The weekly syllabus covers the particular topics and gives a full description of the experiments.
Each week the laboratory session begins or closes with a short test (no more than 20 minutes) based exclusively on the preparatory material of that week of the experiments carried out.
There are five short tests during the semester. Lab grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent) calculated as an average of the tests' results and measurement reports. The minimum requirement for the short tests is 50%.
B, for a mid-semester grade:
The course ends in mid-semester grade, the theoretical part ends in a written end-term test at the abovementioned weeks. The minimum requirement for the written test is 50%. Based on the total score, the grade is given according to the following table:
Score Grade
0-49 fail (1)
50-62 pass (2)
63-75 satisfactory (3)
76-87 good (4)
88-100 excellent (5)
If the case of failure, students can take retake written tests in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. In the mid-term grade, the score for the theoretical part counts is 60% and the lab grade counts is 40%. (Satisfactory level is the criterion in both parts).

Soil Management II

Code: MK3TAV2K04KX25-EN
ECTS Credit Points: 4
Evaluation: exam
Semester: 5th semester
Its prerequisite(s): Soil Management I
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+1

Topics:
LECTURE: In this course, students will learn about inorganic and organic soil pollutants. They will gain a more complete understanding of soil contamination through an understanding of the requirements,

procedures and stages of assessment surveys. They will learn about the systems of permissible limits used in our country and in other countries. They gain knowledge about the transport of pollutants, their distribution and transformation processes. They will also learn about the remediation process, remediation in national and international practice, through examples of remediation in Europe and the US Superfund programme. This is followed by an evaluation of remediation technologies from a general perspective, and an understanding of the principles and implementation of each of the possible remediation technologies (physical, chemical, biological, in situ and ex situ), highlighting advantages and disadvantages.

PRACTICE: Physical and chemical analysis of different soils using soil test methods.

Literature:

- Perk, Marcel van D. Soil and Water Contamination. (2nd edition). Taylor & Francis, 2017.
- Zhang, Chunlong. Soil and Groundwater Remediation. Wiley, 2019.
- Albergaria, Jose T. V. S. D. Soil Remediation. Taylor & Francis, 2016.
- Wise, Donald L. Remediation Engineering of Contaminated Soils. Taylor & Francis, 2000.

Practice: The labmanual is available in e-learning system.

Schedule

1st week Registration week	
2nd week: Lecture: Impact of human activity on soil, types of soil pollutants and the damage they cause. Environmental risks of urban soils, sources of pollution. Practice: -	3rd week: Lecture: Contamination of soil with heavy metals, radioactive isotopes and other inorganic substances. The impact of agricultural activity. Impact of chemical treatment on soil and groundwater. Practice: Block practice
4th week: Lecture: Soil contamination with petroleum, petroleum derivatives and other organic pollutants. Agricultural use of sewage sludge. Practice: Block practice	5th week: Lecture: Regulation of remediation in the European Union. The international and national situation of soil contamination and soil remediation. Soil pollution from transport and industry. Practice: Block practice
6th week: Lecture: Purpose of the environmental status assessmnet survey, requirements for surveying, sampling procedures and analysis of spatial data. Sources of groundwater pollution. Practice: -	7th week: Lecture: Evaluation of soil pollution in relation to soil properties, limit values, limit value systems. Protection of aquifers, protected areas. Groundwater protection, monitoring system. Practice: -
8th week: 1st drawing week	

9th week: Lecture: Transport of pollutants in soil, partitioning and transformation processes. Factors affecting the spread of pollution. The binding of contaminants on the solid phases of soils. Practice: -	10th week: Lecture: Criteria for the selection of remediation technology, technical methods of remediation and damage repair. Principles for the exploration of contaminated sites. Practice: -
11th week: Lecture: Thermal processes to be used in the remediation of contaminated land. Methods of remediation depending on the purpose of the intervention. Practice: -	12th week: Lecture: In situ physical/chemical procedures to be used in the remediation of contaminated land. The effects of oil pollution, the movement of oil in the soil. Practice: -
13th week: Lecture: Ex situ physical/chemical procedures to be used in the remediation of contaminated land. Oil spill related actions. Practice: -	14th week: Lecture: Biological procedures to be used in the remediation of contaminated land. Fitoremediation Practice: -
15th week: 2nd drawing week	

Practices are held in blocks!

1. General rules of laboratory work
2. Schedule of Laboratory Practice:
    1. Toxicological analysis of the combined presence of sewage sludge and soil
        a. Preparation of soil and sewage sludge for testing for toxicological analysis
        b. Preparation of petri dishes for testing
        c. Initiation of toxicity testing (germination test)
    2. Characterisation of soil and sewage sludge toxicity testing
        a. Moisture content measurement
        b. pH measurement
        c. Measurement of conductivity
    3. Evaluation of germination results
        a. measurement of root and stem length of seedlings
        b. Wet and dry biomass weight test

Requirements

A, for a signature:

The lab grade is prerequisite of the signature and the mid-semester grade, too!

Participation at practice classes is compulsory. Students must attend practice classes and may not miss any practice class during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Being late is equivalent with an absence. In case of absence due to health issues, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor. The weekly syllabus covers the particular topics and gives a full description of the experiments.

Each week the laboratory session begins or closes with a short test (no more than 20 minutes) based exclusively on the preparatory material of that week of the experiments carried out.

There are three short tests during the semester. Lab grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent) calculated as an average of the tests' results and measurement reports. The minimum requirement for the short tests is 50%.

B, for an offered grade:

The course ends in an exam. In the theoretical part, an offered grade can be received based in a written tests in the drawing weeks. The minimum requirement for the written test is 50%. Based on the total score, the grade is given according to the following table:

Score Grade
0-49 fail (1)
50-62 pass (2)
63-75 satisfactory (3)
76-87 good (4)
88-100 excellent (5)

If the case of failure, students can take retake written tests in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. In the offered grade, the score for the theoretical part counts 60% and the lab grade counts 40%. (Satisfactory level is the criterion in both parts).

Analytical Methods for Environmental Monitoring I

Code: MK3KMM1K04KX25-EN
ECTS Credit Points: 4
Evaluation: mid-semester grade
Semester: 4th semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:

LECTURE: Students will learn to use the measurements that used in certain environmental element measurement. Air, soil and water conservation, complex waste testing methods and tools of description of the specific gas, water and soil analyses from the sample collection to the evaluation. The main part of the environment in the view of analytical chemistry. The characteristics of the environmental analytics. The reliability of the analytical results. The characteristic performances of the analytical methods and their validity.

Classical methods of analysis. Precipitation-based analytical techniques, acid-base, complexometric, redox titrations and their environmental analytical role.

Instrumental analytical methods and their application in environmental analysis: electrochemistry, optical methods, chromatographic separation.

PRACTICE: Volumetric titrations for environmental analysis; gravimetric analyses.

Literature:

- Dr. Mahmood M. Barbooti (2015) Environmental Applications of Instrumental Chemical Analysis, CRC Press, Boca Raton, ISBN 978-1-4822-6264-3
- Roger N. Reeve: Introduction to Environmental analysis, John Wiley & Sons Ltd. 2002. ISBNs: 0-471-49294-9 (Hardback); 0-470-84578-3 (Electronic)

- David Harvey: Modern Analytical Chemistry, McGraw-Hill Higher Education, 2000. USA, ISBN 0–07–237547–7
- C. N. HEWITT: INSTRUMENTAL ANALYSIS OF POLLUTANTS, ELSEVIER APPLIED SCIENCE, 1991, ISBN 1-85166-548-X

Schedule

1st week Registration week	
2nd week: Lecture: The subject of environmental analytical studies. Sampling procedures and sample preparations used in environmental analysis (air and soil testing). Practice: Block practices	3rd week: Lecture: Sampling procedures and sample preparations used in environmental analysis (water and waste testing). Practice: Block practices
4th week: Lecture: The most important methods of quantitative evaluation: calibration, addition, internal standard method. Reliability of the results of the analysis, types of analytical error. Quality assurance in analytics (validation, performance characteristics). Practice: Block practices	5th week: Lecture: Environmental protection applications of classical analytical methods I. Environmental analytical applications of gravimetry. Environmental analytical applications of acid-base titrations. Practice: Block practices
6th week: Lecture: Environmental protection applications of classical analytical methods II. Environmental analytical applications of other titrations. Practice: Block practices	7th week: Lecture: Instrumental analytical methods and their environmental protection applications: Electroanalytical methods (potentiometry, coulombmetry) and their environmental analytical applications. Practice: -
8th week: 1st drawing week	1st Theoretical test
9th week: Lecture: Instrumental analytical methods and their environmental protection applications: Electroanalytical methods (conductometry, voltammetry, stripping potentiometry) and their environmental analytical applications. Practice: -	10th week: Lecture: Instrumental analytical methods and their environmental protection applications: Optical methods (atomic emission methods: ICP-OES and ICP-MS. Practice: -
11th week: Lecture: Instrumental analytical methods and their environmental protection applications: Optical methods (atomic absorption methods) and their environmental analytical applications.	12th week: Lecture: Instrumental analytical methods and their environmental protection applications: Optical methods (molecular absorption methods: UV-VIS and IR photometry) and their environmental analytical applications.

Practice: -	Practice: -
13th week:	14th week:
Lecture: Instrumental analytical methods and their environmental protection applications: Optical methods (molecular emission methods: fluorescence, phosphorescence; light scattering measurement: turbidimetry, nephelometry) and their environmental analytical applications.	Lecture: 2nd Theoretical test
Practice: -	Practice: -
15th week: 2nd drawing week	Retake of the Theoretical tests

Practices are held in blocks!

1. General rules of laboratory work and using of laboratory equipment:

1.1. Laboratory work and safety training

1.2. Introduction to laboratory equipment

Schedule of Laboratory Practice:

1. Determination of the acidity of drinking water by acid-base titration
2. Determination of the alkalinity of drinking water by acid-base titration
3. Determination of the chemical oxygen demand of surface waters using the permanganometric method
4. Determination of sodium hydroxide concentration in industrial water by conductivity measurement
5. Determination of phosphoric acid concentration by potentiometric titration

Requirements

A, for a signature:

The lab grade is prerequisite of the signature and the mid-semester grade, too!

Participation at practice classes is compulsory. Students must attend practice classes and may not miss any practice class during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Being late is equivalent with an absence. In case of absence due to health issues, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor. The weekly syllabus covers the particular topics and gives a full description of the experiments.

Each week the laboratory session begins or closes with a short test (no more than 20 minutes) based exclusively on the preparatory material of that week of the experiments carried out.

There are five short tests during the semester. Lab grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent) calculated as an average of the tests' results and measurement reports. The minimum requirement for the short tests is 50%.

B, for a mid-semester grade:

The course ends in mid-semester grade, the theoretical part ends in a written end-term test at the abovementioned weeks. The minimum requirement for the written test is 50%. Based on the total score, the grade is given according to the following table:

Score Grade

0-49 fail (1)

50-62 pass (2)

63-75 satisfactory (3)

76-87 good (4)
88-100 excellent (5)
If the case of failure, students can take retake written tests in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. **In the mid-term grade, the score for the theoretical part counts is 60% and the lab grade counts is 40%. (Satisfactory level is the criterion in both parts).**

Analytical Methods for Environmental Monitoring II

Code: MK3KMM2K04KX25-EN
ECTS Credit Points: 4
Evaluation: mid-semester grade
Semester: 5th semester
Its prerequisite(s): Analytical Methods for Environmental Monitoring I
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+1

Topics:
Instrumental analytical methods and their application in environmental analysis: Chromatographic processes. Liquid chromatography. Gas chromatography, GC-MS coupled method.
Capillary electrophoresis.
Environmental monitoring: air and water analytical tasks.

Literature:

- Dr. Mahmood M. Barbooti (2015) Environmental Applications of Instrumental Chemical Analysis, CRC Press, Boca Raton, ISBN 978-1-4822-6264-3
- Roger N. Reeve: Introduction to Environmental analysis, John Wiley & Sons Ltd. 2002. ISBNs: 0-471-49294-9 (Hardback); 0-470-84578-3 (Electronic)
- David Harvey: Modern Analytical Chemistry, McGraw-Hill Higher Education, 2000. USA, ISBN 0–07–237547–7
- C. N. HEWITT: INSTRUMENTAL ANALYSIS OF POLLUTANTS, ELSEVIER APPLIED SCIENCE, 1991, ISBN 1-85166-548-X

Schedule

1st week Registration week	
2nd week: **Lecture:** The basics of separation technology. Repetition and more detailed description of gas chromatography. **Practice:** -	**3rd week:** **Lecture:** Coupled methods: gas chromatography-mass spectrometry (GC-MS). Application of gas chromatography in environmental protection analysis. **Practice:** -
4th week: **Lecture:** Repetition and more detailed description of liquid chromatography.	**5th week:** **Lecture:** Basic characteristics of HPLC detectors and their use.

Basics of the HPLC method. Eluent delivery systems. **Practice:** -	 **Practice:** -
6th week: **Lecture:** Design of HPLC separation. Normal phase and reverse phase liquid chromatography. **Practice:** -	**7th week:** **Lecture**: Reversed-phase ion-pair chromatography. Basics of ion exchange chromatography. **Practice:** -
8th week: 1st drawing week	1st Theoretical test
9th week: **Lecture:** Ion exclusion, size exclusion and hydrophobic interaction chromatography. **Practice:** Block practices	**10th week:** **Lecture:** Basics of capillary electrophoresis (CE) and classification of methods. **Practice:** Block practices
11th week: **Lecture:** The parameters characteristic of separation in CE. Instrument background. Structure of the CE system. Application of CE. **Practice:** Block practices	**12th week:** **Lecture:** Basics of Environmental Monitoring. Air pollution monitoring. **Practice:** -
13th week: **Lecture:** Water pollution monitoring. **Practice:** -	**14th week:** **Lecture:** 2nd Theoretical test **Practice:** -
15th week: 2nd drawing week	**Retake of the Theoretical tests**

Practices are held in blocks!

1. General rules of laboratory work and using of laboratory equipment:

1.1. Laboratory work and safety training

1.2. Introduction to laboratory equipment

Schedule of Laboratory Practice:

1. Examination of water samples by ion chromatography
2. Photometric determination of salicylic acid content
3. Photometric determination of the iron content of an environmental sample
4. Measurement of the total organic carbon content of an environmental sample

Requirements

A, for a signature:

The lab grade is prerequisite of the signature and the mid-semester grade, too!

Participation at practice classes is compulsory. Students must attend practice classes and may not miss any practice class during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Being late is equivalent with an absence. In case of absence due to health issues, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor. The weekly syllabus covers the particular topics and gives a full description of the experiments.

Each week the laboratory session begins or closes with a short test (no more than 20 minutes) based exclusively on the preparatory material of that week of the experiments carried out.

There are 3 short tests during the semester. Lab grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent) calculated as an average of the tests' results and measurement reports. The minimum requirement for the short tests is 50%.

B, for a mid-semester grade:
The course ends in mid-semester grade, the theoretical part ends in a written end-term test at the abovementioned weeks. The minimum requirement for the written test is 50%. Based on the total score, the grade is given according to the following table:
Score Grade
0-49 fail (1)
50-62 pass (2)
63-75 satisfactory (3)
76-87 good (4)
88-100 excellent (5)
If the case of failure, students can take retake written tests in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. In the mid-term grade, the score for the theoretical part counts is 60% and the lab grade counts is 40%. (Satisfactory level is the criterion in both parts).

Water Management and Control

Code: MK3VGVM1K06KX25-EN

ECTS Credit Points: 6

Evaluation: exam

Semester: 6th semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 4+2

Topics:

Water pollution control. The concept of drinking water, regulations. Quality protection of raw water bases. Raw water classification, quality requirement system. Typical sources and components of pollutants. Methods and artifacts of water abstraction. Rates and trends in water abstraction methods. Water abstraction from surface water and groundwater. Well engineering, conveyance of produced water. Safety management of karst and coastal filtered waters. Water quality protection in reservoirs. Production of drinking water from surface water. Introduction to the basic processes used in water treatment. Disinfection of drinking water. Iron and manganese decontamination. Water softening. Coagulation-flocculation. Gas-liquid and solid-liquid phase separation. Adsorption. Desulphurisation, ammonium removal. Application of membrane technologies. Biological processes in drinking water treatment.

The wastewater pollutants: pollution compounds and their main characteristics. Waste water transportation and drainage systems. The wastewater treatment processes: Mechanical wastewater treatment methods (filtration, sedimentation, concentration, centrifugation, flotation, adsorption and

other mechanical processes). Biological and chemical wastewater treatment processes. Design principles and operation of Wastewater Treatment Plants and their environmental problems. Capacity building, improve quality indicators, reconstruction problems of Wastewater Treatment Plants. Sludge management and the basic elements of sludge treatment processes. Placement of process materials from wastewater treatment.

Practice:

Determination of biochemical oxygen demand of water samples (BOD5) by manometric BOD meter. Examination of water samples by Multiline P4 universal hand-held measuring instrument. Determination of the chemical oxygen and different chemical components in water samples by NANOCOLOR Linus spectrophotometer. Study of water samples' turbidity by TURB 555 (IR) instruments (nephelometric methods).

Literature:

Required:

- Mackenzie L. Davis: Water and Wastewater Engineering, Design Principles and Practice, McGraw-Hill Companies, Inc. New York, 2010, ISBN: 978-0-07-171385-6

Recommended:

- Frank R. Spellman: Handbook of Water and Wastewater Treatment Plant Operations (Third Edition), CRC Press by Taylor & Francis Group, Boca Raton, 2014, ISBN-13: 978-1-4665-5338-5 (eBook - PDF)
- Jerry A. Nathanson, Richard A. Schneider: Basic Environmental Technology (Sixth Edition), PEARSON, USA, 2015, ISBN: 978-0-13-284014-9

Schedule

1st week Registration week	
2nd week: Lecture: Water pollution control. The importance of water/sewage. Quality protection of raw water bases. Practice: Raw water certification, quality requirement system	3rd week: Lecture: Methods of water abstraction and its artefacts. Rates and trends in water abstraction methods. Practice: Water extraction from surface water. Groundwater abstraction. Engineering of wells, transport of produced water.
4th week: Lecture: Water quality protection in reservoirs. Drinking water production from surface water.	5th week: Lecture: Removal mechanisms and technologies for certain components: iron removal, manganese removal, ammonium

Practice: Basic water treatment processes. Degassing. Removal of airborne pollutants. Solute removal or concentration reduction. Disinfection.	removal, arsenic removal, disinfection and membrane processes. **Practice:** Biological aspects of drinking water production: secondary water quality degradation, biological processes in the network. Pathogens in the water distribution network.
6th week: **Lecture:** Design and operation of water treatment plants. **Practice:** Checking the operation of the water treatment system and the quality of the water supplied to the network.	**7th week:** **Lecture**: Water distribution, diagnostics and quick repair options for breakdowns. **Practice:** Visit to the Debrecen Waterworks Zrt. Water Production Plant No. II.
8th week: 1st drawing week	
9th week: **Lecture:** Water pollution, wastewater pollutants. The compounds entering the waters during pollution and their important characteristics. **Practice:** Blocked practices	**10th week:** **Lecture:** Sewage transport, sewerage. **Practice:** Blocked practices
11th week: **Lecture:** Wastewater treatment procedures. Mechanical wastewater treatment processes (filtration, sedimentation, compression, centrifugation, flotation, adsorption and other mechanical processes). **Practice:** Blocked practices	**12th week:** **Lecture:** Biological and chemical wastewater treatment processes. **Practice:** -
13th week: **Lecture:** Basic principles and analysis of wastewater treatment plant design, plant operation, and their environmental protection problems. Maintenance of treatment plants. **Practice:** -	**14th week:** **Lecture:** Characteristics of sludge treatment, basic elements, sludge treatment procedures. Placement of materials produced during wastewater treatment. **Practice:** -
15th week: 2nd drawing week	Retake of the Theoretical tests

Practices in blocks in the 2nd part of the semester (Wastewater treatment)!

1. General rules of laboratory work and using of laboratory equipment:

1.1. Laboratory work and safety training

1.2. Introduction to laboratory equipment

Schedule of Laboratory Practice:

1. Determination of biological oxygen demand value of water samples (BOI measurement, Starting). Water analysis with a portable MultiLine P4 set
2. Determination of biological oxygen demand value of water samples (BOI measurement, Starting). Measurement of Chemical Oxygen Demand value of water samples (COD) and photometric water analysis. Turbidity measurement.
3. Visit to Debrecen Sewage Treatment Plant

Requirements

A, for a signature:

The lab grade is prerequisite of the signature and the mid-semester grade, too!

Participation at practice classes is compulsory. Students must attend practice classes and may not miss any practice class during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Being late is equivalent with an absence. In case of absence due to health issues, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor. The weekly syllabus covers the particular topics and gives a full description of the experiments.

Each week the laboratory session begins or closes with a short test (no more than 20 minutes) based exclusively on the preparatory material of that week of the experiments carried out.

There are 2 short tests during the semester. Lab grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent) calculated as an average of the tests' results and measurement reports. The minimum requirement for the short tests is 50%.

B, for a grade:

The course ends in an oral **examination**. Based on the average of the grades of the two main parts.

Environmental Economics

Code: MK3KGDTM03KX25-EN

ECTS Credit Points: 3

Evaluation: Exam

Year, Semester: 4th year, 1st semester

Its prerequisite(s): Macroeconomics

Further courses are built on it: No

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

Topics:

This course aims to make students familiar with the concepts of environmental economics. In particular, the course will focus on the analysis of how economic actors, consumers, and firms choose between different alternatives. By the end of the course, the student should be able to use the basic tools and models of environmental economics and apply them to solve problems. The course focuses on the theory and application of the following: environmental challenges, efficiency, scarcity, environment, and resource use. The environment as an asset. Environmental Problems and Economic Efficiency. Externalities as a source of market failures. Evaluating Trade-Offs: Benefit-Cost Analysis and Other Decision-Making Metrics. Optimal Efficiency. Valuing the Environment. Dynamic Efficiency and Sustainable Development. Environmental Kuznets Curve. Pollution Havens and Halo Hypothesis. Human Development Index. Natural Resources and Depletable Resources. The Transition from Depletable to Renewable Resources.

Literature:

Required literature:

Tom Tietenberg, Lynne Lewis. 2018. Environmental & natural resource economics /— Routledge; 11th edition. ISBN-13: 978-1138632301.

Recommended literature:

1. Tom Tietenberg, Lynne Lewis. (2019): Environmental Economics: the Essentials. Taylor & Francis LTD First ed. ISNB13: 9780367280338
2. Field Barry C. 2024. Environmental Economics, An Introduction: 2024 Release ISE. McGraw-Hill Education.

Schedule

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

Lecture: *Basic Concepts of Environmental Economics*

Introduction to Environmental Economics. Future Environmental Challenges (climate change, Water Accessibility). Key analytical tools. Efficiency, scarcity, environment and use of resources.

Practice: Case study examination

4th week:

Lecture: *Evaluating Trade-Offs:*
Benefit-Cost Analysis and Other
Decision-Making Metrics

Optimal Efficiency. Cost and benefits analysis. Discount rate, internal rate of return. Present value.

Practice: Calculation/team problems: Costs and benefits analysis.

6th week:

Lecture: *Valuing the Environment: Methods*

Types of Values. Classifying Valuation Methods. Market and nonmarket value.

Practice: Test I.

8th week:

Lecture: *Sustainability of Development*

Efficiency and sustainability. Trade and Environment. Environmental Kuznets Curve. Pollution Havens and Halo Hypothesis. Human Development Index.

Practice: Case study examination, Calculation/team problems

10th week:

Lecture: *Energy: The Transition from Depletable to Renewable Resources*

Fossil fuels problems. Income and price elasticity of oil demand. Transitioning to Renewables. Transportation.

Practice: Test II.

Lecture: The Human-Environment relationship

The environment as an asset. Environmental Problems and Economic Efficiency. Property Rights. Externalities as a source of market failure. Types of externalities.

Practice: Calculation problems: Efficiency and inefficiency. Imperfect market structures.

5th week:

Lecture: *Social and private returns*

Cost-Effectiveness Analysis.

Practice: Case study examination and calculation/team problems.

7th week:

Lecture: *Dynamic Efficiency and*
Sustainable Development

Strong and weak sustainability. Environmental sustainability.

Practice: Calculation/team problems

9th week:

Lecture: *Population and development*

Effects of Population Growth on Economic Development. Effects of Economic Development on Population Growth. Urbanisation.

Practice: Case study examination, Calculation/team problems.

Requirements

A, for a signature:

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

During the semester, there are two tests: the mid-term test on the 6th week and the end-term test on the 10th week. Students must sit for the tests.

B, for a grade (ESE):

The course ends in an examination.

The minimum requirement for the mid-term, the end-term test and the teamwork is 50% separately. Based on the scores of the tests separately, the grade for the tests and the examination is given according to the following table:

The grade is given according to the following table:

%	Grade
0-49	fail (1)
50-62	pass (2)
63-75	satisfactory (3)
76-89	good (4)
90-100	excellent (5)

If the score of any test is below 50%, the student once can take a retake test of the whole semester material.

Environmental Management

Code: MK3KOGZK06K125-EN
ECTS Credit Points: 6
Evaluation: mid-semester grade
Semester: 6th semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+3

Topics:

The development and stages of institutionalization of environmental protection. Global environmental problems and the impact of production on the environment. Nature conservation, conservation values, and natural resources. Air pollution, air pollution control, water pollution, water pollution control, soil pollution processes, soil remediation possibilities. Understanding the characteristics of ecosystems, environmental pollution processes and the basics of municipal waste management.

Literature:

- Rogene A. Buchholz: Principles of Environmental Management, Prentice Hall, 1998
- Mary K. Theodore – Louis Theodore: Introduction to Environmental Management, CRC Press Taylor & Francis, Broken Sound Parkway NW; 2009
- Environmental Change and Sustainability. Edited by Steven Silvern and Stephen Young, InTech, ISBN 978-953-51-1094-1, DOI: 10.5772/46198, 2013
- I.V Murali Krishna, Valli Manickam, Anil Shah Naresh Davergave: Environmental Management: Science and Engineering for Industry, Butterworth-Heinemann, 2017
- Marc Lame: Environmental Management, Cambridge University Press, 2022

Schedule

1st week Registration week	
2nd week: Lecture: Development and basic concepts of environmental protection and environmental management. Practice: The Club of Rome, the future of our environment	3rd week: Lecture: Events related to the development of environmental management. Practice: Global problems of the Earth (population growth, armaments, food crisis, material and energy crisis, global environmental crisis.
4th week: Lecture: Earth systems and their relationships, characterization of natural resources. Practice: The relationship between sustainable development and environmental management	5th week: Lecture: Global environmental problems and their analysis Practice: Elements of the environment to be protected (land, water, air)
6th week: Lecture: Environmental factors, climate factors and their effects. Practice: Elements of the environment to be protected (soil, built environment)	7th week: Lecture: Causes, forms and sources of environmental pollution. Practice: The atmosphere and its properties. Potential pollutants of the atmosphere
8th week: 1st drawing week	
9th week: Lecture: The process, and subprocesses of air pollution. Practice: Major gas pollutants, their origin and effects.	10th week: Lecture: Removal of air pollutants from the atmosphere. London smog. Los Angeles smog

	Practice: Types of air pollution and their characteristics. The transmission. Photochemical smogs
11th week: **Lecture:** Forms of water pollution, water classification. **Practice:** Dry and wet acid deposition in the atmosphere	**12th week:** **Lecture:** Process of soil destruction, erosion, deflation. **Practice:** Objectives and principles of the Waste Management Act
13th week: **Lecture:** Waste management, characterization of treatment procedures **Practice:** Utilization of waste as a secondary raw material or energy carrier	**14th week:** **Lecture:** Stages of nature conservation, concept, division. Characterization of nature conservation values. **Practice:** Division of values protected by territory. Concept and task of national park, landscape conservation area, nature conservation area. National parks in Hungary.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Active participation in lectures and exercises is a successful fulfillment of the tasks defined by the lecturer

B, for a grade:

The course ends in mid-semester grade, the course ends in **a written end-term test** at the above mentioned weeks. The minimum requirement for the written test is 50%. Based on the total score, the grade is given according to the following table:

Score Grade
0-49 fail (1)
50-62 pass (2)
63-75 satisfactory (3)
76-87 good (4)
88-100 excellent (5)

If the case of failure, students can take retake written tests in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Project- and Environmental Management

Code: MK3PKMMM05KX25-EN

ECTS Credit Points: 5

Evaluation: mid-semester grade

Semester: 7th semester

Its prerequisite(s): Fundamentals of Quality and Engineering Management

Further courses are built on it: Yes/No

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

Topics:

LECTURE: The aim of the course is to introduce the concepts, tools and methods of project management and their application within the field of environmental management. It also introduces the main environmental management problems, systems and regulations.

The course provides an overview of the definition of project and project management, the project process, the organisation of projects and the actors involved. This is followed by an introduction to the planning, implementation and closure of projects, complemented by a description of software and sources of funding to support project management activities.

In the field of environmental management, an overview of the main problems and systems will be followed by environmental management issues of air qulity, water and wastewater, soil and solid waste. Finally, noise and other pollutants; prevention; environmental risks.

PRACTICE: Case studies and computer practice.

Literature:

- Havranek, Timothy J.: Modern Project Management Techniques for the Environmental Remediation Industry. Taylor & Francis, 2017.
- Schwalbe, Kathy: An Introduction to Project Management: Predictive, Agile, and Hybrid Approaches. (7th edition). Kathy Schwalbe, 2021.
- David, Pierce, F.: Project Management for Environmental, Health and Safety Professionals. Rowman & Littlefield Publishing Group, 2005.
- World Health Organization: Environmental and Health Impact Assessment of Development Projects. Taylor & Francis, 2012.
- Giudice, Fabio, et al: Product Design for the Environment. Taylor & Francis, 2006.

Practice:

- The assignments include exercises using Office applications and project management software.

Schedule

1st week Registration week	
2nd week: **Lecture:** Definition of project and project management **Practice:** Case studies	3rd week: **Lecture:** The project process. Organisation of projects, stakeholders **Practice:** Case studies

4th week: Lecture: Planning projects Practice: Case studies	5th week: Lecture: Implementation and closure of projects Practice: Case studies
6th week: Lecture: Funding sources for environmental projects Practice: Case studies	7th week: Lecture: Software to support project management activities. Practice: Case studies, computer practice
8th week: Lecture: Problems, systems and methods of environmental management Practice: Case studies, computer practice	9th week: Lecture: Environmental management of materials and energy use Practice: Case studies, computer practice
10th week: Lecture: Environmental emissions, environmental management issues. Practice: Case studies, computer practice	

Requirements

A, for a signature:

The practice grade is prerequisite of the signature and the mid-semester grade, too!

Participation at practice classes is compulsory.

B, for a mid-semester grade:

The course ends in mid-semester grade, the theoretical part ends in a written end-term test at the abovementioned weeks. The minimum requirement for the written test is 50%. Based on the total score, the grade is given according to the following table:

Score	Grade
0-49	fail (1)
50-62	pass (2)
63-75	satisfactory (3)
76-87	good (4)
88-100	excellent (5)

If the case of failure, students can take retake written tests in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. In the mid-term grade, the score for the theoretical part counts 50% and the lab practice part counts 50% (satisfactory level is the criterion in both parts).

Food Production and Land use

Code: MK3ETTHK06K125-EN
ECTS Credit Points: 6
Evaluation: mid-semester grade
Semester: 6th semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
LECTURE: During the course, students will learn about soil management practices and the basics of agricultural tillage systems. The subject of the course is the preservation of soil functionality and the importance of protecting our farmland. Among the environmental factors of food production, students will be asked to evaluate the soil and climatic conditions of Hungary from the point of view of crop production. Knowledge of the physical properties of soil, nutrient content and water balance is included in the crop production knowledge. Other topics include the impact of food production on soil, other environmental elements and the Earth's climate. By learning about food production, they will gain insight into the structure and functioning of the food industry. They learn about the food safety risks of toxic substances, microbes, additives, residues in food. The importance of the production of genetically modified plants and animals, the dangers and trends in the world, are also covered. The semester will also include a review of quality assurance and quality management systems in agriculture and the food industry, and the issue of sustainability.

PRACTICE: Case studies and student presentations.

Literature:

- Béné, Christophe and Devereux, Stephen: Resilience and Food Security in a Food Systems Context. Springer International Publishing AG, 2023.
- Mayer, Tamar, and Anderson, Molly D.: Food Insecurity. Taylor & Francis, 2020.
- Brown, Molly: Food Security, Food Prices and Climate Variability. Taylor & Francis, 2014.
- Kastner, Justin: Food and Agriculture Security. Bloomsbury USA, 2010.
- Aswathanarayana, U. (ed.): Food and Water Security. Taylor & Francis, 2007.

Schedule

1st week Registration week	
2nd week: **Lecture**: The history of the development of agriculture.	**3rd week:** **Lecture**: The role of site factors in crop production.

Practice: The evolution of land use systems, classical and modern land use systems.	**Practice:** Soil formation factors and main processes in Hungary.
4th week: **Lecture:** The importance of tillage in crop production, the soil condition requirements of plants, the impact of tillage on soil. **Practice:** Impact of human activity on soil.	**5th week:** **Lecture:** Soil defects that reduce soil fertility and their repair. **Practice:** Soil conservation aspects of nutrient management.
6th week: **Lecture**: The purpose and soil science of soil water balance regulation. **Practice:** The effect of irrigation on the soil.	**7th week:** **Lecture**: The importance of soil and land conservation, protection of agricultural land. **Practice:** The main principles of the EU Soil Strategy. Ten commandments of soil protection.
8th week: 1st drawing week	**Theoretical test**
9th week: **Lecture:** Food safety basics, history, basic concepts. **Practice:** The state of food safety, legal regulation, the concept of unsafe food.	**10th week:** **Lecture:** The importance of FAO/WHO Codex Alimentarius, conventions governing international trade in food. **Practice:** The role of risk analysis in consumer protection, assessment of microbiological risk factors.
11th week: **Lecture:** The origin of our food, microbiological hazards and risks. **Practice:** Food-borne diseases.	**12th week:** **Lecture:** Natural toxins of plant and animal origin, prions, allergens. **Practice:** Environmental pollutants, pesticides.
13th week: **Lecture:** Chemical and physical hazards, testing of complex or processed foods. **Practice:** Processing, packaging, storage hazards.	**14th week:** **Lecture:** Food additives, role and importance of JECFA, rules for the use of additives. **Practice:** GM crops in food, food safety risks of GM foods.
15th week: 2nd drawing week	**Theoretical test**

Requirements

A, for a signature:

The practice grade is prerequisite of the signature and the mid-semester grade, too!

Participation at practice classes is compulsory.

B, for a mid-semester grade:

The course ends in mid-semester grade, the theoretical part ends in a written end-term test at the abovementioned weeks. The minimum requirement for the written test is 50%. Based on the total score, the grade is given according to the following table:

Score Grade
0-49 fail (1)
50-62 pass (2)
63-75 satisfactory (3)
76-87 good (4)
88-100 excellent (5)
If the case of failure, students can take retake written tests in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. **In the mid-term grade, the score for the theoretical part counts 50% and the practice grade counts 50% (satisfactory level is the criterion in both parts).**

Environmental Geographical Information Systems I.

Code: MK3KTI1A04KX25-EN
ECTS Credit Points: 4
Evaluation: mid-year mark
(accomplishment of based on the written exams and evaluation of based on the practise assignments)
Semester: 6th semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
Geographical Information Systems (GIS) are concerned with the collection, storage, management, analysis, visualisation of the derived information, observation and modelling of geographical phenomena.
Geographic information technology (GIS) manages both graphical (maps, space images, aerial photographs, etc.) and descriptive (thematic data) databases, which can be used to perform various analyses using the necessary mathematical, statistical, graph-theoretical and logical skills. The results of these analyses can be presented graphically.
Geographic information systems have a wide range of applications: in the economy, public administration, decision-making, market research, population registers, health, sociology, social context studies, environmental protection, urban planning and facilities planning, and many other fields.
Students will be able to integrate and analyse the vast amount of geo- and attribute data generated in environmental engineering, to draw conclusions, to visualise and to carry out impact assessments, by understanding and applying the use of GIS.
Lessons/Theory: theory of spatial modelling. Theoretical architecture of a geographic information system. Theoretical concepts of geospatial information systems.
Seminars/Practice: steps in geospatial modelling: data collection, processing, organisation, visualisation. Software skills: system, near-system, application software

Literature:
Compulsory:
- Material for the lectures available at Elearning-system.
- QGIS educational materials: https://www.qgis.org/resources/hub/
- Spatial Thinking in Environmental Contexts: Maps, Archives, and Timelines, published by CRC Press, 2019.

- The Handbook of Geographic Information Science, 2007, ISBN: 978-1-4051-0796-9, John Wilson and A. Stewart Fotheringham

Recommended:

- The Implementation and Effectiveness of GIS in Secondary Education: Geographic Information Systems in Education, 2009
- Two chapters in Digital Geography: "Geospatial Technologies in the Social Studies Classroom", 2008 | ISBN-10: 1593116721 | ISBN-13: 978-1593116729

Schedule

1st week Registration week	
2nd week: Lecture: - Introduction to Geographical Information System (GIS). - Development of GIS. Practice: - The role of spatial information in engi-neering. - Application-areas of GIS.	3rd week: Lecture: - Analog and digital cartography. - Terminology of maps, cartography and geoinformation. Practice: - EOV/EOTR system and WGS84 system, mapreading, geoinformations, modeling.
4th week: Lecture: - Parts of Maps. - Map-like representations. - Classification of maps. Practice: - Concept of data (data-acquisition, data-management, data-analysis, visualization). - Data-recovery procedures. - Creating databases. - The components of system (hardware, software, data, user).	5th week: Lecture: - Marks of maps, coding system, ganarali-zation, scales. - Search on maps, morphology representa-tion and nominations. Practice: - AutoCAD basic elements in GIS.
6th week: Lecture: - Projections, Projection systems, reference systems. - Terminology and assortment of map shee-ting. Practice: - GPS use in the practice. - Map downlands, scanning, processing of digitized files, scale-holding in AutoCAD.	7th week: Lecture: - Types of map: cadastral, topographic, administrational and world maps. - National and world mapping and refer-ence systems. Practice: - Create own map. - Creating hibrid datafile and holding abstraction. - Digitalisation.
8th week: 1st drawing week	
9th week: Lecture: - Terminology of Geographical Information Systems.	10th week: Lecture: - Integrated of the graphic and Descriptive datas. - Structure of layers.

- Types of Geographical Information Systems. **Practice:** - Work with objects, scanning digitalized datafiles, raster pictures inclusion in drawing file and conversation.	**Practice:** - Use of AutoCAD layers with object-orientation, map and own object presenta-tion, creating of own map, digitalization.
11th week: **Lecture:** - Formatting vector and raster basic datas. - Therminology (entity, classification, attri-butes). **Practice:** - Digital recording of the abstraction of real world with GIS software in AutoCAD for-mat.	**12th week:** **Lecture:** - Modelling. - Abstraction of real world. **Practice:** - Table creating, table-adjust to maps and according to GIS application.
13th week: **Lecture:** - Geometrical characterization of objects. - Territorial coverage (global, regional, lo-cal). **Practice:** - Draws on layers and digitalization rules. - Description of the Geospatial User Pack-age.	**14th week:** **Lecture:** - Data recovery proceedings with simple data recorders. - GPS recorder. **Practice:** - Database and draw-import to Mapinfo Pro. - Work with structurated database. - Created of thematic information.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance at lectures is recommended, but not compulsory. Attendance at practices is compulsory. Active participation is requested and evaluated by the teacher in every class. There are tests during the semester.

B, for a grade:

There are written exams from the theory educational material during the semester. The students have to do practical assignments until end of the semester. The course ends with mid-year mark and the students get grade on the base of its result of written exams and practical assignments.

Environmental Geographical Information Systems II.

Code: MK3KTI2A04KX25-EN

ECTS Credit Points: 4

Evaluation: mid-year mark

(accomplishment of based on the practise assignments)

Semester: 7th semester

Its prerequisite(s): Environmental Geographical Information Systems I.

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+4

Topics:

Territorial information systems

Spatial information systems can be used as a practical tool in any discipline with a territorial link. Each type of data can be assigned a spatial dimension: municipal, sub-regional, county, regional, national data can be used to produce reports and analyses using specialised spatial information applications.

Analytical systems based on data series can provide a basis for planning, development and decision-preparation work. They provide indispensable support in the preparation of sectoral concepts, programmes, plans and reports.

Landscape planning

The term landscape planning covers all plans at international, regional, national and local - community level - which are considered as interventions in the life of the landscape and its management. Its task is to put into practice the requirements and measures for landscape and nature conservation. There is a close link between landscape planning and land use planning.

Regional planning

Regional planning - Territorial planning - Spatial development planning.

Regional planning refers to any planning activity for a country or a larger territorial unit that envisages changes in the territory, usually with the aim of creating a better, more balanced territorial structure and relations. The underlying database is usually at national, county or municipal level.

Urban planning

Urban information systems have a wide range of applications: urban spatial database construction and registration; urban planning, zoning plans; public utilities registration and planning; registration of residents' affairs; taxation; public administration; property ownership; building development.

Municipal information systems are often set up for urban management purposes.

Urban information system on environmental pollution.

The quality of the environment is influenced by a number of factors, which may be direct environmental (noise, air pollution), technical (technical condition of buildings) or socio-infrastructural (composition of local society, level of infrastructure).

Socio-economic applications include transport networks, urban planning and statistical applications.

Urban information systems cover many areas of urban geography and urban planning, such as utility systems, certain suitability studies, supply and demand analysis of urban real estate, urban labour market, technical condition of urban real estate - buildings, urban health information systems.

Literature:

Required:

- Material for the lectures available at Elearning-system.
- QGIS educational materials: https://www.qgis.org/resources/hub/

Recommended:

- A to Z GIS : an illustrated dictionary of geographic information systems, ESRI Press : Independent Publishers Group, 2006.
- Learning QGIS - third edition, Anita Graser, ISBN: 1785888153, 9781785888151, 1785880330, 9781785880339

Schedule

1st week Registration week	
2nd week: **Practice:** GPS positioning. Coordinate definitions. Assigning data capture and descriptive data to coordinates. Data processing.	3rd week: **Practice:** Discussing and publishing individual tasks. Compare field data with the Google Earth database. Create a custom file with AutoCAD. Field data processing.
4th week: **Practice:** Digitize your own stock, taking into account sequential order. Create a Database (Excel). Add a map to AutoCAD. Merging geoinformation and descriptive data into GIS software. Layer design, digitization.	5th week: **Practice:** Creation of a Geospatial Module (AutoCAD drawing conversion and database file integration, as well as working with structured databases.
6th week: **Practice:** Assign a thematic database to the recorded geographic data. Prepare structured database queries. Thematic querying and recording of student tasks.	7th week: **Practice:** Selecting and assigning data files to specific areas of geoinformation. Applying the knowledge to date in the student task.
8th week: **Practice:** Preparation, creation and recording of thematic maps. SQL Queries, searches, and evaluations with the structured data base. Presentation, evaluation and correction of thematic files.	9th week: **Practice:** Independent student work, consultation.

10th week:

Practice: Describing, editing, and consolidating application areas for tasks.

Consultation.

Task submission evaluation, repair.

Requirements

A, for a signature:

Attendance at practices is compulsory. Active participation is requested and evaluated by the teacher in every class. There are practical assignments during the semester.

B, for a grade:

The students have to do practical assignments until end of the semester. The course ends with mid-year mark and the students get grade on the base of its result practical assignments.

Complex Environmental Engineering Planning I.

Code: MK3KKP1K06KX25-EN
ECTS Credit Points: 6
Evaluation: mid-semester grade
Year, Semester: 3nd year/2st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+4

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

Literature:
Compulsory:

- 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.

Schedule

1st week Registration week	
2nd week: **Lecture:** Adverse Effects of Environmental Pollution. Control Strategies. **Practice:** Complex task.	3rd week: **Lecture:** Environmental Act and Regulations. **Practice:** Complex task.
4th week: **Lecture:** Natural or "Conventional" Water Quality Problems. **Practice:** Complex task.	5th week: **Lecture:** Design of Porous Pavements for Improved Water Quality and Reduced Runoff. **Practice:** Complex task.
6th week: **Lecture:** Industrial Waste Auditing. **Practice:** Complex task.	7th week: **Lecture:** Air Pollution Control Engineering. **Practice:** Complex task.
8th week: 1st drawing week	
9th week: **Lecture:** WEEE Waste problems, definitions **Practice:** Complex task.	10th week: **Lecture:** WEEE Waste: fluids. **Practice:** Complex task.
11th week: **Lecture:** WEEE Waste problems: specific items to be removed. **Practice:** Complex task.	12th week: **Lecture:** WEEE Waste problems: treatments under review. **Practice:** Complex task.
13th week: **Lecture:** Complex task poster. **Practice:** Complex task presentation.	14th week: **Lecture:** Test **Practice:** Test
15th week: 2nd drawing week	

Requirements

A, for a signature:

Participation at **practice classes** 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 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: MK3KKP2K06KX25-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Semester: 7th semester

Its prerequisite(s): Complex Environmental Engineering Planning I

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+4

Topics:
LECTURE: During the course, students will explore modeling options for environmental issues, focusing on several areas (primarily air and noise protection). The practice has to subfields: modelling and hydroponics. In the modelling part the students learn about and gain proficiency in the use of computer modeling software (IMMI for noise mapping and air pollution modelling). In the second part of the practice, students will learn how to grow crops in hydroponic towers and perform the related evaluations.

Literature:

- Howard M. Resh: Hydroponic food production – A Definitive Guidebook for the Advanced Home Gardener and the Commercial Hydroponic Grower eighth edition, Taylor & Francis Group, CRC Press, New York, USA. 2022. ISBN: 9780367678753

- Tutorials for the IMMI software (immi.eu)

Schedule

1st week Registration week	
. 2nd week: Lecture: Basics of noise mapping Practice: Introduction to IMMI. Description of the task related to the hydroponic tower and crop production.	3rd week: Lecture: Noise sources Practice: Modelling noise sources in IMMI Starting to grow a plant in a propagator and feed water quality testing.
4th week: Lecture: Calculation methods Practice: Standard elements, noise sources, noise barriers Testing and replacement of feed water quality. Disinfection of hydroponic tower.	5th week: Lecture: Point, grid and façade calculations Practice: Outdoor noise propagation task. Start growing plants in a hydroponic tower. Inserting plants in the hydroponic tower.
6th week: Lecture: Indoor noise modeling (workplace noise). Practice: Defining workrooms, wall materials, absorption spectra, and elements Control of the hydroponics tower. Water quality testing and pH adjustment if necessary.	7th week: Lecture: Speech clarity, reverberation time Practice: Indoor noise modelling task. Control of the hydroponics tower. Water quality testing and pH adjustment if necessary.
8th week: Lecture: Importing options for modeling Practice: Importing possibilities, data requirements Shutting down the hydroponics tower. Plant analysis (measuring root length, stem length and biomass).	9th week: Lecture: General concepts of air pollution modelling Practice: Air pollution modelling in IMMI Dry plant biomass measurement. Discuss any questions you may have about the submission
10th week: Lecture: Air pollution modelling in IMMI Practice: Air pollution modelling task	

Requirements

A, for a signature:

Participation at practice classes is compulsory. Students must attend practice classes and may not miss any practice class during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Being late is equivalent with an absence. In case of absence due to health issues, a medical certification needs to be presented. The students have to submit the required tasks (three IMMI tasks and one hydroponic task)

B, for a mid-semester grade:

The course ends in a mid-semester grade which is calculated based on the submitted tasks. The evaluation is based on a five-level scale: 1 (fail), 2 (pass), 3 (satisfactory), 4 (good), 5 (excellent).

Within 30 days of the successful final exam the diploma is issued and given out by the Faculty at the graduate's special request. Otherwise, the diploma will be awarded to him/her at the graduation ceremony of the Faculty.

The diploma is an official document decorated with the coat of arms of Hungary which verifies the successful completion of studies in the Environmental Engineering undergraduate programme. The diploma contains the following data: name of HEI (higher education institution); institutional identification number; serial number of diploma; name of diploma holder; date and place of his/her birth; level of qualification; training program; specialisation; mode of attendance; place, day, month and year issued. Furthermore, it has to contain the original signature of the Dean (or in case of his/her indisposition the Vice-Dean) original signature and the seal of HEI. The University keeps a record of the diplomas issued.

At the graduate's special request, a certificate on the completion of studies is issued. The document does not contain any reference to qualification, it merely proves that the candidate has taken a successful final exam. The Faculty keeps a record of the certificates issued.

Calculating diploma grade

The diploma grade (D) is calculated as follows:

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

where A is the cumulative grade point average (CGPA)

B is the average of the final exam subjects

C is the thesis defence grade given by the committee

Classification of the award

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

Diploma with honours

Diploma with honours is awarded to students who get grade 5 in the oral exam and the thesis defence. Moreover, they do not have a grade worse than 4 during their studies.

MODEL CURRICULUM OF ENVIRONMENTAL ENGINEERING BSC – ENVIRONMENTAL TECHNOLOGY SPECIALISATION

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** **Curriculum** **Full-time training**

Environmental Engineering Basic's Program (BSc) - Environmental Technology Specialization

Nr.	Subject group	Subject	Subject code	1st semester félév				2nd semester				3rd semester				4th semester				5th semester				6th semester				7th semester				Prerequisite
				L	P	E	C	L	P	E	C	L	P	E	C	L	P	E	C	L	P	E	C	L	P	E	C	L	P	E	C	
1	Basics of Natural Sciences	Mathematics I.	MK3MAT1A08KX25-EN	4	4	m	8																									
2		Mathematics II.	MK3MAT2A06KX25-EN					2	4	m	6																					Mathematics I.
3		Chemistry I	MK3KEM1K04KX25-EN	2	2	e	4																									
4		Chemistry II	MK3KEM2K06KX25-EN					2	4	e	6																					Chemistry I
5		Chemistry III	MK3KEM3K04KX25-EN									2	2	m	4																	Chemistry II
6		Engineering Physics	MK3MFIZA06KX25-EN	2	2	e	6																									
7		Applied Biology	MK3ALKBK04KX25-EN	2	1	e	4																									
8		Ecology	MK3OKOLS04KX25-EN					2	2	e	4																					
9	Economics and Humanities	Studies of Law and Business	MK3JVISM04KX25-EN									2	2	m	4																	
10		Microeconomics	MK3MIOKM04KX25-EN									1	2	e	4																	
11		Macroeconomics	MK3MAOKM04XX25-EN													1	2	e	4													Microeconomics
12		Fundamentals of Quality- and Engineering Management	MK3MIMMM04KX25-EN													2	2	e	4													
13	Specific Compulsory Subjects	Engineering Informatics	MK3INF1A04KX25-EN	2	2	m	4																									
14		Basics of Engineering	MK3MEISK04KX25-EN	2	2	m	4																									
15		Technical Drawing and Basics of CAD	MK3GEPRG05KX25-EN					2	3	m	5																					Engineering Informatics
16		Materials Engineering	MK3ANISG05KX25-EN																	3	1	e	5									
17		Environmental Operations	MK3KVMVK06KX25-EN									3	3	e	6																	
18		Environmental Energetics	MK3KENGK06KX25-EN													3	2	m	6													Environmental Operations
19		Environmental Law and Administration	MK3KOJGK03KX25-EN																	2	1	m	3									Studies of Law and Business
20		Environment, Health and Safety, Ergonomics (Basics of EHS)	MK3EHSAK04KX25-EN					2	2	m	4																					
21		Radiation Protection and Environmental Radioactivity	MK3SGROK03KX25-EN																	2	1	m	3									Engineering Physics
22		Nature, Landscape and Water Environment Protection	MK3TTVKK04KX25-EN																	2	2	m	4									
23		Environmental Impact Assessment	MK3KAHVK04KX25-EN																	2	2	e	4									
24		Noise and Vibration Control	MK3ZRVDK05KX25-EN													2	3	m	5													
25		Waste Management	MK3HUGKK05KX25-EN									4	1	e	5																	
26		Air Pollution Control	MK3LETVK05KX25-EN									4	1	e	5																	
27		Soil Management I	MK3TAV1K06KX25-EN													4	2	m	6													
28		Soil Management II	MK3TAV2K04KX25-EN																	2	1	e	4									Soil Management I
29		Analytical Methods for Environmental Monitoring I	MK3KMM1K04KX25-EN													2	2	m	4													
30		Analytical Methods for Environmental Monitoring II	MK3KMM2K04KX25-EN																	2	1	m	4									Analytical Methods for Environmental Monitoring I
31		Water Management and Water Quality Protection	MK3VGVM1K06KX25-EN																					4	2	e	6					
32	Field-Specific Subjects	Environmental Economics	MK3KGDTM03KX25-EN																									2	1	e	3	Macroeconomics
33		Environmental Management	MK3KOGZK06K125-EN																					2	3	m	6					
34		Project- and Environmental Management	MK3PKMMM05KX25-EN																									2	2	m	5	Fundamentals of Quality- and Engineering Management
35		Food Production and Land Use	MK3ETTHK06K125-EN																					2	2	e	6					
36		Environmental Geographical Information System I	MK3KTI1A04KX25-EN																					2	2	m	4					
37		Environmental Geographical Information System II	MK3KTI2A04KX25-EN																									0	4	m	4	Environmental Geographical Information System I
38		Complex Environmental Engineering Planning I	MK3KKP1K06KX25-EN																					2	4	m	6					
39		Complex Environmental Engineering Planning II	MK3KKP2K06KX25-EN																									2	4	m	6	Complex Environmental Engineering Planning I.
40	Thesis	Thesis I	MK3SZD1K05KX23-EN																					0	5	m	5					
41		Thesis II	MK3SZD2K10KX23-EN																									0	10	m	10	Thesis I, Complex Environmental Engineering Planning I
42	Optional Subjects *	Optional Subject I																													
43		Optional Subject II									2																					
44		Optional Subject III													2																	
45		Optional Subject IV																	2												
46		Optional Subject V																					2								2
47		Internship	MK3NSGYK00KX25-EN																					6 weeks								
				L	P	E	C	L	P	E	C	L	P	E	C	L	P	E	C	L	P	E	C	L	P	E	C	L	P	E	C	
		Total number of credits:		14	13	0	30	10	15	0	27	16	11	0	30	14	13	0	31	15	9	0	29	12	18	0	33	6	21	0	30	**Total**
		Number of exams				4				3				5				3				4				3				0		number of exam subjects 22
		Number of mid-semester grades				3				3				2				4				4				4				4		number of mid-semester grade subjects 24
		Number of subjects				7				6				7				7				8				7				4		number of subjects 46
		Number of contact hours		27				25				27				27				24				30				27				number of teaching hours 187
																																number of optional credits 10
																																total number of credits 210

Abbreviations:

L = number of lectures/week

P = number of practical classes/week

E = form of evaluation (mid-semester grade or exam)

S = signature

m = mid-semester grade

e = exam

C = Credit points

Criteria subjects:

Optional subjects:

Optional subjects (Rules and Regulations XIII. Faculty of Engineering 10 § (2)). The minimum number of credits assigned to optional subjects: 10 credits.

The suggested order and credit number of optional subjects in the curriculum is only a recommendation.

Internship

The length of the internship is 6 week after the 6th semester. Students must register for the Internship subject in the 6th semester.

The credit value of the subject is 12 credits, which does not count in the total number of credits required in order to get the degree certificate, as defined in the training and outcome requirements of the programme.