Óbuda University
Rejtő Sándor Light Industry and Environmental Engineering

TRAINING PROGRAMM
WITH DETAILED SUBJECTS

Environmental Engineering BSc
(F)

01 September 2023

BASIC SUBJECTS

Title of the course: **Fundamentals of Natural Sciences**	**NEPTUN-code:** RKXTA1EBNF	**Weekly teaching hours:** l+cw+lw 1+3+0	**Credit:** 5 **Exam type**: tm
Course leader: Csaba Ágoston Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:** -	

Curriculum:

The primary aim of the course is to develop students' scientific literacy, critical thinking and problem-solving skills. In addition to learning about natural laws, systems and processes, emphasis is placed on developing students' ecological perspectives. The practical tasks and projects are based primarily on the knowledge acquired in secondary school, thus enabling the knowledge acquired to be assessed and providing a basis for learning the subjects at university. In addition to basic knowledge of physics, biology, geography, chemistry and environmental protection, the course will provide a synthesis of knowledge focusing on the interrelationship of environmental elements that will help to solve engineering problems and develop environmentally aware behaviour. The integration of complex knowledge is realised in the understanding of the basic interrelationships between natural systems and is applied in project work and integrated into the students' thinking and actions.

Curriculum Description:

Weeks	**Topics of lectures and practice**
1.	Concept of science, different between science and pseudoscience. Subfield of sciences. description of project tasks (1., 2., 3.)
2.	Fundamental of physics. Description of movements, reference systems. Velocity and acceleration. Newton's laws. Force laws and equation of motion. Energy, work, energy conservation. Conservation of angular momentum. Presented through practical examples.
3.	Fundamentals of mechanics of point systems. Field of gravity force. Dynamics of periodic movements. Description of movements in accelerating coordinate system. Presented through practical examples.
4.	Mechanics of inflexible objects. Elastic deformation. Structure of solid object. Presented through practical examples. 1. Project presentations.
5.	Mechanics of fluids. Molecular forces in liquids. Flow of fluids. Waves. Presented through practical examples.
6.	Mechanical waves, sound. Propagation and speed of light. Reflection and refraction of light. Optical tubes. Fundamental of optic. Interference and diffraction. Optical grid. Presented through practical examples.
7.	History and topics of chemistry. Chemistry in other scientific fields, its importance in environmental protection.
8.	The role of chemistry in subfields of environmental protection. 2. Project presentations.
9.	History and topics of biology. Biology in other scientific fields, its importance in environmental protection.
10.	The role of biology in subfields of environmental protection.
11.	History and topics of geography. Geography in other scientific fields, its importance in environmental protection. 3. Project presentations.
12.	The role of geography in subfields of environmental protection.

13.	Written test.
14.	Replacement (supplementary) written test.

Mid-semester requirements:

Attendance at lectures:

It is compulsory to attend the lectures. The rules of education and exam directory (TVSZ) are the guidelines.

Exams and tests (types, data)

1.	1. project task 20 points
2.	2. project task 20 points
3.	3. project task 20 points
4.	Written test 40 points

Requirements for qualification:

Total points: 100 (20+20+20+40). Term marks: 86-100%: excellent (5), 71-85%: good (4), 56-70%: average(3), 41-55%: pass(2), 0-40%: fail(1)
If the student has not met the requirements of obtaining the term mark (e.g. has not written or failed the in-class test, has not submitted the measurement report, etc.), he/she must be given one opportunity to make up for the term mark in the study period.

Professional competencies:

- Open and receptive to the application of new, modern and innovative organic farming practices and methods.
- In his/her work, he/she strives to act in a law-abiding manner and to respect engineering ethics.
- Ability to acquire new knowledge through the empirical solution of practical problems.
- Ability to translate solutions developed in nature into technical practice.
- Ability to participate in and lead teamwork.
- Understand and authentically represent the role of the environment in society and its fundamental relationship with the world.

Literature:

1. Townsend, C.R., Begon, M., Harper, J.L. (2006). Essentials of Ecology (2nd Edition). Blackwell Publishing.
2. Darrell Ebbing, Steven D. Gammon: General Chemistry, Cengage Learning, 2015, Cengage Learning, Boston, ISBN-13: 978-1305580343; ISBN-10: 1305580346
3. Serway Jewett: Physics for Scientist and Engineers
4. William M. Marsh, Martin M. Kaufman: Physical geography, Cambridge University Press, 2013.
5. Michael Allaby (2000): Basics of Environmental Science, Routledge, New York, ISBN 0415-21175-1

Title of the course: **Mathematics I.**	**NEPTUN-code:** RKXMA1EBNF	**Weekly teaching hours:** l+cw+lw 2+2+0	**Credit:** 6 **Exam type**: e
Course leader: Aurél Galántai, Dr.Prof.	**Position:** professor	**Required preliminary knowledge:** -	

Curriculum:

The main goal of the course is to introduce the set theory marks and to describe the algebraic and geometric properties of the real number line, complex numerical plane and the three-dimensional space. Additionally, with the help of the concepts of sequences, real functions and convergence to construct univariate differential and integral computing in a way which makes the students capable of solving any technical / mathematical / physical problems that arise in subsequent studies.

Detailed schedule of the course:

Topics of lectures*:*

Week	**Description**
1.	Sets. Natural numbers. Integers. Rationals, real numbers, upper limit. Roots, powers.
2.	Trigonometric functions. Complex numbers, algebraic, trigonometric and exponential form. Taking *n*th roots. Polynomials, rational expressions.
3.	Three-dimensional vectors. Vector algebra, vector geometry. Matrices. transpose matrix. Three-dimensional determinants.
4.	Real functions. Operations with functions. Polynomial and power functions. Trigonometric and arc functions. Exponential and logarithmic functions. Sketching graphs of functions.
5.	Convergence of real sequences. Monotonic and bounded sequences. Density points.Limit calculation methods. Celebrated sequences. The Eulerian number. Powers of irrational exponents. Limits of type 1^{∞}.
6.	Limits and continuity of real functions. The concept of differentiation. Equations of tangent and normal lines. The rules of differentiation.
7.	Solution Test #1 type problems.
8.	Elementary functions and their derivatives. Mean value theorems of differential calculus. Monotonity of differentiable functions. L′Hôpital's rule.
9.	Calculus of extrema. Higher order derivatives. Convexity and inflection. Discussion of real functions.
10.	The concept of definite integral, its geometrical meaning and basic properties. Primitive functions, indefinite integral.
11	Newton–Leibniz formula. Fundamental integrals. Integration by parts and by substitution.
12	Arc-length, area. Revolution surfaces and bodies. Improper integrals. Nujerical integration. Conversation into partial fractions. Integration of rational functions.
13	Solution of Test #2 type problem.
14	Supplementary Test.

Practical work:

Week	**Description**
1.	Common denominators. Roots and powers. Quadratic equations. Polynomial division.

2.	Radian, trigonometric functions. Complex operations in algebraic and trigonometric form.
3.	Solving complex equations.
4.	Equations of lines and planes. Fitting space elements, distances and angles between them.
5.	Matrix operations, transposition. Thre-dimensional determinants. Real functions.
6.	Limit of real sequences.
7.	ZH1+Derivatives, equations of the tangent and normal lines.
8.	L'Hôpital's rule.
9.	Calculus of extrema. Integration by parts. Integration by substitution.
10.	Convexity and inflection.
11	Basic integrals. Integration by parts.
12	Definite integral and applications.
13	ZH2+Integration by substitution.
14	Solution of problems for the exam.

Mid-semester requirements:

Attendance at lectures:

The rules of education and exam directory (TVSZ) are the guidelines.

Exams and tests (types, data)

written	Test #1 (week #7),
written	Test #2 (week #13): both for max. 30 pts.

Requirements for qualification:

Signature can be obtained if the sum of the two tests is greater than or equal to 30 pts.
In the opposite case a supplementary test from the material of the two tests on week #14, and (if required) one more possibility on the 2nd week exam session, with similar percents.

Type of exam (written, oral, tests etc.) and the method of assessment:

Written exam from the material of the whole semester for max. 26 pts.
Marking:
22-26: excellent (5)
18-21: good (4)
14-17: satisfactory (3)
10-13: pass (2)
0 - 9: fail (1)

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.

- In possession of state-of-the-art IT skills, being able to use professional databases and certain design, modelling, and simulation software depending on their specialty.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.
- Open to professional cooperation with specialists related to their profession but involved in other areas.

Literature:

1. Thomas – Weir – Hass: Thomas' Calculus, 13e, Pearson, 2013.
2. Anton – Bivens – Davis: Calculus, 10e, Wiley, 2012.
3. Anton – Rorres: Elementary Linear Algebra, 11e, Wiley, 2013.
4. Gilbert Strang: Differential Equations and Linear Algebra, Cambridge University Press, ISBN 9780980232790, 2015

Title of the course: **Mathematics II.**	**NEPTUN code:** RKXMA2EBNF	**Weekly teaching hours:** l+cw+lw 2+2+0	**Credit:** 6 **Exam type: e**
Course leader: Aurél Galántai Dr.Prof.	**Position:** professor	**Required preliminary knowledge:** RKXMA1EBNF sign	

Curriculum:

Introduction of complex numbers. The most important types of ordinary differential equations and construction of their solutions. Basic concepts of linear algebra. Vector geometry of the 3-dimensional Euclidean space. Convergence in n-dimensional Euclidean spaces. Differential calculus of functions in several variables. Geometrical problems connected to smooth curves and surfaces. Basic concepts of mathematical statistics. Construction of the line of linear regression.

Curriculum Description:

Week	**Topics of lectures**:
1.	Systems of linearequations. Gauss--Jordan elimination. Rank of a matrix.
2.	First order differential equations. General and particular solutions. Separable differential equations. First-order linear differential equations.
3.	Second-order linear differential equations with constant coefficients. Damped and harmonic oscillations.
4.	Open, closed and bounded sets of euclidean spaces. Convergence of point sequences. Limits and continuity of multivariate functions. The *n*-dimensional space. Multivariate functions (scalarfields), vectorfields. Partial derivatives, gradient. The chain rule in several variables. Partial derivatives of order 2, Young theorem, Smooth curves, velocity field. Derivativein a direction. Total differentiability. Smooth surfaces, tangent plane, normal line.
5.	Solution of Problems of Test 1
6.	Test 1
7.	Hesse-determinant. Extrema of functions of two variables. Areal and volume integral, calculation of volumes.
8.	Line and surface integrals. Jacobi matrix. Divergence, curl. Vector field without sources and whirls. Scalar and vector potential. Stokes-type theorems.
9.	Event algebras, probability fields. Geometrical probability. Conditional probability. The full probability theorem. Sampling with replacement and without replacement.
10.	Random variables of discrete and continuousdistributions. Expectations, standard deviations..
11.	Binomial and hypergeometrical distributions, sampling. Exponential and normaldistributions.
12.	Statistical samples. Sample average, empirical deviations. The equation of the regression line.
13.	Test 2.
14.	Retake for signature

Week	**Practical work description**
1.	Solvability of linear systems byelimination.
2.	Initial problems for Separable Differential Equations and First Order Linear equations.
3.	Initial problems for 2nd-order linear equations with constant coefficients.

4.	Partialderivatives, derivatives in a given direction. Tangent plane and Normal line.
5.	Preparation for Test 1(Solution of Problems)
6.	Extrema of function of two variables.
7.	Area lintegral.
8.	Divergence, curl. Line integral, potential function.
9.	Line integral, potential function.
10.	Sampling with and without replacement.
11.	Basic properties of cumulative distibution function and probability densities.
12.	Preparation of Test 2(Solution of Problems)
13.	Sample average, empirical deviation, linear correlation coefficient. Regression line. Retake Exercises.
14.	Retake and Exam Exercises.

Mid-semester requirements:

Attendance at lectures:

The rules of education and exam directory (TVSZ) are the guidelines.

Exams and tests (types, data)

Test #1 (week #6),
Test #2(week #13).

Requirements for qualification:

Signature can be obtained if the sum of the points obtained in the two test is at least 40 % of the total of points.
In the opposite case a supplementary test from the material of the two tests on week #14, and (if required) one more possibility at the beginning of the exam session, with similar percents.

Type of exam (written, oral, tests etc.) and the method of assessment:

Written exam from the material of the whole semester for max. 26 pts.
Marking:
22-26: excellent (5)
18-21: good (4)
14-17: satisfactory (3)
10-13: pass (2)
0 - 9: fail (1)

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- In possession of state-of-the-art IT skills, being able to use professional databases and certain design, modelling, and simulation softwares depending on their specialty.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.
- Open to professional cooperation with specialists related to their profession but involved in other areas.

Literature:

1. Anton, H., Rorres, C.: Elementary Linear Algebra with Applications, 9e, Wiley, 2005, ISBN: 0-471-66959-8.
2. Thomas, G.B. et al.: Thomas' Calculus, 11e, Addison-Wesley, 2005, ISBN: 0-321-18558-7.
3. Gilbert Strang: Linear Algebra for Everyone, Wellesley Cambridge Press, ISBN 9781733146630, 2020
4. Douglas C. Montgomery-Elizabeth -A Peck, G. Geoffrey Vining: Introduction to Linear Regression Analysis, Yohn Wiley & Sons, INC. ISBN 0 471 31565 6, 2001

Title of the course: **Chemistry I.**	**NEPTUN-code:** RMXCA1KBNF	**Weekly teaching hours:** l+cw+lw 2+0+2	**Credit:** 4 **Exam type**: e
Course leader: Csiszér Tamás Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** -	

Curriculum:

The goal of the subject is to acquire the essential knowledge of the structure, properties and transformations of chemical substances. The subject discusses the characteristics and reactions of the substances through the formation of unique atomic and molecular structures through chemical bonds and interactions to the characterization of homogeneous and heterogeneous sets. It also describes the grouping, production and most important applications of elements and inorganic compounds with students. In practice, students practice solving the most important computational tasks in the field of inorganic chemistry (writing and sorting reaction equations based on oxidation numbers, stoichiometry, concentration of solutions concentration, conversion of concentration units, gas laws).

Curriculum Description:

Weeks	**Topics of lectures and practices**
1.	**Lecture:** A brief history of chemistry. Structure of the atom. **Practice:** Basics of laboratory work (safety rules). Calculations. Preparation of solution (2 points).
2.	**Lecture:** Atomic models. Radioactivity. Quantum mechanical atomic description.
3.	**Lecture**: Periodic table theory. Types of covalent bonding. Transition between bond types. **Practice:** Test (calculation of concentration). (5 point) Volumetric analysis, acid-base titration (3*2 points)
4.	**Lecture:** The quantum mechanical molecular model.
5.	**Lecture:** Classification of material systems; SI system of units. Properties of gases. Concentration of solutions. Properties of dilute solutions. **Practice:** Test (gas laws). (5 points) Absorption spectrometry: determination of phosphorus concentration by spectrophotometry (2 points);
6.	**Lecture:** Types of colloidal systems, their production and changes.
7.	**Lecture:** Basics of chemical thermodynamics. Main terms. Basics of reaction kinetics. Law of mass action, chemical equilibria. **Practice:** Test (pH calculations). (5 points) Determination of sodium and potassium concentrations by flame photometer (2*2 points)
8.	**Lecture:** Electrolyte equilibria. Buffers.
9.	**Lecture:** Interpretation and quantitative relationships of chemical reactions. Acid-base theories.

	Practice: Test (calculation- electrochemistry). (5 points) measurement of pH (2 points)
10.	**Lecture:** Electrochemistry, conductivity and dissociation, electrode potential.
11.	**Lecture:** Galvanic elements. Corrosion and corrosion protection. **Practice:** Test (buffers). (5 points) measurement of Nitrit-N by spectrophotometer (2 points)
12.	**Lecture:** Interpretation and quantitative relationships of chemical reactions. Acid-base theories.
13.	**Lecture:** Inorganic Chemistry 1. **Practice:** Calculations and possibility for corrections (measurements and calculations)
14.	**Lecture:** Inorganic Chemistry 2.

Mid-term requirements:

Participation in occupations:

Attendance is compulsory. **Written test, week 12 (lectures + laboratory work).**
Weekly schedule is shown above, practice and lecture times: according to schedule.
It is compulsory to attend lectures and laboratory exercises. Up to 30% of lectures may be missed, but not laboratory exercises.
Both tasks are mandatory and participation in the classes, too. Achieving the two specified minimums is a condition to get a sign and a note.

Midterms, protocols, reports, etc.:

1) During the laboratory practice will be 4 short calculation tests will be written (it is worth up to 5 points) (total 20 points)
2) Laboratory measurements are worth up to 2 points each (total 18 points).
The written exercises and submitted laboratory protocols must fulfill a minimum of 20 points.
3) The theoretical and calculation classroom test will be on the examination period. (Up to 62 points can be achieved - minimum.: 32 points)
The minimum is 52 points.

The method of obtaining a signature / exam mark:

For those who fail the midterm, a make-up test will be given at an agreed time.

In case of failure of the end-of-year mark, the exam will be held on the date announced in the first week of the examination period. Both exams can be made up at the end of the year.

Below 52 points: unsatisfactory; 52-62 points: satisfactory; 63-75 points: intermediate; 76-85 points: good; 86 points and above: excellent

Anyone who has not reached the minimum of 52 points and does not fulfill the minimum points: his or her grade is insufficient. If the note is unsuccessful, it is possible to replenish the provisions of Section 17 (6) of the TVSZ.

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Knowledge of the main methods to examine the quantity and quality features of environmental elements and systems, their typical measuring instruments and limitations thereof, as well as methods for the evaluation of data measured.
- Able to perform basic tests of the quantity and quality characteristics of environmental elements and systems by state-of-the-art measuring instruments; to draw up and implement measurement plans; and to evaluate data.
- Able to solve tasks of water, soil, air, radiation, and noise protection, as well as of waste treatment and processing at proposal level; to participate in preparing decisions; to perform authority audits; and to take part in the operation of these technologies.
- Able to reveal deficiencies in the technologies applied and process risks and to initiate mitigation measures after getting familiarized with the technology concerned.

Literature:

1. A. Pahari, B. Chauhan: Engineering Chemistry, Infinity Science Press LLC, Hinghan, Massachusetts, New Delhi, India, 2007
2. Darrell Ebbing, Steven D. Gammon: General Chemistry, Cengage Learning, 2015, Cengage Learning, Boston, ISBN-13: 978-1305580343; ISBN-10: 1305580346
3. Peter G. Nelson: Introduction to Inorganic Chemistry, Key ideas and their experimental basis, 2018, 3 edition, Pages: 177, ISBN: 978-87-403-1912-5

Title of the course: **Chemistry II.**	**NEPTUN-code:** RMXCA2KBNF	**Weekly teaching hours:** l+cw+lw 2+0+2	**Credit:** 4 **Exam type**: e
Course leader: Tamás Csiszér Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** RMXCA1KBNF	

Curriculum:

The goal of the subject is the transfer of the basic concepts of organic chemistry required for other professional subjects. During the exercises, the students can acquire basic laboratory knowledge that is essential for the successful completion of other professional subjects.

Basic Concepts of Organic Chemistry: The structure and properties of alkanes. Nomenclature. The structure, reactions and properties of open-chain unsaturated hydrocarbons. The structure, reactions and properties of closed-chain saturated and unsaturated hydrocarbons. Production, Physical and Chemical Properties of Halogenated Organic Compounds. The grouping, physical and chemical properties of oxygen-containing organic compounds. The Grouping, Structure and Properties of Nitrogenous Organic Compounds.

Curriculum Description:

Weeks	**Topics of lectures and practices**
1.	**Lecture:** Hydrocarbons, Alkanes and Cycloalkanes. **Practice:** Exercises are 4 hours every 2 weeks in the laboratory. Basics of laboratory work (safety rules). Several topics from the first semester. Practice calculations.
2.	**Lecture:** Alkenes and Alkynes; Aromatic Hydrocarbons.
3.	**Lecture**: Naming Hydrocarbons Derivatives of Hydrocarbons**.** **Practice:** Calculation of titrations. Volumetric analysis. Weak Base-acid titration (2 points).
4.	**Lecture:** Organic Compounds Containing Oxygen.
5.	**Lecture:** Organic Compounds Containing Nitrogen 1. **Practice:** Titration of ammonium-chloride. (2 points)
6.	**Lecture:** Organic Compounds Containing Nitrogen 2.
7.	**Lecture:** Polymers: synthetic and biological 1. **Practice:** Test (titrations). (5 points). Complexometric titration (2 points)
8.	**Lecture:** Polymers: synthetic and biological 2.
9.	**Lecture:** Proteins 2. **Practice:** Test (calculation on thermochemistry and organic compounds) (5 points). Determination protein concentration. (2 points)
10.	**Lecture:** Proteins 2.
11.	**Lecture:** Carbohydrates 1. **Practice:** Test (organic chemistry) (5 points) Spectrophotometry (2 points)

12.	**Lecture:** Carbohydrates 2.
13.	**Lecture:** Nucleic Acids 1. **Practice:** Possibility for correction and replacement options
14.	**Lecture:** Nucleic Acids 2.

Mid-term requirements:

Participation in occupations:

Attendance is compulsory. **Written test, week 14 (lectures + laboratory work).**
Weekly schedule is shown above, practice and lecture times: according to schedule.
It is compulsory to attend lectures and laboratory exercises. Up to 30% of lectures may be missed, but not laboratory exercises.
Both tasks are mandatory and participation in the classes, too. Achieving the two specified minimums is a condition to get a sign and a note.

Midterms, protocols, reports, etc.:

1) During the laboratory practice will be written 3 short calculation tests (it is worth up to 5 points) (total 15 points)
2) Laboratory measurements are worth up to 2 points each (total 10 points).
The written exercises and submitted laboratory protocols must fulfill a minimum of 13 points from 25 points.

The method of obtaining a signature / exam mark:

For those who fail the midterm, a make-up test will be given at an agreed time.

In case of failure of the end-of-year mark, the exam will be held on the date announced in the first week of the examination period. Both exams can be made up at the end of the year.

The theoretical classroom test will be in the period of exams (up to 75 points can be achieved - minimum.: 38 points)

Weekly schedule is shown above, practice and lecture times: according to schedule.

Marks: >51: 1; 51-60: 2; 61-75: 3; 76-85: 4; 86-100: 5

In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Knowledge of the main methods to examine the quantity and quality features of environmental elements and systems, their typical measuring instruments and limitations thereof, as well as methods for the evaluation of data measured.

- Able to perform basic tests of the quantity and quality characteristics of environmental elements and systems by state-of-the-art measuring instruments; to draw up and implement measurement plans; and to evaluate data.
- Able to solve tasks of water, soil, air, radiation, and noise protection, as well as of waste treatment and processing at proposal level; to participate in preparing decisions; to perform authority audits; and to take part in the operation of these technologies.
- Able to reveal deficiencies in the technologies applied and process risks and to initiate mitigation measures after getting familiarized with the technology concerned.

Literature:

1. Darrell Ebbing, Steven D. Gammon: General Chemistry, Cengage Learning, 2015, Cengage Learning, Boston, ISBN-13: 978-1305580343; ISBN-10: 1305580346
2. John E. McMurry: Organic Chemistry, Edition: 9TH 16, Copyright: 2016, Publisher: Cengage Learning, Published: 2016, ISBN-13: 978-1305080485; ISBN-10: 1305080483
3. David R. Klein: Organic Chemistry, 2015, Wiley, Edition: 2nd, ISBN: Main edition: 978-1-118-45228-8; Binder version: 978-1-118-45431-2

Title of the course: **Physics for Engineers**	**NEPTUN-code:** RKXFI1ABNF	**Weekly teaching hours:** l+cw+lw 2+2+0	**Credit:** 4 **Exam type**: e
Course leader: Sándor Pekker, Dr.	**Position:** research professor	**Required preliminary knowledge:** -	

Curriculum:

The following topics will be covered in the course: the propagation and speed of light. Fundamentals of physical optics. Interference and diffraction phenomena. Principles of light scattering. Optical fibres. Lens exchange systems, imaging errors. Imaging of optical devices. Temperature. Thermal expansion of solids, liquids and gases. Basic thermodynamic concepts. Principles of thermodynamics. Fundamentals of statistical physics. Phase transitions. Irreversible thermodynamic processes. Electrostatics. Current conduction, direct currents. Basic magnetic phenomena. The magnetic field. Forces in magnetic field. Magnetic properties of materials. Law of excitation. Mechanisms of conduction. Electromagnetic induction. Electromagnetic waves. Theory of relativity. Thermal radiation. The photoelectric phenomenon. Photons. Fundamentals of quantum mechanics. Basics of quantum electronics, lasers. Basic properties of nuclei, models of nuclei.
The following topics are presented in the Fundamentals of Science subject: Newtonian mechanics, such as Description of motions, reference frame. Newton's laws. Laws of force and the equation of motion. The work theorem. Periodic motion. The law of angular momentum. The gravitational force field. Description of motions in an accelerating coordinate system. Basics of mechanics of point systems. Plane motion of a rigid body. Spinning motion. Elastic deformations. Mechanics of quiescent liquids and gases. Molecular forces in fluids. Flow of liquids. Wave theory.

Curriculum Description:

Training week	**Topics of lectures and practices**
1.	Sound waves. Speed of sound. Sound propagation. Sound levels. Doppler effect and sonic boom in sound (air).
2.	Determination of speed of sound and SPL (in dB). Solution of thermodynamics problems. Linear and volume expansion. Use of ideal gas law. Application of first law of thermodynamics.
3.	Thermodynamics. Absolute temperature scale. Thermal expansion of solids and liquids. Phase change. Heat and latent heat. State equation of ideal gases. Internal energy, work done by gas. First law of thermodynamics. Special processes.
4.	Problem solving for heat propagation, and heat engines.
5.	Heat propagation. Thermal Conduction. Heat engines. Carnot cycle in p-V plane.
6.	Problems for Electricity, and Coulomb’s law. Substance of Lorentz force.
7.	Electricity. Electric fields. Coulomb’s law. Motion of charged particles in a uniform electric field. Electric potential. Application of electrostatics. Capacitors. Combinations of capacitor.
8.	Problems for DC, and AC. What is the relationship between AC circuit powers.
9.	Direct current (DC) circuits. Electric current and resistance. Kirchhoff’s laws (junction and loop rule). RC circuit.
10.	Problems for atomic physics, binding energy, and natural radioactivity.
11.	Magnetism. Magnetic fields. Magnetic (Lorentz) force. Motion of a charged particle in a uniform magnetic field. Magnetic force between two parallel conductors. Faraday’s law of induction. Transformer. Alternating Current (AC) circuits. AC circuit powers.
12.	Written test 1, and its solution.
13.	Modern physics. Mass and energy. The photoelectric effect. Atomic physics. Size and density of the nuclei. Nuclear fission. Binding energy. Natural radioactivity. Atomic power station in Paks. Safety and waste disposal.
14.	Replacement (supplementary) written test, and its solution.

Mid-term requirements:

Participation in occupations:

It is compulsory to attend the lectures. The rules of education and exam directory (TVSZ) are the guidelines.

Midterms, protocols, reports, etc.:

Written test 1 on the week 13.
Replacement (supplementary) written test on the week 14.

The method of obtaining a signature / mid-term mark:

One written test. Total points: 100, if the score is > 40 points (successful) → signature.
If the student has not met the requirements of obtaining the term mark (e.g. has not written or failed the in-class test, has not submitted the measurement report, etc.), he/she must be given one opportunity to make up for the term mark in the study period. If the student is still unable to obtain the term mark through this opportunity and the requirements of the course give an opportunity for it, then the student can make an attempt to obtain the term mark on one occasion on one of the first ten work days of the examination period against a fee specified in the "Regulations of ÓU on possible benefits for students and on fees and charges payable by them" (hereinafter RBF).

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.
- Open to professional cooperation with specialists related to their profession but involved in other areas.
- Efforts to improve knowledge by on-going self-education and continuously update their knowledge of the world.

Literature:

1. Serway Jewett: Physics for Scientist and Engineers
2. Bueche, F., Hecht, E.: Schaum's Outline of College Physics, 11th edition, McGraw-Hill Education, 2011.
3. Feynman R., Leighton, R.B. and Sands M.: The Feynman Lectures on Physics. Volumes I-III. Revised and extended edition, Addison-Wesley, 2005.
4. Shankar, R.: Fundamentals of Physics: Mechanics, Relativity, and Thermodynamics. Yale University Press, 2014.
5. Shankar, R.: Fundamentals of Physics II: Electromagnetism, Optics, and Quantum Mechanics. Yale University Press, 2016.
6. Feynman R., Leighton, R.B. and Sands M.: The Feynman Lectures on Physics. Volumes I., II. Revised and extended edition, Addison-Wesley, 2005.
7. Fleisch, D., Kinnaman, L.: A Student's Guide to Waves, Cambridge University Press, 2015.
8. Shankar, R.: Fundamentals of Physics: Mechanics, Relativity, and Thermodynamics. Yale University Press, 2014.

Title of the course: Fundamentals of Environmental Biology	**NEPTUN-code:** RKXBI1EBNF	**Weekly teaching hours:** l+cw+l 2+2+0	**Credit:** 4 **Exam type**: tm
Course leader: Prof. Dr. habil. Hosam Bayoumi Hamuda	**Position:** Associate professor	**Required preliminary knowledge: -**	

Curriculum:

The aim of the course is to fill the gap between basic environmental science and advanced environmental biotechnology. The course is divided into two parts, the first dealing with biology and topics related to environmental sciences, and the second with environmental biotechnology. Environmental biology is a multidisciplinary subject and covers a wide range of topics such as ecological issues, global environmental problems and socio-economic scenarios, as well as modern fields such as molecular biology, genetics, ecology, etc. Topics covered. Biodiversity, taxonomy and modern classification. Hierarchy of biomolecules. Plasmids and their role in the adaptation of microorganisms to their environment. Biogenic elements. Types of micro-organisms. Fungi. Degradation of carbohydrates. Phototrophy and photosynthesis, light and dark phase. General characterisation and basic concepts of ecological systems. Soil microbiology. Water microbiology. Air microbiology. Microbiology of anaerobic environments. Antibiotics and their mechanism of action. Understanding environmental effects on animal and plant cells. Understanding the relationship between living organisms and environmental factors, the systems involved in the regulation of life functions and the behaviour and functioning of living systems.

Curriculum Description:

Weeks	**Topics of lectures and practicals**
1.	**Lecture**: The main characteristics of living organisms. Biodiversity, systematics and modern classification. Hierarchy of biomolecules: Proteins. Carbohydrates. Lipids. DNA, RNA properties, biosynthesis. **Practical**: Microbiological laboratory tools, equipment, and safety regulations. Nutrient requirements of bacteria, types of nutrition. Cultivation of bacteria. Complex media.
2.	**Lecture:** DNA replication and error correction. Occurrence and importance of mutations. Inheritance of genetic material. Possibilities of gene transfer. Plasmids and their role in the adaptation of microorganisms to the environment. **Practical**: Studying the practical application of the methods of isolation and cultivation of microorganisms. Incubation conditions. Characteristics of cultivation in different cultural media.
3.	**Lecture:** Biogenic elements. Structure of cells. Classification of microorganisms. Type of microorganisms: comparison of akaryotic, prokaryotic and eukaryotic organisms. Basic concepts and structure, structure, and morphology of viruses. Virus multiplication. Interferons. **Practical**: Theory and practical performance of biochemical examinations used to characterize microorganisms. The morphological characteristics of bacterial colonies. Bacterial types (size, shape, surface, edges).
4.	**Lecture:** The structure and morphology of the bacterial cell. Gram negative and positive bacteria. The archeae. **Practical**: Bacterial motility test and growth on an agar slant. The more common strain maintenance and conservation methods.
5.	**Lecture**: Fungi: Characteristics of yeasts and filamentous fungi. The importance of fungi in agriculture and the food industry.

	Practical: Morphological characterization of microbes, construction and use of the microscope. Fungal culture conditions. Metabolism and reproduction of fungi.
6.	**Lecture**: Eukaryotes: unicellular and algae. Types of microbial respiration: characteristics of aerobic and anaerobic respiration. **Practical**: Bioremediation. Microbial ecology. The effect of environmental factors on microorganisms. Soil-Plant-Microbe interactions.
7.	**Lecture**: Overview of catabolic and anabolic processes. Energy acquisition by oxidative phosphorylation. Chemolithotrophic metabolism. Breakdown of carbohydrates. General characteristics of fermentations. Phototrophy and photosynthesis, light and dark phase. **Practical**: Origin of eukaryotes, body organization. Lichens. The origin of eukaryotes, their body organization. Mycorrhiza.
8.	**Lecture**: General characterization and basic concepts of ecological systems: Trophic levels, food chains and networks. Types of interactions between microbes. Human and natural microbe partners. Biogeochemical cycles, role of microbes. **Practical**: Mitosis and Meiosis.
9.	**Lecture**: Soil microbiology. Microbiology of water. Air microbiology. Microbiology of anaerobic environments. Microbial biofilms. Antibiotics and their mechanism of action. **Practical:** Animal physiology studies.
10.	**Lecture**: Introduction to environmental effects on animal and plant cells. Structure and organization of multicellular organisms. Characteristics of colonial, tissue-organic organisms. **Practical**: The system of organisms representing the producing, consuming and degrading levels in the hot zone.
11.	**Lecture**: Importance of plants. Plant classification. The main types of multicellular plant organization. **Practical**: Forms of multicellular organization.
12.	**Lecture**: Invertebrates and Vertebrates. **Practical**: Plant morphology. Examination of fixed plant tissues, drawing up a report based on the microscopic examination.
13.	**Lecture**: The practice of animal and fungi identification, the recognition of the main groups (indicator groups) that are especially important from the point of view of environmental protection. **Practical**: The impact of human activity on the organization and functioning of the biosphere.
14.	**Lecture**: Introducing the relationship between living organisms and environmental factors, the systems involved in the regulation of life functions, and understanding the behavior and functioning of living systems. **Practical**: Direct interactions between microorganisms and higher plants, animals and human activity. Consequences of human interventions.
Mid-semester requirements:	
Attendance: Participation in practical lessons and lectures is obligated. Students should not absent more than 4 lectures and 1 practical lesson. If more, the course result is disable.	

Mid-terms, protocols, reports, etc.:

Their prisons, minutes, reports, etc.: Completion of 2 (theory + practice in one) indoor theses at a minimum level. The extra-local one is in the 14th week, and the TVSZ of the exam period. in the period prescribed by

The method of obtaining a signature / mid-term mark:

Signature conditions: a sufficient level of performance of the 2 med-term examinations, solving the homework and write the assay as well as the practical final report of the practices.
In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection
- Knowledge of the learning, knowledge acquisition, and data collection methods of the special fields of environment protection, their ethical limitations and problem-solving techniques.
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Able to cooperate with engineers involved in the development and application of production and other technologies to develop the given technology in terms of environment protection.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.
- Collaboration with civil organizations engaged in environment protection, but willing to argue in order to develop optimal solutions.
- Constantly upgrading their knowledge of environment protection by attending organized professional development training courses.
- Sharing experiences with colleagues, thus promoting their development.
- Taking responsibility towards society for their decisions made in the scope of environment protection.

Literature:

1. J.H. Postlethwait and J.L. Hopson (2009): Modern Biology. Holt, Rinehart and Winston. A Harcourt Education Company, New York, London. ISBN-13: 978-0-03-006769-4
2. Kenneth Todar (2008): Todar's Online Textbook of Bacteriology. University of Wisconsin
3. David M. Sander (2007): Big Picture Book of Viruses.
4. Julie B. Wolf (2005): Applied Molecular Biology. Beginning Laboratory Manual. University of Maryland, Baltimore County (UMBC).
5. T. A. Brown (2002): Genomes 2nd edition Bios Scientific Publishers Ltd IBSN: 9781859962282
6. Harry L. T. Mobley, George L. Mendz, Stuart L. Hazell (2001): Helicobacter pylori: Physiology and Genetics. ASM Press ISBN: 9781555812133
7. Madigan, Martinko and Parker (2000): Biology of Microorganisms. 8th edition Southern Illinois University, Carbondale

Title of the course: **Electrotechnics**	**NEPTUN-code:** RKXEL1EBNF	**Weekly teaching hours:** l+cw+lw 1+2+0	**Credit:** 4 **Exam type**: tm
Course leader: Sándor Pekker, Dr.	**Position:** research professor	**Required preliminary knowledge:** -	

Curriculum:

Production and features single-phase alternating current. Peak and RMS value. The coil and the capacitor AC circuit. RLC circuits. AC power, power factor correction. Production of three-phase voltage. Three-phase networks. Star and delta. Transformers operating principle, equivalent circuit, operating conditions. The transformer structure. Special transformers. The basics of electronics. Semiconductor devices. The diode characteristics, application areas. Rectifier circuits. Special properties diodes. Power supplies. The thyristor, triac and diac structure, characteristic curves and application areas. Transistors construction, operation, characteristic curves. Amplifier basic circuits. The transistor switching operation. Amplifier circuit features. Operational Amplifiers construction, operation modes. Oscillators. Multi Plate. Operating principles, structure, replacing the coupling of the asynchronous machine. The single-phase asynchronous motor. Operating principle, starting torque and asynchronous machines. Principle of operation of DC machines, excitation solutions and operational features.

Curriculum Description:

Week	**Topic of lectures and practices**
1.	Revision of DC quantities (charge, voltage, current, resistance, work, power)
2.	Notable basic circuits and basic laws (Kirchoff I.-II., voltage and current divider)
3.	Passive circuit elements (inductivity, capacitor)
4.	Introduction of alternating current quantities
5.	Behavior of circuit elements in alternating current circuits I. (RC and RL)
6.	Behavior of circuit elements in alternating current circuits II. (RLC)
7.	1st Midterm
8.	The magnetic property of current
9.	Basics of electric machines I.
10.	Basics of electric machines II.
11.	Physical and electrochemical foundations of semiconductors
12.	Types of diodes and their applications
13.	Presentation of project work
14.	Retake

Mid-term requirements:

Participation in occupations:

Compulsory

Midterms, lab reports, etc.:

Completion of 1 (theory+practice in one) midterm at least at a sufficient level and preparation and presentation of the published group project work.

The project work is a model/simulation related to electricity (magnetic phenomenon, simple circuit, etc.) and its presentation.

The method of obtaining a signature / mid-term mark:

Basis of marking: attendance at lectures and laboratory works/practice.

Written tests min. and project work min. = 2 (pass) (separately).
In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- In possession of state-of-the-art IT skills, being able to use professional databases and certain design, modelling, and simulation software depending on their specialty.
- Efforts to improve knowledge by on-going self-education and continuously update their knowledge of the world.
- Responsible proclamation and representation of the value system of the engineering profession; openness to professionally well-founded critical remarks.
- Sharing experiences with colleagues, thus promoting their development.

Literature:

1. Valery Vodovozov: Introduction of to Electronic Engineering, 2010. http://bookboon.com; ISBN: 978-87-7681-539-4
2. Don Johnson: Fundamentals of Electrical Engineering I, Connexions , 2010; https://cnx.org/contents/d442r0wh@9.72:g9deOnx5@19/Themes; 1999-2018, Rice University; ID: 778e36af-4c21-4ef7-9c02-dae860eb7d14@9.72
3. John A. I. E. E. Henderson: Electrotechnics, Wentworth Press, 2016. aug. 25. - 188 pages, ISBN: 1362012750, 9781362012757

Title of the course: **Ecology**	**NEPTUN-code:** RKXOK1ABNF	**Weekly teaching hours:** l+cw+lw 2+1+0	**Credit:** 4 **Exam type**: tm
Course leader: Prof. Dr. habil. Hosam Bayoumi Hamuda	**Position:** Associate professor	**Required preliminary knowledge:** RKXBI1EBNF	

Curriculum:

The aim of the course is to introduce the concepts and principles of ecology. Topics: Units of supra-individual organization; biological organizational levels, with particular regard to supra-individual organizational levels, definitions, characterizations. Interaction between nature and man, biological-cultural coevolution, complementarity of biological capacity and mediating systems. Association theories. Interpretation of environmental and nature protection. The concept of primary production, its distribution on Earth, environmental factors limiting primary production. Population, community ecology. Changes in communities over time, main types of succession. The structure and change of living communities (associations). The main status indicators of ecosystems, the characteristics of communities of organisms interpreted as systems. The biome and the biosphere. The biosphere and its history; the concept of biodiversity, its importance, and the need to protect it; the Gaia hypothesis; changing associations and global biogeochemical cycles and their consequences; the history of man's nature-transforming activity; the problem of world food; the lack of fresh water; the problem of world population growth; the growth of the world economy, economic globalization; environmentally friendly technologies, environmental protection.

Curriculum Description:

Weeks	**Topics of lectures and practices**
1.	**Lecture**: Presentation of concepts and principles of ecology. **Practical:** Effect of climatic changes on vegetation
2.	**Lecture**: Levels of supra-individual organization; biological organizational levels, definitions, and characterizations.
3.	**Lecture**: Interaction between nature and human, biological-cultural coevolution, complementarity of biological capacity and mediating systems. Association theories. **Practical**: Effect of CO_2 on plant growth and nutrition
4.	**Lecture**: Interpretation of environmental and nature protection.
5.	**Lecture**: The concept of primary production, its distribution on Earth, environmental factors limiting primary production. **Practical**: Eco-friendly nutrient replenishment and plant protection in the small garden
6.	**Lecture**: Ecology of population and community.
7.	**Lecture**: Changes in communities over time, main types of succession **Practical**: Ecologically, sustainable development as a principle of environmental regulation, Industry and environment. Agriculture as environment. With the weather forecast, with air pollution.
8.	**Lecture**: The structure and change of living communities (associations).
9.	**Lecture**: The main status of indicators of ecosystems, the characteristics of communities that can be interpreted as systems **Practical**: Environmental protection in corporate practice, Institutions of Environmental organization. Requirements and application guidelines.

10.	**Lecture**: The biome and the biosphere
11.	**Lecture**: The biosphere and its history **Practical**: Vegetation "population". The ecological foundation of the Excel spreadsheet program. Graphic display. Use of statistical functions. Data analysis functions.
12.	**Lecture**: The concept of biodiversity, its importance and the need to protect it; the Gaia hypothesis
13.	**Lecture**: Changing associations and global biogeochemical cycles and their implications Practical: Using Quadrat methods to measure the vegetation rates
14.	**Lecture**: The history of man-nature-transforming activity; the problems of: world food; the lack of fresh water; the problem of world population growth; the growth of the world economy, economic globalization; environmentally friendly technologies, environmental protection.

Mid-semester requirements:

Participation in occupations:

Participation in practicals and lectures is obligated.
Students should not absent more than 4 lectures and 1 practical lesson. If more, the course result is disable.

Mid-terms, protocols, reports, etc.:

Their prisons, minutes, reports, etc.: Completion of 2 (theory+practice in one) indoor theses at a minimum level. The extra-local one is in the 14th week, and the TVSZ of the exam period. in the period prescribed by.

The method of obtaining a signature / mid-term mark:

Signature conditions: a sufficient level of performance of the 2 med-term examinations, solving the homework and write the assay as well as the practical final report of the practices.
In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection
- Knowledge of the learning, knowledge acquisition, and data collection methods of the special fields of environment protection, their ethical limitations and problem-solving techniques.
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Able to cooperate with engineers involved in the development and application of production and other technologies to develop the given technology in terms of environment protection.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.
- Collaboration with civil organizations engaged in environment protection, but willing to argue in order to develop optimal solutions.

- Constantly upgrading their knowledge of environment protection by attending organized professional development training courses.
- Sharing experiences with colleagues, thus promoting their development.
- Taking responsibility towards society for their decisions made in the scope of environment protection.

Literature:

1. Townsend, C.R., Begon, M., Harper, J.L. (2006). Essentials of Ecology (2nd Edition). Blackwell Publishing. (Highly recommended).
2. Begon, M., Townsend, C. R., Harper, J. L. (2006). Ecology (4th edn).
3. Towsend, C.R., Begon, M., Harper, J. (2003): Essentials of Ecology. 2nd ed. Blackwell Science, Oxford.
4. Press, M.C., Huntly, N.J., Levin, S. (2001): Ecology: Achievement and challenge. Blackwell Science, Oxford.
5. Crawley, M. J. (1997): Plant ecology. 2nd ed. Blackwell Science, Oxford.
6. Begon M., Harper J.L., Townsend C.R. (1996): Ecology. Blackwell Science
7. Krebs, C. J. (1994 & 2001). Ecology. (4th & 5th edns). Harper Collins, New York.

Title of the course: **Earth sciences knowledge**	**NEPTUN-code:** RKXFT1ABNF	**Weekly teaching hours:** l+cw+lw 2+0+2	**Credit:** 4 **Exam type**: tm
Course leader: Krisztina Demény Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge: -**	

Curriculum:

The geological history of the Earth. The internal structure of the Earth (the crust, the mantle, the core). Volcanism (type of volcanoes, volcanoes, and plate boundaries) and plate tectonics. Rocks (igneous, sedimentary, and metamorphic) and minerals classification systems. Major types of landforms (plains, mountains, cratons). Exogenous processes and main landform methods (the work of rivers, the formation of shores and coastlines, glacial processes, the work of wind). Main features of surface waters (rivers and lakes) and waters below the surface (groundwater, confined water, crack water). Karst processes (karst forms on or below the surface). Main soil types in the world (definition, functions, and major soil formations).

Curriculum Description:

Weeks	**Topics of lectures and practices**
1.	Lecture: Internal structure of the Earth (the crust, the mantle, the core) Practice: Talking general topics, requirements (fieldtrip, exercises)
2.	Lecture: Plate tectonics Practice: Minerals classification and rocks classification. Classifying and practising of igneous rocks and minerals
3.	Lecture: Volcanism (type of volcanoes, volcanoes and plate boundaries) Practice: Classifying and practising of sedimentary rocks and minerals
4.	Lecture: The geological history of the Earth Practice: Classifying and practising of metamorphic rocks and minerals
5.	Lecture: Landforms (shelves, cratons, mountains, plains), exogenous processes (in general). Practice: Kiscelli-Doberdó educational path (fieldtrip)
6.	Lecture: Landform processes (the work of rivers, the formation of shores and coastlines, glacial processes, the work of wind) Practice: Minerals and rocks systematization (igneous, sedimentary, metamorphic rocks)
7.	Written test I.
8.	Lecture: Main features of surface waters (rivers and lakes). Practice: Defining and counting of main parameters of water level I..
9.	Lecture: Main features of waters below the surface (groundwater, confined water, crack water). Practice: Defining and counting of main parameters of water level II..
10.	Lecture: Karst processes (karst forms on or below the surface). Practice: Defining and counting of runoff.
11.	Lecture: Visiting to Szemlőhegy-cave
12.	Lecture: Main soil types in the world (definition, functions, and major soil formations). Practice: Defining and counting of catchment area. Analysis of main hydrological parameters.
13.	Written test II.
14.	Replacement test

Mid-term requirements:

Participation in occupations:
Compulsory

Mid-terms, protocols, reports, etc.:

2 Written tests (lectures + laboratory/practice work)

The method of obtaining a signature / mid-term mark:

Basis of marking: attendance at lectures and laboratory works,
Written tests min. = 2 (pass) in each tests (separately).
In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Able to perform basic tests of the quantity and quality characteristics of environmental elements and systems by state-of-the-art measuring instruments; to draw up and implement measurement plans; and to evaluate data.
- Open to professional cooperation with specialists related to their profession but involved in other areas.

Literature:

1. William M. Marsh, Martin M. Kaufman: Physical geography, Cambridge University Press, 2013.
2. PPT files on the homepage of Moodle learning system
3. Jane H. Hodgkinson, Frank D. Stacey: Practical Handbook of Earth Science, ISBN 9781138054448. CRC Press, 2017

Title of the course: **Economics**	**NEPTUN-code:** GKXKG1QBNF	**Weekly teaching hours:** l+cw+lw 2+1+0	**Credit:** 4 **Exam type**: tm
Course leader: Szemere Tibor Pál, Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:** -	

Curriculum:

Introduction to Macroeconomics and National Income Accounting. The MPS and the SNA-system. Gross Output, GDP, GNI, NDP, Nni, GNDI, NNDI. The Determination of National Income. The Circular Flow. The Consumption Function. The Investment Demand. Money and Modern Banking. Money and its Functions. The Monetary Base and the Money Multiplier. Commercial Banks and the Central Bank. Equilibrium in the Financial Markets. Money and Inflation. The Cost of Inflation. The Government in the Circular Flow. The Government Budget. Monetary and Fiscal Policy. Lorenz Curve and the Gini Coefficient. Economic Growth and the Business Cycle. International trade and Commercial Policy. Absolute and Comparative Advantage in the World Trade. The Components of the Balance of Payments,
The Tools of Economic Analysis. The Market. Demand, Supply and Equilibrium. Free Markets and Price Controlls: Price Ceilings and Maximum Prices. Price Elasticity Of Demand, Cross-elasticity of demand, Income-elasticity.The Theory Of Consumer Choice. Complements and Substituties. Business Organization and Behaviour. The Firms Production Decision. Production costs.Type of Business Organizations. Market Structures and Mesurement of Market Power: Herfindahl, CR and Lerner-index. Perfect Competition and Pure Monopoly. Monopolistic Competition. Oligopoly. Game-theory.and interdependent Decision. Nash- Equilibrium. Dominant Equilibrium. The Analysis of Factor Markets: Labour Market. Human Capital. Capital Markets. Rentals, Interest Rates and Assets Prices. Net Present Value.

Curriculum Description:

Weeks	**Topics of Lectures and Practices**
1.	Basic economic concepts, Characterisation of the market and market players.
2.	Characteristics of supply and demand. Price and income elasticities. Analysis of consumer behaviour. Consumer preference system and its characteristics.
3.	The utility function. The indifference curve. The budget line. Equilibrium situation. The effect of price and income changes on the equilibrium situation. Firm, enterprise, forms of enterprise.
4.	The technical - economic context of production. Costs of production. Classification of costs, cost functions.
5.	Short and long-term cost functions. Understanding the different concepts of profit. Characteristics of market types.
6.	Writing the 1st written exam.
7.	The nature and forms of competition in different types of markets.
8.	Corporate behaviour (optimal output) in perfectly competitive, monopoly and oligopoly markets.
9.	Characteristics of the market for factors of production. Characteristics of the capital market.
10.	Different ways of valuing real capital. Specificities of the labour market.
11.	Characteristics and role of the securities market. The land and real estate market.
12.	Specificities of the capital market. Different ways of valuing real capital. Specificities of the labour market. Characteristics and role of the securities market. The land and real estate market.
13.	Writing the 2nd written exam.
14.	Repeat written exams

Mid-semester requirements:	
Students write two written exams during the semester, in weeks 6 and 13. Students who have not written or failed their essay can correct or repeat their exam in week 14. Attendance in class and practical lesson is compulsory, and absences are limited to the extent allowed by the TVSZ. Students exceeding the permitted number will be excluded from the course. To obtain a mark, two written examinations must be passed. Students will receive a mark based on the result of the two exams (arithmetic avarage). A pass mark is awarded if the student achieves at least 51% in total.	
Test papers, measurement records, reports, etc. (number, date):	
1.	1st written exam – week 6.
2.	2nd written exam – week 13.
3.	Repeat exam – week 14.
4.	You can earn extra points by doing extra work in class and by completing other extra assignments, which will be announced in class with a deadline. These points will count towards the written exam if the deadline is met, but are not compulsory.
Methods of qualification:	
Attendance at the class and the practical lesson is compulsory, and you may only miss the maximum number of lessons allowed in the Education and Examination Regulations (TVSZ). Students who exceed the permitted number will be excluded from the course. To obtain a mark, the student must pass two written exams. Students will receive a mark based on the result of the two exams (arithmetic average). A pass mark is awarded if the student achieves at least 51% in total.	
Professional competencies:	
– Knowledge of the concepts and tools of economics and environmental economics, project and environment management in environment protection. – Able to perform public administrative and authority tasks related to environment protection after getting acquainted with the duty assigned to them. – Undertaking and authentically representing the social role of environment protection, its basic relationship with the world. – Efforts to improve knowledge by on-going self-education and continuously update their knowledge of the world. – Responsible proclamation and representation of the value system of the engineering profession; openness to professionally well-founded critical remarks.	
Literature:	
1. Begg, David et al. Economics. McGraw-Hill Edition, 2014. 2. Peter Jochumzen: Essentials of Macroeconomics. 2010. www.bookboon.com 3. Ian Jaques: Mathematics for Economics and Business, Addison-Wesley	

Name of subject: **Management and Enterprise Economics (blended)**	**NEPTUN-code:** GVEVG2QBNF	**Number of hours:** lec+gs+lab 2+1+0	**Credit:** 4 **Requirements:** term mark
Course coordinator: Péter Szikora Ph.D.	**Title:** senior lecturer	**Prerequisite:** -	

Curriculum:

The aim of the course is for students to acquire knowledge which will enable them to dealwith economic and financial problems from a corporate point of view. Students are introduced to the concepts of enterprise, objectives, business environment, business forms,value creation, production processes, organizational forms, strategy creation and corporatemarketing. Students also gain an insight into the development of enterprises, different development strategies, problems of growing, optimal operational size and various other essential aspects of managing a corporation.
The aim of the course is to further develop the students' basic business and economic knowledge and thinking, keeping the practical requirements in mind, with appropriate theoretical knowledge acquisition. Students are introduced into company asset management, labor management issues, cost management, cost accounting methodology, analysis of the economics of investments and the basics of corporate finance. Students alsogain an insight into basic marketing concepts and methods.

Curriculum Description:

week	**Topics of lectures and practicals**
1.	Business environment and purpose
2.	General characteristics of the company - Company organisation
3.	Organising and managing companies. Management. Management styles, management theory.
4.	Forms of business
5.	Financial management of the company. Finance, Balance sheet. Examining the economy and efficiency of a company. Controlling.
6.	Running companies. Production. Production management, optimisation and logistics.
7.	Fixed asset management. Investments. Current asset management and storage.
8.	Company human resources management. HR. Market activity of the company. Marketing
9.	Management disciplines: strategy, project, innovation and marketing management, TQM. Environmentally conscious management
10.	Problem and conflict resolution, crisis and conflict management.
11.	Decision theory, decision process, problem and decision relationship
12.	Techniques to stimulate creativity. Case studies: regarding decision making, responsibility, power and authority.

Mid-semester requirements:

The method of assessment: term mark

Based on written exams.

Professional competencies:

- Knowledge of the concepts of economics and environmental economics, project and environmental management, tools in the field of environmental protection.
- Ability to carry out administrative tasks related to environmental protection, to perform official tasks.

- Ability to participate in environmental consultancy, advisory and decision-preparation work.
- Understand and credibly represent the role of the environment in society and its fundamental relationship with the world.
- Is open to professional cooperation with professionals in other fields related to his/her profession.
- Strives to continuously improve his/her knowledge through self-learning and to keep his/her knowledge of the world up to date.
- To be accountable to society for the choices he/she makes in the environmental field.
- In the performance of his/her professional duties, he/she cooperates with qualified professionals in other fields (primarily economic and legal).

Litreture:

1. Kadocsa, Gy. (2007): Entrepreneurial Management. Amicus Press, Budapest – München
2. Spinelli, S., Adams, R. (2011): New venture creation: Entrepreneurship for the 21st Century. McGraw-Hill Education

Name of subject: **Projectmanagement (blended)**	**NEPTUN-code:** RMEPR1EBNF	**Number of hours:** lec+gs+lab 1+1+0	**Credit:** 4 **Requirement:** examination
Course coordinator: Áron Takács Ph.D.	**Title:** associate professor	**Prerequisite:** -	

Curriculum:

The topics of the course provide knowledge on how to implement projects with different objectives in a strategy-oriented way, how to manage uncertainties and risks, and how to find solutions to project-related problems using organisational-management, technical-technical and economic knowledge. In industrial and service activities, in the competitive sector, each task is solved by means of a specific design and implementation, in which a new product has to be produced within a given budget and within a given deadline, using finite resources (building a facility, designing a service, designing a product, etc.). Projects of this kind and similar activities require a new approach, the use of specific methods and techniques. In this sense, project management also represents the emergence of a new discipline.

Curriculum Descriptoin:

Week	**Topics of lectures and practices**
1.	The concept of project, the tasks of project management. Initiating a project, planning, implementation, monitoring/supervision, closure.
2.	Routines, improvisation and the project. Starting a project. Forming the project team. Project management phases. Goal setting, project planning.
3.	Project planning tools: stakeholder analysis, logical framework matrix, work breakdown structure, responsibility matrix, time planning, resource planning.
4.	System of processes, aspects of time planning GANTT.
5.	Stochastic mesh design. Risk assessment of time planning. Cost planning. Quantification of resources, time valuation, cash flow.
6.	Cost monitoring. Modifying costs and their impact.
7.	Project quality criteria. Quantification of objectives, trade-offs between objectives.
8.	Quality planning in the project process.
9.	Monitoring quality characteristics. Corrective and preventive actions for quality.
10.	Project organisations. The organisational commitments required for different projects. Projects in practice, contracting, planning, documentation, monitoring, measurement, corrective actions.
11.	Projects in practice, contracting, planning, documentation, monitoring, measurement, corrections.
12.	Development of project methodology. Using completed projects for continuous improvement. Results and process orientation. Project cycle management Extreme project management, MS Project as a practical support tool.
13.	Seminary test (ZH). PMBOK Consultation
14.	Supplementary seminary test.

Mid-term requirements:

Attendance at lectures and practices/labs:

Participation at the exercises is compulsory, absence according to the TVSZ. Attendance at lectures is also compulsory, for the successful completion of the semester (exam) knowledge of the material presented in the lectures is required.

Tests, minutes, reports, essays, etc.:

Week 13: Writing one valid final test.
Week 14: Supplementary seminary test.

Method of obtaining a signature/mid-term mark:

Condition for obtaining a signature:
- Timely submission and acceptance of the assigned assignments
- The deadline for the submission of the assignment is the submission of the assignment by the due date and time.

The maximum mark for the final examination is 100, of which a minimum of 50 must be achieved. The relevant provisions of the current Study and Examination Regulations apply for the replacement of the signature.
Examination is written and take approximately 60 minutes.
The assessment is based on the percentage of marks obtained:
0 - 49% unsatisfactory,
50 - 62 % satisfactory
63 - 75 % moderate,
76 - 88 % good
89 - 100 % excellent

Professional competencies:

- Knowledge of the concepts of economics and environmental economics, project and environmental management, tools in the field of environmental protection.
- In the development and application of production and other technologies, the ability to cooperate with engineers developing and applying the technology in order to improve the technology from an environmental point of view.
- Their multidisciplinary knowledge enables them to participate creatively in engineering work and to adapt to constantly changing requirements
- Ability to identify shortcomings in the technologies used, process risks and take the initiative to mitigate them.
- Open to professional collaboration with professionals in other fields related to his/her profession.
- In the performance of his/her professional duties, he/she will also cooperate with qualified professionals from other disciplines (primarily economic and legal).
- He/she monitors and implements changes in legislation, technical, technological and administrative developments in the field.

Literature:

1. https://elearning.uni-obuda.hu/ electronic notes and aids prepared by the instructor
2. Project management guide (PMBOK® Guide) 5. Akadémiai Kiadó, Budapest, 2013, ISBN: 978 963 05 9426 4

Title of the course: **Learning methodology**	**NEPTUN-code:** RTXTM1EBNF	**Weekly teaching hours:** l+cw+lw 1+2+0	**Credit:** 4 **Exam type**: tm
Course leader: Marianna Halász Ph.D.Prof.	**Position:** professor	**Required preliminary knowledge:** -	

Curriculum:

The aim of the course is to prepare students entering higher education to learn effective and efficient learning strategies, to develop individual conditions for self-regulated learning. Students will learn techniques for tuning in to learning, learning and resting while learning. They develop individual and cooperative learning skills. They will learn to deal with learning difficulties in a conscious way and to form success-oriented learning attitudes. Students will gain comprehensive and practical knowledge of factors influencing learning effectiveness, effective learning methods, effective ways of obtaining and organising information online, learning support interfaces and constructive career development. The main aim is to develop competences that will help students to succeed in the subjects they have studied and to prepare for exams.

Curriculum Description:

Week of Semester	**Topics of lectures and practices:**
1.	Learning challenges in the information society (formal, non-formal, informal learning). The need for a change in learning strategies in higher education, the development of self-regulated learning. Assessing our learning style.
2.	Shaping our learning environment. Online group work for developing a personal learning environment.
3.	Characteristics of youth and adult learning, previous learning experiences. Self-assessment of our learning motivation (goals, interests, values, attitudes), capacities (knowledge, skills, abilities) through questionnaires (online survey - Complex Learning Diagnostic Assessment and Self-Assessment).
4.	Simple learning techniques. Note-taking techniques. Techniques for independent processing of larger materials. Reflections on learning.
5.	Identifying learning difficulties. Questionnaire and evaluation of results.
6.	Using mind maps. Learning about software and their use in learning and teaching (making a mind map for a unit of learning material).
7.	Learning strategies (techniques for tuning into learning, specific methods, relaxation techniques). Known and frequently used learning techniques in the field of technical education.
8.	Speed reading, flash reading. Watching, analysing, and evaluating professional videos. Individual experiments to master the methods.
9.	Understand time management, methods, online techniques (Daily, weekly, monthly learning schedules.)
10.	Co-operative learning techniques (team learning, PBL, IBL, project groups). Development of professional and soft skills at university. Development of group techniques in the online space.
11.	Designing the learning process. Preparation for lectures, exercises, consultations. E-learning. Integrated learning methods. eLearning and mLearning strategies. Discussing experiences, sharing good practices.
12.	Strategies for successful learning (role of NLP techniques). Use of methods (e.g. goal setting, communication techniques, reflection, reframing failures), impact on personal development.
13.	Effective and efficient exam preparation techniques.
14.	Evaluation of the semester.

Mid-semester requirements:

Attendance:

Completion of an online test paper (Moodle) with at least a satisfactory grade (2) in week 13.
Individual development and submission of the four mid-term assignments via Moodle not later than week 13.

Test papers, measurement records, reports, etc. (number, date):

Assignment 1
Assignment 2
Assignment 3
Assignment 4
Test

Methods of qualification:

To receive a grade, the final test and the assignments must be completed at least satisfactorily. The grade is based on the simple mathematical average of the 5 submissions.

Professional competencies:

- The ability to see and manage the phenomenon of learning in a complex way, and to use effective communication techniques.
- Ability to make adequate use of a varied and up-to-date toolbox of learning methods, based on individual needs.
- Ability to learn independently.
- Ability to work in a cooperative way, preferably by listening to the opinions of colleagues under his/her control, in order to solve problems and make management decisions.
- Ability to implement lifelong learning.
- Ability to continuously develop his/her skills by participating in organized training in his/her field.

Literature:

1. Nick Rushby- Dan Surry: The Wiley Handbook of Learning Technology, Wiley-Blackwell, 2016, ISBN: 978-1-118-73643-2
2. John Branch - Paul Bartholomew - Claus Nygaard :Technology-Enhanced Learning in Higher Education, Libri Publishing Ltd., Oxfordshire, UK, 2015, ISBN: 9781909818613
3. Terri Pantuso -Sarah LeMire - Kathy Anders: Informed Arguments: A Guide to Writing and Research, Texas A&M University, 2019
4. Chunfang Zhou: Handbook of Research on Creative Problem-Solving Skill Development in Higher Education, Paratext, 2017, ISBN: 9781522506430

Title of the course: **Construction of a tutoring system and modern learning techniques**	**NEPTUN-code:** RTXTK1EBNF	**Weekly teaching hours:** l+cw+lw 1+1+0	**Credit:** 3 **Exam type**: tm
Course leader: Marianna Halász Ph.D. Prof.	**Position:** professor	**Required preliminary knowledge:** -	

Curriculum:

The aim of the course is to prepare students for tutoring, where one or a small group of students receive individual, personalised instruction. The tutorials are designed to develop individual learning pathways, independent learning, subject skills, communication, and social competences, so that students are able to help each other in their learning and thus reduce dropouts. The role of the tutor in reducing dropouts and catching up. The responsibilities of the student mentor, data management of mentored students. The role of the peer mentor. Mentor responsibilities related to role provision. The person of the mentor, the competency requirements of mentoring. Getting to know the peer mentor, the specificities of communication with them. Developing relational skills. Exploring the mentor's prior knowledge, subject skills, and personal characteristics. The characteristics of adult learning. Subject-specific support for the mentored person (mentoring and tutoring). Identification of mentoring problems. Personal mentoring support needs for successful learning progress. Objectives of mentoring support, stages of mentoring work, the spectrum process of mentoring. Planning mentoring support. Choice of mentoring strategies, their application. Methods of mentoring support. Motivating the mentored. Peer learning strategies and techniques. Developing reflective thinking. Levels of reflection. Opportunities for self-development. Processing, analysis, and evaluation of contemporary mentoring case studies. Diagnostic-, formative-, formative-, developmental assessment-, sensitive feedback/evaluation in mentoring. Outcomes of mentoring, holistic evaluation of the mentee. Aftercare of the mentored.

Curriculum Description:

Week of Semester	**Topics of lectures and practices**
1.	The role of the tutor system in reducing drop-outs. Responsibilities of the student tutor, data management protocol.
2.	Specificity of peer tutor roles. Responsibilities related to the role.
3.	The self of the tutor, competency requirements of the role. Getting to know the peer tutees and master the specific communicational strategies. Developing connectional skills.
4.	Exploring the tutee’s prior knowledge, field-specific skills, and personal characteristics. Understand the specificities of adult learning.
5.	Field-specific tutoring for the supported student (mentoring and tutoring).
6.	Identification of tutoring difficulties. The need for personal tutoring for successful learning outcomes.
7.	Objectives of the tutoring interaction, stages of mentoring, spectrum process theory.
8.	Planning the tutoring support.
9.	Choice of supporting strategies and their application. Methods in tutoring. Motivation of the tutees.
10.	Peer learning strategies and techniques.
11.	Developing reflective thinking. Stages of self-reflection. Opportunities in self-development.
12.	Processing, analysing, and evaluating peer tutoring case studies.
13.	Giving constructive, formative, developmental and sensitive feedback in tutoring.
14.	Outcomes of the tutoring. Holistic evaluation of the tutee’s progress. Follow-up of the supported student.

Mid-semester requirements:

Attendance:

Compulsory, according to the TVSZ.

Methods of qualification:

In the practical sessions of the course, you will be required to complete the training tasks and to prepare a written assignment based on the given model.

The mid-year grade (average) is determined by the performance in the practical sessions (50%) and the assessment of the coursework (50%).

The instructor may offer a grade of "excellent" or "good" based on the student's great performance or scientific work during the teaching period, which the student is not compulsory to accept. During the first ten working days of the examination period, the written assignment may be substituted, but there is no such option for the practical assignments.

Professional competencies:

- Able to listen to others sympathetically and give meaningful answers.
- The ability to ask questions that help to self-discover the other person's abilities, personal qualities and aspirations.
- Ability to create an atmosphere of trust that supports the learning/acquisition/catching-up process.
- Ability to consider the confidentiality of the mentored person.
- Empathic and cooperative.
- Ability to help a less experienced student to correct minor mistakes and prevent major mistakes.
- Ability to make a consistent, effective, and efficient professional impact in the mentoring relationship.
- Ability to recognize the needs of the mentored, even if the mentored cannot articulate them.
- Believes in the positive impact of mentoring, especially in professional identification, and is willing to help others.

Literature:

1. Joseph Psotka - L. Dan Massey - Sharon A. Mutter: Intelligent Tutoring Systems: Lessons Learned, Psychology Press, 1988, ISBN: 978-0805801927
2. Scotty D. Craig: Tutoring and Intelligent Tutoring Systems, Nova, 2016, ISBN: 978-1-53614-085-9
3. Beverly Park Woolf: Building Intelligent Interactive Tutors: Student-centered Strategies for Revolutionizing E-learning, Morgan Kaufmann Publishers, 2009, ISBN: 978-0123735942

Title of the course: **Student tutorial**	**NEPTUN-code:** RTXHT1EBNF	**Weekly teaching hours:** l+cw+lw 0+2+0	**Credit:** 3 **Exam type**: tm
Course leader: Marianna Halász Ph.D., Prof	**Position:** professor	**Required preliminary knowledge:** -	

Curriculum:

The aim of the course is to provide tutoring to a student or a small group of students in an individual, personalised way. The practical lessons are designed to develop individual learning pathways, independent learning, subject-specific skills, communication and social competences, and to help students meet subject requirements by explaining and practising the subject matter of a particular subject, in order to reduce drop-out rates.

Curriculum Description:

Week of Semester	**Topics of lectures and practices:**
1.	Getting to know your tutor/tutee.
2.	Identification of tutoring problems.
3.	Specific discussion of learning outcomes with the supported student.
4.	Applying communicational, interactional and conflict management techniques in tutoring sessions.
5.	Planning the tutor's activities (developing a tutoring plan), considering the specificities of the supported student.
6.	Motivating the tutee.
7.	Understanding the learning style of the tutored student.
8.	Encouraging the tutored student for independent and persistent learning.
9.	Learning how to put influential strategies into practice.
10.	In-person or online support.
11.	Methods and techniques used by the tutor.
12.	Monitoring the tutoring process; formative and developmental assessment.
13.	Reflection and assessment techniques.
14.	Closing the tutoring activity, summary and documentation of the results.

Mid-semester requirements:

Methods of qualification:

Documentation of the 14-week-long tutoring activity in Moodle. Submission of the tutoring plan (2-3 pp.). Submission of the mis-semester evaluation summary (1 pp.).
The mid-semester mark is determined in 50% by the quality of the implementation of the 14-week-long tutoring activity. 25% of the grade is the mentoring plan and the remaining 25% is determined by the effectiveness of the tutoring programme.

Professional competencies:

- Knowledge of the subject content and ability to transfer knowledge.
- Ability to provide personalised assistance.
- Ability to listen to others sympathetically and give meaningful answers.

- Ability to ask questions that help to self-discover the other person's abilities, personal qualities and aspirations.
- Ability to create a climate of trust that supports the learning/acquisition/catching-up process.
- Ability to take into account the confidentiality of the mentored person.
- Empathic and cooperative.
- Ability to help a less experienced student to correct minor mistakes and prevent major mistakes.
- Ability to make a consistent, effective and efficient professional impact in the mentoring relationship.
- Ability to recognize the needs of the mentored, even if the mentored cannot articulate them.
- Believes in the positive impact of mentoring, especially in the area of professional identification, and is willing to help others.

Literature:

1. Catherine A. Simon - Stephen Ward: A Student's Guide to Education Studies, Routledge, 2020, ISBN 9780367276690
2. Charles Neil: The Tutorial Prayer Book: For the Teacher, the Student, and the General Reader (Classic Reprint) Forgotten Books, 2017, ISBN: 978-1331693697

Title of the course: **Environmental elements protection I-II. (Water and Soil Protection)**	**NEPTUN-code:** RKXKE1ABNF	**Weekly teaching hours:** l+cw+lw 2+0+4	**Credit:** 5 **Exam type**: tm
Course leader: Rita Kendrovics-Boda, Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** -	

Curriculum:

The course objective is to provide overall knowledge about topics of water quality protection and water management. Within this scope it deals in detail with water circulation in the nature and in the society and with water incidences available for residential utilization. It examines impacts and impurities affecting natural waters of the industrializing world and water quality resulting from that, together with monitoring possibilities. It reviews general questions of water and water management, like basics of water management, fundamentals of water resources management, current and future water demands. It shows different types of water utilization and the return options of used waters to the nature. It presents basic hydrological notions, transmission of impurities in surface and subsurface waters, as well as impacts of oil pollution to water quality and possibilities of environmental clean-up.

The other aims of this course to present the basic knowledge of the soil - soil concept, features, soil forming materials, physical properties of soil, soil nutrient supply, soil classification. It summarizes the analysis of soil degradation processes and the impacts of human activities on soil quality within the soil conservation process. It provides comprehensive knowledge about soil organic and inorganic pollutants, their effects and the factors determining the spread of contamination. It presents the various remediation technologies and opportunities for remediation of contaminated sites and international experience. A particular lecture is devoted to on-site (in-situ, ex-situ) and off-site procedures. Furthermore, a special lecture deals with the various polluting substances and their detection and termination.

Curriculum Description:

Topics of lectures and practical works of Water quality protection and water management.

Modul	**Topics of Online Lecture**
1	Natural and social circulation of water. Water in human environment.
2	Type of freshwater 1: Surface water
3	Type of freshwater 2: Subsurface water
4	Process of water qualification 1: Physical parameters, Physico-chemical parameters
5	Process of water qualification 2: Biological and Bacteriological parameters
6	Water Framework Directive and ecological state weighing
7	Water pollutions and protections - Oil pollution in water
Week	**Topics of Practice session (four lessons every two weeks)**
1	Field trip introduction – Introduction of Aranyhegyi stream - What we will do on the field?
2	

3	Field work 1- field observation of the Aranyhegyi stream, Process of water qualification, sampling, types of samples, sampling equipment, fixation How to measure water flow
4	
5	Field work 2- measurement of water flow in the field (Aranyhegyi stream / at the border of Bp.) The spread of contaminants in surface water and self-cleaning
6	
7	Presentation of principles and equipment of analytical methods, Field work 3 – sampling and measurement in the field (mounth of Aranyhegyi)
8	
9	Surface Water Quality Standard
10	
11	Measurement in the Lab (411)
12	
13	Written exam
14	

Mid-semester requirements:

Attendance:

compulsory - lecture in the MOODLE SYSTEM (online curriculum), practice in the LAB, preparation of essay and ppt presentation from a given topic.

Test papers, measurement records, reports, etc. (number, date)

1.	Report of field works (4 x 6 points) 24 points
2.	Essay and ppt (2 x 8 points) 16 points
3.	Written exam 60 points

Methods of qualification:

Basis of marking: attendance at lectures (in MOODLE SYSTEM) and practical works, passing written examinations (with minimum mark 2) during the semester, submit record of measurement and essay (+ppt).
Marking: max. 60+40 points for written examination + practical works = 100 points

0-40 points: fail (1), 41-55 points: pass (2), 56-70 points: satisfactory (3), 71-85 points: good (4), 86-100 points: excellent (5)
In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Topics of lectures and practical works of Soil protection

Week	Topics of lectures
1.	Definition and properties of the soil.
2.	Soil phases, and their role. Silicates, soil minerals I.
3.	Silicates, soil minerals II. Soil formations.
4.	Properties of Colloids.

5.	Colloids and their role in soils.
6.	National Holiday
7.	Soil conservation.
8.	Physical degradation of soils.
9.	Eastern
10.	Methods of soil protection.
11.	Inorganic origins of various types of the soil contamination.
12.	Organic origins of various types of the soil contamination.
13.	Phytoremediation of the soils.
14.	Test in e-learning system.
Laboratory practice (four lessons every two weeks)	
Week	**Topics of laboratory practice**
1.	
2.	Safety of laboratory rules. Examination of soil binding. Definition of soil colour.
3.	
4.	Soil sampling. Texture of soil. C/N ratio in soil with different methods.
5.	
6.	Visit into Institute of Soil Sciences. (The date may vary depending on the pandemic). Should the visit fail due to the pandemic, phenol concentration in soil will be measured by HPLC.
7.	
8.	Determination of exchangeable nitrate content in soil solutions by different shaking techniques (ultrasound and shaker) and different shaking agents (1M KCl; 0.01M $CaCl_2$ and 1% KCl solutions)
9.	
10.	Determination of exchangeable ammonium-N content in soil solutions by different shaking techniques (ultrasound and shaker) and different shaking agents (1M KCl; 0.01M $CaCl_2$ and 1% KCl solutions)
11.	
12.	Determination of exchangeable phosphate content in soil solutions by different shaking techniques (ultrasound and shaker) and different shaking agents (1M KCl; 0.01M $CaCl_2$ and 1% KCl solutions)
13.	
14.	pH measurement in soil with different methods.
Mid-semester requirements:	

Attendance: is obligatory. You can miss 3 lectures or 1 practice. If absences exceed this rate, the semester is invalid.

Test papers, measurement records, reports, etc. (number, date)

1. During the semester:

1.1. We expect the preparation of a report on laboratory and field measurements and laboratory visits. Tasks must be uploaded to Moodle by the specified deadline. I score each task in %, of which I determine an average %. Everyone gets the corresponding % of the maximum score available. (30 points available maximum)

1.2. During the year, in the Teams system, the soils of one's own country and its protection must be described in a summary lecture (compulsory). (10 points available maximum)

Minimum score: 21 points

For the semester sign: Everybody has to give a presentation about the soil and protection about own country (10 points). Give laboratory reports (30 points). (10+30=40 points; the minimum performance is 21 points).

2. At the end of the semester: In the last lecture of the semester a final test is written in the Moodle system. You can get 60 points for this. Minimum score: 31 points.

Written test in e-learning system (60 points). The successful test is from 31 points.

Methods of qualification:

Marks of the end of semester:

>52: 1; 52-60: 2; 61-75: 3; 76-85: 4; 86-100: 5

In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

The mid-year grade is the arithmetic average of the grades received for water quality protection and soil protection.

Professional competencies:

- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Knowledge of the main methods to examine the quantity and quality features of environmental elements and systems, their typical measuring instruments, and limitations thereof, as well as methods for the evaluation of data measured.
- Able to perform basic tests of the quantity and quality characteristics of environmental elements and systems by state-of-the-art measuring instruments; to draw up and implement measurement plans; and to evaluate data.
- Able to solve tasks of water, soil, air, radiation, and noise protection, as well as of waste treatment and processing at proposal level; to participate in preparing decisions; to perform authority audits; and to take part in the operation of these technologies.
- Able to carry out assignments as environmental officer.
- Able to carry out management duties subject to sufficient professional experience.
- Knowledge of general and specific mathematical, natural, and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- Knowledge of the methodology and legal regulations for performing environmental impact assessments and for compiling impact studies.
- Able to apply environmental remediation methods, to prepare for and participate in remediation.
- Able to take part in environment expertise, advisory, and decision preparation work.
- Constantly upgrading their knowledge of environment protection by attending organized professional development training courses.

Literature:

1. Dr. Pregun, Csaba: Hydrology, Publication date 2011,
2. Szerzői jog © 2011 Debreceni Egyetem. Agrár- és Gazdálkodástudományok Centruma, in e-learning system
3. R.C.Gaur: Basic environmental engineering, New Age International Publishers. 2008 in e-learning system
4. RPC Morgan: Soil Erosion and Conservation, National Soil Resources Institute, Cranfield University, Blackwell Publishing, 2005,
5. Humberto Blanco, Rattan Lal: Principles of Soil Conservation and Management, Springer Verlag, 2008 (in the e-learning system)

Title of the course: **Environmental elements protection III-IV. (Noise, Vibration, and Air Protection)**	**NEPTUN-code:** RKXKZRABNF	**Weekly teaching hours:** l+cw+lw 2+4+0	**Credit:** 4 **Exam type**: tm
Course leader: Rita Kendrovics-Boda, Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** -	

Curriculum:

The study of this subject of the first part can be divided into two main parts:
1. noise, noise pollution and effect on human, physical describing of sound waves, sound levels (SWL, SPL, SIL) loudness and frequency (Fletcher-Munson curves), noise reduction methods, noise filters, noise measurement and calculation, noise map. Noise protection at the source, transmission path and receiver.
2. vibration, vibration pollution, modelling of vibration (free and damped), levels in decibels (acceleration, velocity, displacement), forced oscillations, resonance frequency (Tacoma Narrows Bridge), effects of vibration on human depend on many factors, whole body and hand-arm vibrations, vibration absorption, vibration measurement. Vibration insulation and damping.
The aim of the second part of the course is to prepare students to protect air quality by learning about the structure of the atmosphere, the damaging effects of the atmosphere, the effects of solar radiation, the greenhouse effect, the spread of pollutants, self-pollution, air quality protection limits, and emission-emission standards. In the context of the practical training, they will learn the basic concepts of dust technology, air quality measurement methods, the principles of operation of dust collection chambers, filters, cyclones and electrostatic precipitators.

Curriculum Description:

Week	**Topics of lectures and practical**
1.	Environmental harm. Defining sound, noise and vibration. Hearing range. Characteristics of noise sources. Mechanisms of hearing. Colour images. Intensity levels. A- sound pressure level.
2.	Point source sound. Basic phonological concepts. Sound propagation in different media. Sound pressure and intensity. Levels and relationships between them.
3.	Line and surface radiators. Sound propagation through walls and confined spaces. Determination of reverberation time. Methods for noise and vibration testing at work. Noise standards. Sound propagation in open and enclosed spaces. Determination of reverberation time. Sabine formula. Sound phenomena. Doppler effect, sound explosion. Equivalent and maximum A-weighted sound pressure levels allowed in workplaces. Fletcher-Munson loudness curves.
4.	Hearing loss. Theoretical principles of noise and vibration reduction. Noise meters. Theoretical background to noise measurement. Performance and evaluation of noise measurements.
5.	The impact of sounds and noises on humans. Technical methods of noise reduction. Reducing human exposure to noise.
6.	Basics of vibration measurement. Mechanical noise and vibration sources. Protection against vibration. Vibration damping and vibration isolation.
7.	Writing exam on Noise and Vibration Protection.
8.	Spheres of the Earth. Air pollution and its effects. Composition of the atmosphere, air pollutants and their properties.
9.	Legal background, emission and immission limit values.
10.	Basic dust engineering concepts. Air cleaning, dust collectors, Filters, electrostatic precipitators, Wet gas cleaning.
11.	Air pollution and measurement systems, measurement of ambient air pollution and atmospheric emissions.
12.	Indoor air quality, "sick building syndrome", quality control.
13.	Physiological effects of asbestos and odour, odour as an air pollutant.

14.	Writing exam on Air quality protection.

Mid-semester requirements:

Attendance:

Attendance of the lectures is compulsory {according to the Education and Examination Regulations of the University of Óbuda (TVSZ) § 23.1. and the decision of the Dean of the Faculty - RKK }! Attendance at exercises and lectures will be checked. If absences exceed the value set in the TVSZ, student will be suspended (TVSZ § 23.3. point 3)!

Test papers, measurement records, reports, etc. (number, date):

Measurement report 1: measurement of sound pressure level,
Measurement report 2: complex traffic noise measurement,
Measurement report 3: vibration measurement.
Written exam on noise and vibration protection

Methods of qualification:
The mid-semester grade is composed of two parts (noise and vibration protection up to 50 points and air quality protection up to 50 points). Total 100 points. In details:

- Noise and vibration protection (written exam, maximum 35 points - minimum 40 %) and 3 measurement reports; 2 in noise (5-5 points) and 1 in vibration (5 points).
- Air pollution (maximum 50 points)

Grade based on a total of 100 points:
0-39 points: unsatisfactory; 40-55 points satisfactory; 56-70 points average; 71-85 points good; 86-100 points excellent.
If the repeat exam test is also unsuccessful, opportunity for correction is provided in accordance with the provisions of the TVSZ.

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- In possession of state-of-the-art IT skills, being able to use professional databases and certain design, modelling, and simulation software depending on their specialty.
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Able to perform basic tests of the quantity and quality characteristics of environmental elements and systems by state-of-the-art measuring instruments; to draw up and implement measurement plans; and to evaluate data.
- Able to carry out assignments as environmental officer.
- Able to carry out management duties subject to sufficient professional experience.
- Constantly upgrading their knowledge of environment protection by attending organized professional development training courses.
- Able to solve tasks of water, soil, air, radiation, and noise protection, as well as of waste treatment and processing at proposal level; to participate in preparing decisions; to perform authority audits; and to take part in the operation of these technologies.
- Able to communicate both verbally and in writing in their mother tongue and in at least one foreign language, in respect of professional issues, and to continuously develop their professional skills as required.
- Open to professional cooperation with specialists related to their profession but involved in other areas.
- Efforts to improve knowledge by on-going self-education and continuously update their knowledge of the world.
- Responsible proclamation and representation of the value system of the engineering profession; openness to professionally well-founded critical remarks.

Literature:

1. Serway Jewett: Physics for Scientist and Engineers,
2. http://pcfarina.eng.unipr.it/Public/Acoustics-Course/Penn-State-Course/10_osp.pdf
3. http://www.processindustryforum.com/hottopics/nucleardisasters
4. Sivakumaran Sivaramanan: Noise, Vibration and Light pollution: Complete review on noise, vibration and light pollution causes, effects and solutions, Kindle, 2016, ISBN 1976942349: Nicholas P. Cheremisinoff, Ph.D.: Handbook of Air Pollution Prevention and Control
5. Margeret Pence - Handbook of Air Pollution control Systems and Devices
6. Roy M. Harrison - Handbook of Air Pollution Analysis 2 Sub Edition
7. Joel M. Haight Ph.D., P.E. - Control of Air Pollution

Title of the course: **Environmental elements protection V-VI. (Radiation Protection and Waste Management)**	**NEPTUN-code:** RKXKE3ABNF	**Weekly teaching hours:** l+cw+lw 2+2+0	**Credit:** 4 **Exam type**: tm
Course leader: Rita Kendrovics-Boda, Ph.D.	**Position:** associate professor	**Required preliminary knowledge: -**	

Curriculum:

The aim of the course is to introduce students to the radiation protection and the waste management. History of atomic structure. Classification of radiations (ionizing and non-ionizing). Radiation from environmental. Detect of natural radioactivity. Law of natural activity. Particle radiations (α, γ, neutron). Penetrating power of radiations. Uses of nuclear energy and radiation (food preservation, nuclear power stations and weapons). Working method of a pressurized-water nuclear station. Relationship between mass defect and binding energy. Nuclear fission. Dose quantities in SI units. Radiation effects on human. Protection against radioactive radiation (time, distance, shielding). Nuclear disasters.to waste management technologies. The subject provides a comprehensive knowledge of theoretical concepts, types of waste quantity and composition of the waste. Furthermore, in the frame of the course, expectations and conceptions of the European Union's waste management and the Sustainable Waste Management in Hungary will be taught.
The subject deals primarily with sustainable management of waste materials and the available technologies that treat those materials successfully. Moreover, the course contains knowledge about technological solutions like emission streams. Part of the curriculum includes municipal solid waste, used (wreck) cars, electronic waste, batteries, rubber, plastic, glass, construction waste, packaging waste and other types of waste generated by industrial activity. Waste recovery, recycling as possible enemy solutions and the necessary preparation technologies will be presented as well. During the semester, we will examine how the composition of the various areas (residential, agricultural, industrial, etc.) influences waste and environmental impacts and sustainability principles in waste management. It shows the importance of the connection between waste management plan and the steps that are taken to deal with waste and its legal context as well. Waste collection, reloading and delivery of technological progress will be discussed in detail. The course describes the technological possibilities of disposing waste, such as orderly disposal, disposal of thermal and chemical processes or mechanical-physical processes. Main fields of the subject:

- environmental issues; waste as an environmental issue; applying environmental science to the management of waste.
- managing legal issues and activities in the cleaning and waste industries; managing human resources in the cleaning and wastes industries.
- mechanical, biological and thermal treatment of waste.
- environmental laws of waste management.
- contaminated land; landfill processes.

Curriculum Description:

Weeks	**Topics of lectures and practicals**
1.	Electromagnetic radiation. Basic properties of the nucleus. Nuclear forces, binding energy. Laws of radioactive decay.
2.	Natural nuclear transformations. The interaction of radiation and material.
3.	Detection of radiation. Dosimetry. Legal background. Measuring instruments, measurement methods.
4.	Use of nuclear energy, environmental impacts of nuclear power plants, accidents.
5.	Radioactive waste disposal issues. Radiation exposure of natural and artificial origin.
6.	Radon in the environment. Radiocarbon age determination.

7.	Waste management - basic concepts, categories, characteristics. The concept of the circular economy. Waste management models, waste management indicators, material flow diagram
8.	Characteristics, composition and quantity of municipal solid waste and production waste
9.	Waste collection and methods for the selective treatment of municipal solid waste. The technological process of waste transport.
10.	Waste pretreatment - physical, chemical processes. Component separation processes.
11.	Waste disposal, recovery - aerobic waste treatment. Anaerobic waste treatment processes.
12.	Thermal treatment processes for waste. Waste landfilling.
13.	Packaging waste - the concepts of product fee and licence fee. Waste recovery - recovery options for rubber, plastic, glass, construction waste and the Waste Management Plan.
14.	Semester evaluation. Writing a written exam.

Mid-semester requirements:

Attendance:

Attendance at lectures and exercises is compulsory. If absences exceed the limits set out in the Education and Examination Regulations (TVSZ), the student will be suspended.
Students will write one final exam in the semester. The maximum score is 100 points. A minimum of 50 points must be achieved at the exam. In case of an unsuccessful final exam, student can write a repeat exam once.
If the repeat exam is also unsuccessful, opportunity for correction is provided in accordance with the provisions of the TVSZ § 24 (5).

Test papers, measurement records, reports, etc. (number, date):

During the semester, students write one written exam, if they fail, they can write a repeat exam once.

Methods of qualification:

Grade based on a total of 100 points achievable at the written exam:

0-49 points: unsatisfactory; 50-65 points satisfactory; 61-79 points average; 80-91 points good; 92-100 points excellent.

If the repeat exam test is also unsuccessful, opportuunity for correction is provided in accordance with the provisions of the TVSZ.

Professional competencies:

- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Knowledge of major environmental technologies, equipment and structures associated with each technology, including the functioning and operation thereof.
- Able to perform basic tests of the quantity and quality characteristics of environmental elements and systems by state-of-the-art measuring instruments; to draw up and implement measurement plans; and to evaluate data.
- Able to solve tasks of water, soil, air, radiation, and noise protection, as well as of waste treatment and processing at proposal level; to participate in preparing decisions; to perform authority audits; and to take part in the operation of these technologies.
- Able to carry out assignments as environmental officer.
- Able to carry out management duties subject to sufficient professional experience.
- Able to reveal deficiencies in the technologies applied and process risks and to initiate mitigation measures after getting familiarized with the technology concerned.
- Constantly upgrading their knowledge of environment protection by attending organized professional development training courses.

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- Able to communicate both verbally and in writing in their mother tongue and in at least one foreign language, in respect of professional issues, and to continuously develop their professional skills as required.
- Open to professional cooperation with specialists related to their profession but involved in other areas.
- Efforts to improve knowledge by on-going self-education and continuously update their knowledge of the world.
- Responsible proclamation and representation of the value system of the engineering profession; openness to professionally well-founded critical remarks.

Literature:

1. Márton Herczeg: Municipal waste management in Hungary EEA project manager Almut
2. Reichel ETC/SCP February 2013 Eurostat, 2012: 'Waste database municipal waste' http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/data/database Accessed May 2012
3. European Commission (2012). Support to Member States in improving waste management based on assessment of Member States' performance. Screening Report. Screening of all EU Member States' waste management performance. DRAFT Version 1. 12 April 2012
4. Nijkerk, A.A., Dalmijn, W.L. : Handbook of Recycling Techniques (ISBN 90-802909-3-9). Nijkerk Consultancy February 2001, 5th Revised edition (pp.1-254)
5. Ram Chandra: Environmental Waste Management, 2015 by Taylor and Francis Group, U.S.

Title of the course: **Environmental Technologies and Operations I.- Water and waste-water treatment technologies**	**NEPTUN-code:** RKXKM1ABNF	**Weekly teaching hours:** l+cw+lw 1+2+0	**Credit:** 4 **Exam type**: e

Course leader: Rita Kendrovics-Boda, Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** RKXKE1ABNF

Curriculum:

The course objective is to show water (drinking) and wastewater treatment technologies and the requirements of drinking water, law and standard of drinking water and cleaned wastewater. The first aim of this course is to provide technological knowledge about advanced drinking water treatment. Focus is on both, conventional and new, emerging technologies. The course discusses relevant unit processes involved, and their role and location in a typical treatment chain. Physical, chemical and biological unit processes will be covered in the course. Further emphasis is on the effect of treatment on water quality and the transformations taking place in the water phase.
The second aim of this course is to describe wastewater definition, types of wastewaters, and components of wastewater and sewer systems. Introduces wastewater treatment steps: Pre-treatment, Primary, Secondary and Tertiary treatment steps and available technologies within each step.
Highlights treatment technologies and reuse of sludge remaining in large volumes at the end of the treatment process.

Curriculum Description:

Weeks	**Topics of lectures and practices**
1.	Introduction – the origin of wastewater, the types of wastewater Compositions of wastewater
2.	Collection system of wastewater
3.	Preliminary treatment technologies
4.	Primary treatment – Sedimentation
5.	Secondary treatment -Biological treatment
6.	Tertiary treatment - Nutrient removal
7.	Disinfection
8.	Membrane technology
9.	The types of sewage sludge and treatment
10.	Sewage sludge uses is agriculture
11.	Operation of BKSZT – presentation of the Budapest Wastewater Treatment Plant's operation
12.	Natural wastewater treatment
13.	Decentralized wastewater treatment
14.	Summary, pre-exam

Mid-semester requirements:

Attendance:

compulsory

Test papers, measurement records, reports, etc. (number, date)	
1.	Essay (15 points)
2.	Presentation of essay (15 points)

Methods of qualification:

Basis of exam's marking:

- attendance at lectures,
- passing written examination (70 points, minimum 40%) at the end of the semester,
- submit essay and present it.

Marking: max. 15+15+70 points for essay + presentation + written examinations = 100 points
0-40 points: fail (1), 41-55 points: pass (2), 56-70 points: satisfactory (3), 71-85 points: good (4), 86-100 points: excellent (5)

In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Knowledge of major environmental technologies, equipment and structures associated with each technology, including the functioning and operation thereof.
- Able to perform basic tests of the quantity and quality characteristics of environmental elements and systems by state-of-the-art measuring instruments; to draw up and implement measurement plans; and to evaluate data.
- Able to solve tasks of water, soil, air, radiation, and noise protection, as well as of waste treatment and processing at proposal level; to participate in preparing decisions; to perform authority audits; and to take part in the operation of these technologies.
- Able to carry out management duties subject to sufficient professional experience.
- Able to reveal deficiencies in the technologies applied and process risks and to initiate mitigation measures after getting familiarized with the technology concerned.
- Constantly upgrading their knowledge of environment protection by attending organized professional development training courses.

Literature:

1. Nicholas P. Cheremisinoff, Ph.D.: Handbook of water and wastewater
2. treatment technologies, ISBN: 0-7506-7498-9, in e-learning system
3. Dr. Michael R. Templeton, Prof. David Butler: Introduction to wastewater treatment in e-learning system, bookboon.com, 2011., ISBN: 978-87-7681-843-2
4. Frank Spellman: Water and Wastewater Treatment, Taylor & Francis Inc, 2012, ISBN: 9781439854006

Title of the course: **Environmental Technologies and Operations II.- (energy in environmental protection)**	**NEPTUN-code:** RKXKM2ABNF	**Weekly teaching hours:** l+cw+lw 1+2+0	**Credit:** 4 **Exam type**: e
Course leader: Rita Kendrovics-Boda, Ph.D.	**Position:** associate professor	**Required preliminary knowledge: -**	

Curriculum:

The aim of the course is to introduce the basic concepts of energy, the energy chain, energy transformation, efficiency, and forms of energy. Students will learn about the types of renewable energy sources, their importance, and environmental benefits. They will be introduced to the history of wind power, the components of wind energy, wind turbines and the basics of their operation. Students will learn about the concept of biomass, its possible applications and biogas production. Hydropower, hydroelectric power plants, and geothermal energy sources and applications will be introduced. The potential of solar energy (solar collectors and solar panels) will be introduced at a basic level, including the types of solar collectors and solar panels, and the calculation of efficiency and payback time.

Curriculum Description:

Week	**Topic of lectures and practices**
1.	Introduction to electrical energy, basic concepts
2.	Single-phase systems
3.	Three-phase systems
4.	Production of electricity, types of power plants
5.	Electric energy converters, Electric energy transmission network
6.	1st Mid-term
7.	Electrical energy transmission devices, cables, consumers
8.	Utilization of solar energy
9.	Utilization of wind energy
10.	Utilization of biomass and biogas
11.	Utilization of geothermal energy
12.	Energy storage systems
13.	Project work presentation
14.	Retake

Mid-semester Requirements:

Attendance:

Compulsory

Midterms, lab reports, etc.:

Completion of 1 (theory+practice in one) midterm at least at a sufficient level.
The project work is the planning, documentation and presentation of a solar energy system.

The method of obtaining a signature / mid-term mark:

Basis of marking: attendance at lectures and laboratory works/practice.
Written tests min. + project work min. = 2 (pass) (separately).
In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- Able to perform basic tests of the quantity and quality characteristics of environmental elements and systems by state-of-the-art measuring instruments; to draw up and implement measurement plans; and to evaluate data.
- Able to carry out management duties subject to sufficient professional experience.
- Able to reveal deficiencies in the technologies applied and process risks and to initiate mitigation measures after getting familiarized with the technology concerned.
- Collaboration with civil organizations engaged in environment protection, but willing to argue in order to develop optimal solutions.
- Taking responsibility towards society for their decisions made in the scope of environment protection.

Literature:

1. Ristinen R.: Energy and the Environment, John Wiley and Sons Ltd, 2022, ISBN: 9781119800255
2. Bent Sørensen: Renewable Energy, 4th Edition, Physics, Engineering, Environmental Impacts, Economics and Planning, Academic Press, 2010, eBook ISBN: 9780080890661
3. Hardcover ISBN: 9780123750259
4. B Viswanathan: An Introduction to Energy Sources, Indian Institute of Technology 2006, 289 pages, https://nccr.iitm.ac.in/ebook%20final.pdf
5. Robert Ferry, Elizabeth Monoian: A Field Guide to Renewable Energy Technologies, Society for Cultural Exchange 2012, ISBN/ASIN: 061561597X, ISBN-13: 9780615615974; Number of pages: 71
6. Vaclav Smil: Energy in Nature and Society: General Energetics of Complex Systems (MIT Press) First Edition (1st printing) Edition, ISBN-13: 978-0262693561; ISBN-10: 0262693569
7. Gyorgy Elmer Dr. – Electrical engineering – University of Pécs

Title of the course: Public Health and Health Protection	**NEPTUN-code:** RKXKU1ABNF	**Weekly teaching hours:** l+cw+lw 2+1+0	**Credit:** 4 **Exam type**: e
Course leader: Prof. Dr. habil. Hosam Hamuda Bayoumi	**Position:** Associate professor	**Required preliminary knowledge: -**	

Curriculum:

The aim of the course is for students to get to know the tasks and methods of public health and environmental health. Topics: Concept of health and illness. The history of public health and its outstanding personalities. The structure and organizational system of Hungarian and international public health. The main tasks and areas of health education. Education for an environmentally and health-conscious lifestyle. Demographic basics, risk assessment and investigation methods, demographic characteristics of the Hungarian and international situation. The impact of globalization on health. Environmental health science: consequences of globalization. Climate change. Epigenetics. Occupational health and health care. General epidemiology of infectious diseases. Epidemiological measures for the benefit of the infectious patient and his environment. National and international epidemiological situation. Levels and arenas of prevention. Epidemiology and prevention of non-communicable diseases. Hospital hygiene, prevention of nosocomial infections. Health protection. Acquisition of health protection and public health knowledge. Health promotion. Nutrition and health science. Characteristics of Hungarian nutrition. Environmental health aspects of nutrition. Alternative forms of nutrition. The structure and functioning of the immune system. Antibodies. Immunity and vaccinations. Transplantation, transfusion. Antibiotics. Allergy, AIDS, autoimmune disease. Air, soil and water hygiene. Mental health. Infection control. Ionizing and non-ionizing radiations. Environmental health problems of the skin organ system, respiratory and movement organ system and metabolic processes. Non-communicable diseases: Epidemiology of cardiovascular and tumour diseases. Mental health care. Old and new addictions. Current duties of mother, child and youth protection. Aging societies and the public health challenges of old age. Health problems caused by waste. Effect of environmental pollution. Presence of environmental pollutants in food. Basic concepts of toxicology. Toxicology of metals, their compounds and pesticides. Toxicological tests and their characteristics, measurement options. Genotoxicology and its expected effects. Adaptation processes of the weather and the organism. Recognizing the connections between the environment and health. Expected health effects of climate change.

Curriculum Description:

Weeks	**Topics of lectures**
1.	**Lecture**: Concept of health and illness. The history of public health and its outstanding personalities. The structure and organizational system of Hungarian and international public health. The main tasks and areas of health education. Education for an environmentally and health-conscious lifestyle. **Practical**: Activities of healthcare institutions, social and human insurance organizations
2.	**Lecture** Demographic basics, risk assessment and investigation methods, demographic characteristics of the Hungarian and international situation.
3.	**Lecture** The impact of globalization on health. Environmental health science: consequences of globalization. Climate change. Epigenetics. Occupational health and health care. **Practical**: High-quality analysis of demographic, mortality and morbidity, as well as other health and social security data initiates the development of the analysis methodology

4.	**Lecture** General epidemiology of infectious diseases. Epidemiological measures for the benefit of the infectious patient and his environment. National and international epidemiological situation. Levels and arenas of prevention. Epidemiology and prevention of non-communicable diseases. Hospital hygiene, prevention of nosocomial infections.
5.	**Lecture** Health protection. Acquisition of health protection and public health knowledge. Health promotion. **Practical**: Health promotion methods
6.	**Lecture** Nutrition and health science. Characteristics of Hungarian nutrition. Environmental health aspects of nutrition. Alternative forms of nutrition.
7.	**Lecture** The structure and functioning of the immune system. Antibodies. Immunity and vaccinations. Transplantation, transfusion. Antibiotics. Allergy, AIDS, autoimmune disease. **Practical**: Basic principles of healthcare management and conditions for its practical application
8.	**Lecture** Air, soil and water hygiene. Mental health.
9.	**Lecture** Infection control. Ionizing and non-ionizing radiations. **Practical**: Environmental pollutants and health problems
10.	**Lecture** Environmental health problems of the skin organ system, respiratory and movement organ system and metabolic processes.
11.	**Lecture** Non-communicable diseases: Epidemiology of cardiovascular and tumor diseases. Mental health care. Old and new addictions. Current duties of mother, child and youth protection. Aging societies and the public health challenges of old age. **Practical**: Lifestyle and health problems
12.	Lecture Health problems caused by waste. Effect of environmental pollution. Presence of environmental pollutants in food.
13.	**Lecture** Basic concepts of toxicology. Toxicology of metals, their compounds and pesticides. Toxicological tests and their characteristics, measurement options. Genotoxicology and its expected effects. **Practical**: Nutrition and food toxicants
14.	**Lecture** Adaptation processes of the weather and the organism. Recognizing the connections between the environment and health. Expected health effects of climate change.
Mid-semester requirements:	
Attendance: Participation in practical lessons and lectures is obligated. Students should not absent more than 4 lectures and 1 practical lesson. If more, the course result is disable.	
Mid-terms, protocols, reports, etc.: Their prisons, minutes, reports, etc.: Completion of 2 (theory+practice in one) indoor theses at a minimum level. The extra-local one is in the 14th week, and the TVSZ of the exam period. in the period prescribed by.	
The method of obtaining a signature / mid-term mark: Signature conditions: a sufficient level of performance of the 2 med-term examinations, solving the homework and write the assay as well as the practical final report of the practices.	

In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- Knowledge of the learning, knowledge acquisition, and data collection methods of the special fields of environment protection, their ethical limitations and problem-solving techniques.
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Able to cooperate with engineers involved in the development and application of production and other technologies to develop the given technology in terms of environment protection.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.
- Collaboration with civil organizations engaged in environment protection, but willing to argue in order to develop optimal solutions.
- Constantly upgrading their knowledge of environment protection by attending organized professional development training courses.
- Sharing experiences with colleagues, thus promoting their development.
- Taking responsibility towards society for their decisions made in the scope of environment protection.

Literature:

1. Rozanov V. (2016): Stress and Epigenetics in Suicide, 1st Edition, Academic Press, Print Book ISBN: 9780128051993
2. Emerging Infectious Diseases www.cdc.gov/eid Vol. 22, No.10, October 2016
3. International travel and health (2013): Information on health risks for travellers. IBSN: 9789240686434
4. Merck and the Merck Manuals (2011): Infectious Diseases, in: Merck Manual Merck Sharp & Dohme Corp.
5. Michael Stuart Bronze, Burke A Cunha, Ronald A Greenfield, et al. (2011): Infectious Diseases Medscape Reference WebMD
6. Victorian State Government, Australia (2009): Blue Book. Guidelines for the control of infectious diseases Victorian State Government
7. Paget Stanfield et al. (2008): Diseases of Children in the Subtropics and Tropics. 4th edition ISBN: 9780340506332
8. David Coggon, David Barker, Geoffrey Rose (2008): Epidemiology for the Uninitiated. BMJ Publishing Group

Title of the course: **Environmental analytics-Analytical chemistry**	**NEPTUN-code:** RKXKA1EBNF	**Weekly teaching hours:** l+cw+lw 2+0+3	**Credit:** 5 **Exam type**: e
Course leader: Ágnes Bálint-Mészáros, Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** RMXCA2KBNF, RKXFI1ABNF	

Curriculum:

The aim of the course is to present the possibilities of testing and analytical methods for toxic pollutants released into the environment because of human activities. Environmental analytics uses analytical chemistry and other techniques to study our environment. The primary objective is to familiarise you with the possibilities of sampling different environmental elements (atmosphere, surface and subsurface water and soil) to assess whether they are contaminated with organic and inorganic toxic substances. The course introduces the physical and chemical principles of environmental analysis, presents the different validation methods, and highlights the importance of standardisation. Students will learn about different sampling and sample preparation procedures, review atomic and molecular spectroscopy techniques and the most important separation techniques. In laboratory exercises, they will apply the methods learned in theory to environmental samples, from sampling to sample preparation, using appropriate analytical instrumentation to measure the possible presence of inorganic or organic toxicants.

Curriculum Description:

Weeks	**Topics of Lectures and Practices**
1.	General introduction, Sampling, Accident prevention, Laboratory rules, Calculation exercises, Alkalinity of waters
2.	Sample preparation, classical analyses, electroanalysis, Chemical oxygen demand, solid phase extraction
3.	AAS, ICP, X-ray, liquid-liquid extraction, flame photometry
4.	Chromatography
5.	Gas chromatography
6.	MS, quality assurance, validation
7.	Written exam
8.	The importance of chemical analysis. Transport processes of pollutants in the environment. Definition, fields and tasks of environmental analysis. Process and main steps of environmental analysis. Key performance characteristics (lower limit of measurement, uncertainty of measurement). Requirements for the methods used, concept and types of limit, practical application. Documentation. Requirements on the form and content of the sampling plan, the sampling protocol and the test report.
9.	Quality assurance, accreditation, legal requirements for the methods used. Classification of methods (standards, standardisation, other methods). Traceability to international standards. The concept of certified material samples, their application. Validation, verification.
10.	Sampling rules. Sample preparations. The problem of representative sampling, types of samples and sampling. Quality assurance of sampling. Field and laboratory testing. Special sampling problems (medium that changes rapidly over time).
11.	Sampling and testing of soil and groundwater. Legal requirements, inorganic and organic chemical analyses. Waste sampling and analysis issues. Special sampling and testing for landfill disposal and SRF recovery. Sampling of municipal waste.
12.	Surface water sampling and testing. Analytical requirements of the Water Framework Directive. Analytical problems of low concentrations of organic pollutants. Sampling and analysis of waste water. The concepts of qualified point sampling, time-averaged and volume-averaged sampling. Limit values and their interpretation. Technological and discharge monitoring studies. Wastewater self-monitoring plan. Drinking water utility service measurements. Well baseline tests, endpoint monitoring. Chemical and biological

	parameters. Biological risks of domestic hot water networks, sampling and testing of legionella bacteria.
13.	Air quality protection measurements. Sampling and analysis of ambient air, workplace air and air pollutants emitted. Limit values, their application and interpretation. Rolling average and smog alert. Special problems: indoor air quality, measurement of environmental nuisance odours.
14.	Semester evaluation, Written exam.

Mid-semester requirements:

Attendance:
Participation in lectures and practical classes is compulsory. If the absences exceed the values set in the Education and Examination Regulations (TVSZ), the student will be suspended.
Students are required to write an exam during the mid-term laboratory exercises. A minimum of 50% of the available points must be achieved in the exam. In case of unsuccessful exam, the student has the opportunity to write one repeat exam.
If the repeat exam is also unsuccessful, opportunity for correction is provided in accordance with the provisions of the TVSZ § 24 (5).

Test papers, measurement records, reports, etc. (number, date):

Two written exams are due during the semester. In the laboratory exercises, a short examination is written to check that the student is prepared to carry out the practical tasks. If the student's examination does not reach at least 50% of the maximum points, the student will not be allowed to participate in the practical exercises. The tasks performed in the laboratory exercises must be documented in a measurement report, which is evaluated (accepted or returned for correction or completion) by the supervisor.

Methods of qualification:

Achieve an average of 2.0 in the exams written at the laboratory exercises.
Grade of med-term exams: 0-49 points: unsatisfactory; 50-65 points satisfactory; 66-79 points average; 80-91 points good; 92-100 points excellent.
If the repeat exam is also unsuccessful, opportunity for correction is provided in accordance with the provisions of the TVSZ § 24 (5).

Professional competencies:

- Knowledge of general and specific mathematical, natural, and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- In possession of state-of-the-art IT skills, being able to use professional databases and certain design, modelling, and simulation software depending on their specialty.
- Knowledge of the learning, knowledge acquisition, and data collection methods of the special fields of environment protection, their ethical limitations, and problem-solving techniques.
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Knowledge of the methodology and legal regulations for performing environmental impact assessments and for compiling impact studies.
- Able to perform basic tests of the quantity and quality characteristics of environmental elements and systems by state-of-the-art measuring instruments; to draw up and implement measurement plans; and to evaluate data.
- Able to solve tasks of water, soil, air, radiation, and noise protection, as well as of waste treatment and processing at proposal level; to participate in preparing decisions; to perform authority audits; and to take part in the operation of these technologies.
- Able to perform environmental impact assessments and to participate in compiling impact studies.
- Able to apply in practice as well the regulations and requirements of health and safety, fire protection, and safety engineering as related to their special field.

Literature:

1. David Harvey: Modern Analytical Chemistry, McGraw Hill, Boston Burr Ridge, IL Dubuque, IA Madison, WI New York, San Francisco, St. Louis, Bangkok, Bogotá Caracas, Lisbon, London, Madrid, Mexico City, Milan, New Delhi, Seoul, Singapore, Sydney, Taipei, Toronto, 2000
2. Gary D. Christian: Analytical Chemistry, John Wiley and Sons Inc., 2004
3. Roger N. Reeve: Introduction to Environmental Analysis, Wiley, 2002, ISBN 0-471-49295-7
4. Chunlong Zhang: Fundamentals of Environmental Sampling and Analysis, Wiley, ISBN: 978-0-471-71097-4, 456 pages April 2007
5. Baranowska, Irena (Ed.): Handbook of Trace Analysis, Fundamentals and Applications, Springer International Publishing Schwitzerland, 2016, ISBN 978-3-319-19614-5

Title of the course: **Technical mechanics**	**NEPTUN-code:** RKXME1EBNF	**Weekly teaching hours:** l+cw+lw 1+2+0	**Credit:** 4 **Exam type**: tm
Course leader: Lóránt Szabó, Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:** -	

Curriculum:

Engineering mechanics is the application of mechanics to solve problems involving common engineering elements. The goal of this Engineering Mechanics course is to expose students to problems in mechanics as applied to plausibly real-world scenarios. Dividing of Engineering mechanics. Physical quantities.

Statics (part of dynamics). Basic concepts, fundamentals. Planar forces, force systems. Power system bound to tractrix action on the rigid body. Planar forces, force systems. Centre of gravity, bearing force. Holders and articulated mechanisms. Friction.

Strength of Materials. Basic concepts, stress and stress states. Material Laws. Simple strain of prismatic bars. Stress theories.

Kinematics. The kinematics of a point. Basic concepts, uniform and uniformly changing motion. Projectile motions, circular motion, harmonic motion, swinging motion. Kinematics of the rigid body. Basic concepts, velocity and acceleration states, elemental and finite motions. The kinematics of relative motions.

Kinetics (part of dynamics). Kinetics of the material point, axioms, general theorems. The free, forced and relative motion of the material-point. The kinetics of a rigid body. The moment of inertia, and general theorems and principles. The rotation of a rigid body around an axis, translational and plane motion of a rigid body.

Curriculum Description:

Week	**Topics of lectures and practices**
1.	Statics. Basic concepts, fundamentals. Fundamental principles of theoretical mechanics. Vectors. The force in Cartesian system of reference. Three laws of Newton, for example: principle of the action and the reaction. Components of the force. Planar forces, force system.
2.	Moment of a force for a given point. Moment of the force for a given axis. Couple of two forces. Reduction of a force in a given point. Cases of reduction. Systems of parallel forces. Center of the parallel forces.
3.	Centre of gravity. Centres of gravity for homogeneous bodies. Laws of friction. Equilibrium of the particle with constraints with friction.
4.	Modelling the action of forces. Statics of the rigid body. Simple, hinged and fixed support. Loads. Beams (holders). Trusses.
5.	Strength of materials. Theory of elasticity. Direct stresses (tensile state). Shearing stress.
6.	Bending stress. Instability (buckling stress). Strength calculation.
7.	Summary of statics and elasticity. Written test one, from statics and strength of materials.
8.	Kinematics of the particle. Motion in one dimension. Position, velocity, and acceleration of the particle.
9.	Motion in two dimensions. Circular motions. Projectile motions.

10.	Summary of kinematics of point-like objects.
11.	Kinematics of the rigid body. Basic concepts, velocity and acceleration states, elemental and finite motions.
12.	The kinematics of relative motions. Kinetics. The laws of motion. Kinetics of the material point, axioms, general theorems. Forces of friction. Work, power, kinetic and potential energy. Work-kinetic energy theorem.
13.	The rotation of a rigid body around an axis, translational and plane motion of a rigid body. Written test two from kinematics and kinetics.
14.	Summary of full semester.

Mid-semester requirements:

Attendance:

It is compulsory to attend the lectures. The rules of education and exam directory (TVSZ) are the guidelines.

Methods of qualification:

Two written tests. Total points: 100 (2x50). Term marks: 85-100%: excellent (5), 70-84%: good (4), 55-69%: average(3), 40-54%: pass(2), 0-39%: fail(1)
If the student has not met the requirements of obtaining the term mark (e.g. has not written or failed the in-class test, has not submitted the measurement report, etc.), he/she must be given one opportunity to make up for the term mark in the study period. If the student is still unable to obtain the term mark through this opportunity and the requirements of the course give an opportunity for it, then the student can make an attempt to obtain the term mark on one occasion on one of the first ten work days of the examination period against a fee specified in the "Regulations of ÓU on possible benefits for students and on fees and charges payable by them" (hereinafter RBF).

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- Adequate perseverance and endurance of monotony to perform practical operations.
- Open to professional cooperation with specialists related to their profession but involved in other areas.
- Efforts to improve knowledge by on-going self-education and continuously update their knowledge of the world.
- Responsible proclamation and representation of the value system of the engineering profession; openness to professionally well-founded critical remarks.

Literature:

1. Serway Jewett: Physics for Scientist and Engineers
2. (**Statics**) http://www.icivil-hu.com/Civil team/2nd/Statics/Statics,%20R.C.%20Hibbeler,%2012th%20book.pdf
3. (**Dynamics**) https://docs.google.com/file/d/0Bw8MfqmgWLS4V0NFR2dVUWpuYzg/edi
4. Lóránt Szabó: Physics for Undergraduate Students
5. Lóránt Szabó: The World of Engineering Mechanics (electronic book)

Title of the course: **Technical drawing and documentation**	**NEPTUN-code:** RKEMR1EBNF	**Weekly teaching hours:** l+cw+lw 1+0+2	**Credit:** 4 **Exam type**: tm
Course leader: Rita Kendrovics-Boda, Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** -	

Curriculum:

The aim of this course is to introduce drawing fundamentals and to develop drawing skills of students. The first part of the course covers such topics as layout of Technical Drawings, line styles, lettering, scale, geometric construction, transformation, projection (orthographic projection, central or perspective projection, oblique projection), axonometric view (isometric, diametric, Cavalier etc.). The second part of the course focuses on topics as follows: sketching, dimensioning, sectioning, fits and tolerances, surfaces roughness, symbolical representation, detail and assembly drawing.

Curriculum Description:

Modul (in the Moodle System)	**Topics of lectures**
1.	Introduction to the technical drawing: Drawing standards, layout of drawings, lines, letters
2.	Systems of projection – Multiview projection Monge projection
3.	Systems of projection - Axonometric projections
4.	Section views: full-, half-, broken-, offset-, removed sections
5.	Dimensioning
6.	Representation of threaded surfaces
7.	Signs of surface machining on the technical drawing
Week of Semester	**Topics of lectures and practical works**
2	Basic of technical drawing: projection Geometric constructions Homework 1: Study aid 7.3
4	Projections of the machine elements in the technical drawing
6	Axonometric projections Objects with circular geometry and their projections
8	Section drawings Section views - cylinder Homework 2: Study aid: 7.11
10	Detail drawings (views +dimensions) based on axonometric drawing and machine part Homework 3: detail drawing of machine part
12	Written exam - test 55 points
14	Reading of drawing - practical Repeat exam

Mid-semester requirements:		
Attendance:		
Participation in lectures and practical sessions: compulsory		
Test papers, measurement records, reports, etc. (number, date)		
1.	Homework 1 - Projections	15 points
2.	Homework 2 - Cylindric sections	15 points
3.	Homework 3 - Detail drawing of machine part	15 points
4.	Written exam – test	55 points
Methods of qualification:		

Attendance at lectures and practical works, passing written test (exam) (with minimum mark 2) during the semester.

- 3 drawing tasks (homework): 15 x 3 = 45 points
- test on tech. drawing (written exam): 55 points

Altogether : 100 points

Mark: 0-40 points: 1(fail); 41-55 points: 2 (pass); 56-70 points: 3 (satisfactory); 71-85 points: 4 (good); 86-100 points: (excellent)

In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- In possession of state-of-the-art IT skills, being able to use professional databases and certain design, modelling, and simulation software depending on their specialty.
- Adequate perseverance and endurance of monotony to perform practical operations.
- Able to cooperate with engineers involved in the development and application of production and other technologies to develop the given technology in terms of environment protection.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.

Literature:

1. Addisu Dagne Zegeye: A Textbook of Engineering Drawing: for Undergraduate Engineering Students, Independently Published, 2020, ISBN: 9798656430043
2. Coli H.Simmons, Dennis E. Maguire: Manual of Engineering drawing in e-learning system
3. David Anderson: Technical drawing, Spring, 2006
4. Sachidanand Jha: AutoCAD Mechanical: 400 Practice Drawings For AUTOCAD MECHANICAL and Other Feature-Based 3D Modeling Software, Independently Published, 2019, ISBN: 1070883298

Title of the course: **Machine elements**	**NEPTUN-code:** RKXGZ1ABNF	**Weekly teaching hours:** l+cw+lw 1+2+0	**Credit:** 4 **Exam type**: tm
Course leader: Andrea Paukó, Ph.D.	**Position:** associate professor	**Required preliminary knowledge (with code too):** RKXMR1EBNF	

Curriculum:

The course aims to introduce the most basic machine parts, giving insight to the engineering speciality. The subject deals with machine parts and machine structures used in up-to-date machines, their types, properties, and design principles. Main topics:
The concept of machine elements, groups, and design principles

- rotating machine parts, shaft joints,
- mechanical drives: gear drives, worm gearing, chain drive, belt drive. Principle of friction transmission,
- brakes: structure, function, and design basics,
- supporting shafts, bearings, basic concepts of tribology
- storage elements: pipelines and fittings, pipe joints, valve, gate valve, check valve. Flow losses of pipe networks, characteristic curves, reservoirs and seals,
- grouping of fluid machinery, characteristic parameters. Essential features of pumps, pump head, efficiency, and useful power.
- structure of ventilation equipment and operation (fans, blowers, compressors, vacuum pumps).

Curriculum Description:

Week	**Topics of lectures and practical works**
1.	basics, strength calculations
2.	joints
3.	shafts; bolted joint calculation
4.	tribology, sliding bearings;
5.	rolling bearings
6.	couplings + cluches; key joint calculation
7.	brakes
8.	drives
9.	mechanisms; rolling bearing calculation
10.	storage elements : tanks + pipes
11.	valves, seals, test
12.	fluid machinery, pumps
13.	ventilators
14.	evaluation

Mid-semester requirements:	
Attendance:	
compulsory	
Test papers, measurement records, reports, etc. (number, date)	
1.	bolted joint calculation
2.	key joint calculation
3.	rolling bearing calculation
4.	test on rotating elements
Methods of qualification:	

Participation in lectures and practical sessions: compulsory
Basic of marking:
attendance at lectures and practical works, passing test during the semester.

- 3 tasks (homework): 10 x 3 = 30 points
- test on rotating elements: 10 points
- written exam: 60 points

Altogether: 100 points

exan mark: 0-40 points: 1(fail); 41-55 points: 2 (pass); 56-70 points: 3 (satisfactory); 71-85 points: 4 (good); 86-100 points: 5 (excellent)

In case of fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- Knowledge of major environmental technologies, equipment and structures associated with each technology, including the functioning and operation thereof.
- Adequate perseverance and endurance of monotony to perform practical operations.
- Able to cooperate with engineers involved in the development and application of production and other technologies to develop the given technology in terms of environment protection.
- Able to reveal deficiencies in the technologies applied and process risks and to initiate mitigation measures after getting familiarized with the technology concerned.

Literature:

1. Steven R. Schmid, Bernard J. Hamrock, Bo. O. Jacobson: Fundamentals of Machine Elements, ISBN 9781439891322
2. Machine elements, handbook, http://www.gbi.bgk.uni-obuda.hu/oktatas/segedanyagok/gepelemek/Machine_Design_2/Machine%20Element.pdf

Title of course: **Data processing of measurements**	**NEPTUN-code:** RKXMF1ABNF	**Weekly teaching hours:** l+cw+lw 1+0+2	**Credit:** 4 **Exam type**: tm
Course leader: Ágnes Bálint-Mészárosné, Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** RKXMA2EBNF	

Curriculum:

When we look at the environmental elements (air, water, soil), we get a large amount of measurement data. Large amounts of data are not in themselves meaningful. Our data must be evaluated, i.e. processed, in order to make sense of it. In simpler cases, we use data processing programs such as Microsoft Excel. The principles of data sorting are described. We may need special statistical software packages to help us establish relationships between our measured data. Describe the basic principles of statistics (descriptive statistics, ANOVA, etc.). There are several statistical software packages: e.g. SPSS, SAS, etc. We will also introduce students to an important program for scientific data processing (Origin).The free R2 software package will help us to write procedures for analysing our data. We can compare the algorithms that can be generated using Matlab, Maple with programs written specifically for statistical analysis.

Curriculum Description:

week	**Topics of lectures and practices**
1.	**Lecture:** Introduction. Experiment. The measurement. Basic statistics. Error propagation **Practice:** Types of averages. Calculation of excel.
2.	**Practice:** Correlation test exercise with excel.
3.	**Lecture**: Analysis of correlation. The correlation coefficient. Functions describing the measurement results. Linear regression. **Practice:** Practising correlation analysis with Excel.
4.	**Practice:** Linear regression with Excel and presentation with Origin and SPSS.
5.	**Lecture:** The method of least squares. Nonlinear regression. **Practice:** Additional regression calculation exercises.
6.	**Practice:** Nonlinear regression. One possible help Origin
7.	**Lecture:** Design and evaluation of experiments. **Practice:** Preparation for the 1st midterm, practice exercises.
8.	**Practice:** 1. Writing a midterm. Solving theoretical test questions in Moodle. Solving problems in Excel and uploading them to Moodle.
9.	**Lecture:** Practice one-factor analysis of variance. **Practice:** Practice one-factor analysis of variance. Demonstration of analysis of variance with SPSS. Other free programs.
10.	**Practice:** Further one-way ANOVA exercise.

11.	**Lecture:** Two-factor analysis of variance. **Practice:** Practice exercises in two-factor analysis of variance.
12.	**Practice:** Repeated and unreplicated two-factor analysis of variance exercises
13.	**Lecture:** Three or more factor analysis of variance. **Practice:** Factor analysis through examples, presented with SPSS.
14.	**Practice:** Writing midterm 2 from the second part of the material (test in e-learning from the theoretical part and solving the problem)

Mid-term requirements:

Participation in occupations:

Attendance is compulsory. 2 final papers are compulsory (weeks 8 and 14)

Midterms, protocols, reports, etc.:

Midterms: weeks 8 and 14. In the Moodle system, test tasks from the theory must be solved. Exams are done in Excel and uploaded to Moodle .

The method of obtaining a signature / mid-term mark:

1) Midterm1: 50 points (20 points theoretical test; 30 points task solution) Minimum: 26 points
2) Midterm2: 50 points (20 points theoretical test; 30 points task solution) Minimum: 26 points
The two midterms, which must be written, give the mid-year mark.
Below 52 points: unsatisfactory; 52-62 points: satisfactory; 63-75 points: intermediate; 76-85 points: good; 86 points and above: excellent
For those who fail the midterm, a make-up test will be given at an agreed time.
In case of failure of the end-of-year mark, the exam will be held on the date announced in the first week of the examination period. Both exams can be made up at the end of the year.

Proffesionals Competences:

- Ability to process measurement data using different methods and software. You must have basic and specialist statistical skills. You must be able to develop yourself. You must be able to perform calculations accurately. Be able to identify the most appropriate methods for processing your data. He/she must be able to think logically.
- You should be able to present your calculations and justify the results.

Literature:

1. e-books 1. Mohamed A. Shayib: Descriptive Statistics – The basics for Biostatistics: Volume I. 1st edition, 2018, bookboon.com, ISBN 978-87-403-2125-8; 2. Mohamed A. Shayib: Inferential Statistics – The basics for Biostatistics: Volume II. 1st edition, 2018, bookboon.com, ISBN 978-87-403-2127-2
2. lecture presentation in the system e-learning
3. Felix C. Veroya: Introduction to Statistical Process Control, A Problem Solving Process Approach, bookboon.com, 2014, ISBN: 978-87-403-0789-4, 1 edition, Pages: 72
4. Matthias Kohl: Introduction to statistical data analysis with R, bookboon.com, 2015, ISBN: 978-87-403-1123-5, 1 edition. Pages: 228

Title of the course: **Open and Closed loop Control**	**NEPTUN-code:** RKXSV1EBNF	**Weekly teaching hours:** l+cw+lw 1+0+2	**Credit:** 4 **Exam type:** tm
Course leader: Lóránt Szabó, Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:** -	

Curriculum:

Learning the basic concept of the open and closed loop control. The open loop control using only On/Off signals. Overview PLC systems. Open loop control with pneumatic final elements.

Review the theoretical background of closed loop control, structure of a control system, signals and basic control blocs. Time response, frequency response, steady state characteristics.

Curriculum Description:

Week	**Topic of lectures and practices**
1.	Division of control technology, characteristics of sub-areas. Control, regulation. Procedures for describing control tasks.
2.	Logical networks - building blocks
3.	Combinational networks
4.	Sequential networks
5.	Relays, basic relay circuits
6.	Programmable logic controllers
7.	1st Mid-term
8.	Programmable logic controllers
9.	Pneumatic systems
10.	Electropneumatic systems
11.	Basics of control technology, test functions
12.	Control technology basic members
13.	2nd Mid-term
14.	Retake

Mid-term requirement:s

Attendance:

Compulsory

Midterms, lab reports, etc.:

Completion of 2 (theory+practice in one) midterm at least at a sufficient level.

The method of obtaining a signature / mid-term mark:

Basis of marking: attendance at lectures and laboratory works/practice.

Written tests min. = 2 (pass) (separately).
In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- In possession of state-of-the-art IT skills, being able to use professional databases and certain design, modelling, and simulation software depending on their specialty.
- Efforts to improve knowledge by on-going self-education and continuously update their knowledge of the world.
- Responsible proclamation and representation of the value system of the engineering profession; openness to professionally well-founded critical remarks.
- Sharing experiences with colleagues, thus promoting their development.

Literature:

1. Javad, Mohammadpour: Control of Linear Parameter Varying systems. Chapter: 1, 2, 3; ISBN: 978-1-4674-1832
2. Keviczky, László: Control Engineering, Chapter: 1, 2, 4, 6, 8; ISBN: 978-963-9819-74-0
3. E-learning materials in Moodle (lectures)

Title of the course: **Informatics (blended)**	**NEPTUN-code:** RMEIF1EBNF	**Weekly teaching hours:** l+cw+lw 1+0+3	**Credit:** 4 **Exam type**: tm
Course leader: Eszter Kormány, Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:** -	

Curriculum:

The aim of the course is to provide a basic knowledge of IT for university studies and future engineering work. In the lectures of the course, students will learn about computer architecture, the hardware and software components required for operation, ethical and safe computer use, the basics of database management and programming, algorithm description tools and their use.
The exercises include data analysis, problem solving and algorithmic exercises. The knowledge gained can be used for coursework and in future work. Students will learn how to create and manage databases using Ms Access, design databases, normalization steps, create tables, set up key relationships, query, report and use SQL language. Simplify algorithms, create functions to extend the toolset of the Ms Office application.

Curriculum Description:

Training week	**Topics of lectures and practices**
1.	Introduction of the course MsOffice Application Word. Computer generations. The structure and operation of computers. Excel worksheet structure, settings, formatting, cell references: absolute (also by name), relative references. Simple statistical and text functions MsOffice Word Basic
2.	MsOffice Application Excel Basic and Financial functions. Operating systems. Computer networks (Local networks and Internet) Grouping of softwares. MsOffice Application Word Mail Marge
3.	MsOffice Application Excel What-if Analysis MsOffice Application Excel Basics
4.	MsOffice Application Excel as Database MsOffice Application Excel Financial Functions
5.	MsOffice Application Excel Power BI MsOffice Application Excel What-if Analysis Goal Seek, Data Table
6.	MsOffice Application Excel Solver Trendline
7.	Test MsOffice Application Excel Solver Shortest Problem
8.	Networks in the operation of complex systems MsOffice Application Excel Solver Function Analysis, Transportation Problem
9.	MsOffice Application Excel as Database (Sort, Filter, Advanced Filter)
10.	Introduction to Multimedia MsOffice Application Excel PivotTable, Power Pivot
11.	Basic knowledge of Word (formatting, creating columns, using headings, creating a table, inserting images, editing equations, using different headers and footers. Creating a table of contents -, table of figures -, index -, footnotes. Recording sources, inserting references

	in the text, creating a bibliography)
12.	Presentations.
13.	Seminary test (ZH)
14.	Supplementary seminary test.

Mid-term requirements:

Attendance lectures and practices/labs:

Participation in the exercises is compulsory, absence according to the TVSZ. Attendance at lectures is also compulsory, for the successful completion of the semester (exam) knowledge of the material presented in the lectures is required.

Tests, minutes, reports, etc.:

Week 7: Test 1
Week 12: Upload the homework into the Moodle eLearning system.
Week 13: Seminary test 2
Week 14: Supplementary seminary test

Method of obtaining a signature/mid-term mark:

Signature requirement:
- Completion of the exercises,
- Preparation of the minutes and submission in the laboratory exercise following completion,
- a minimum of a final paper on the material from the exercises. 51%,
- 1 min. 51% of the final grade, 51% of the final grade, 51% of the final grade, and 1 min. 80%, ZH 2 min. 51%.

A student who does not have a signature at the end of the semester may attempt to obtain a signature (in case of failure in the ZH) once in the first two weeks of the examination period. The signature requirement is the same as during the mid-year. The written examination and the final mark will be based on the results of the written tests and the work submitted to obtain the signature.

Professional competencies:

- In possession of state-of-the-art IT skills, being able to use professional databases and certain design, modelling, and simulation softwares depending on their specialty.
- Adequate perseverance and endurance of monotony to perform practical operations.

Literature:

1. PPT files on the homepage of Moodle learning system

Title of the course: **Nature and landscape protection, Environmental and nature field exercises**	**NEPTUN-code:** RKXTT1ABNF	**Weekly teaching hours:** l+cw+lw 2+4+0	**Credit:** 5 **Exam type**: 1m
Course leader: Krisztina Demény Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:** -	

Curriculum:

The purpose of the subject is to present the basic knowledge of nature and landscape protection through the following topics, and to prepare students for effective nature protection: Definition of landscape, natural and cultural landscape. Hierarchical system of landscape. Landscape-forming factors (biotic and abiotic factors). Types of landscape, landscape potential and protection. History of nature protection/conservation in Hungary and in the world. Major types of protected areas. Subjects of nature protection/conservation: geological, hydrological, zoological, botanical, cultural values. Main protected areas in Hungary and in the world.

The aim of the course is to apply the theoretical knowledge acquired in professional subjects to practical work, field work and field visits. Sampling and measurements on the field and in the lab provide students with experience that they can build upon to solve a problem later on. The main objective of the course is to create a competence-based environmental engineer training in addition to advanced theoretical science training. During the semester the students will participate in field visits and field work to identify environmental and nature conservation issues. Direct contact with the environment helps to develop an environmentally conscious approach, to recognize the causal relationships and relationships between the state of the natural environment and human activity. It is possible to observe anthropogenic impacts in the environment - waste incineration plant, sewage treatment plant, landfill, small water streams, municipal infrastructure, etc., and to carry out impact studies. During the course students will have the opportunity to interpret and analyze complex environmental and nature conservation problems.

Curriculum Descriptoin:

Week	**Topics of lectures and practices**
1.	Lecture: Definition of landscape, natural and cultural landscape. Hierarchical system of landscape Practice: Talking general topics, requirements, and student's lectures. Introducing of the theoretical background of the field working and researching.
2.	Lecture: Landscape-forming factors (in Hungary) Practice: Natural values I. (field observations, analyses, sampling): geological, cultural historical and landscape values. Visit to Hárs-Mt.- Budai-Mts.)
3.	Lecture: Landscape types of Hungary Practice: Natural values II. (field observations, analyses, sampling): geomorphological (karst form treasure), botanical and hydrological values. Visit to the Máriaremete Gorge Valley (In Buda Mts.) observing the landscape change.
4.	Lecture: Protected areas, history, IUCN categories Practice: Repeating, summarizing of lectures topics – online tasks I.
5.	Lecture: Subjects of nature/landscape protection/conservation. Practice: Natural values II. (field observations, analyses, sampling): geomorphological (karst form treasure), botanical and hydrological values. Visit to the Hármashatár Mts. (In Buda Mts.) observing the landscape change.
6.	Lecture: Main conventions on nature conservations Practice: Anthropogenic impacts: I. waste incinerator visiting

7.	Lecture: Definition of nature and landscape protection/conservation. Main types of protected areas Practice: Repeating, summarizing of lectures topics – online tasks II.
8.	Lecture: Introduction to nature conservation in Hungary, main emblematic values, parks in Hungary. Practice: Anthropogenic impacts II.: sewage treatment plant visiting
9.	Lecture: National parks in the world I. Practice: Student's lectures
10.	Protected areas in North-America, Middle and South America.
11.	Protected areas in Africa and In Europe Practice: Topography test (Practice test)
12.	Protected areas in Australia and in Asia.
13.	Written test and discussion and assessment of the reports.
14.	Replacement test

Mid-term requirements:

Attendance:

Compulsory

Mid-terms, protocols, reports, etc.:

- student lecture
- practical reports
- written tests (theoretical and practical)

The method of obtaining a signature / mid-term mark:

Requirement of midterm mark:

- attendance at classroom works,
- student lecture min. = 2 (pass)
- preparing reports about practical works, fields works and field visits, min. = 2 (pass).
- written test (theoretical and practical), min. = 2 (pass) (separately)

Mid-term mark = written test - 80%; reports – 10%; lecture – 10%

In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Undertaking and authentically representing the social role of environment protection, its basic relationship with the world.

- Open to professional cooperation with specialists related to their profession but involved in other areas.
- Knowledge of the learning, knowledge acquisition, and data collection methods of the special fields of environment protection, their ethical limitations, and problem-solving techniques.
- Knowledge of the main methods to examine the quantity and quality features of environmental elements and systems, their typical measuring instruments, and limitations thereof, as well as methods for the evaluation of data measured.
- Able to perform environmental impact assessments and to participate in compiling impact studies.
- Able to apply in practice as well the regulations and requirements of health and safety, fire protection, and safety engineering as related to their special field.
- Able to participate in project and proposal implementation and audit tasks based on their knowledge.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.

Literature:

1. Kertész, A. (2013): Landscape and environmental assessment (http://p2014-1.palyazat.ektf.hu/public/uploads/kertesz-landscape-and-environmental-assessment_532c37799f86c.pdf)
2. Stuart Chape et al.(edit) 2008: The world protected areas (statues, values and prospects in the 21th century), University of California Press (http://www.the-eis.com/data/literature/The%20worlds%20protected%20areas.pdf
3. PPT files on the homepage of Moodle learning system
4. Ravi Jain - Lloyd Urban - Harold Balbach - M. Diana Webb: Handbook of Environmental Engineering Assessment: Strategy, Planning, and Management, Elsevier - Health Sciences Division, 2012, ISBN: 9780123884442Brian
5. Barkdoll: Field guide to environmental engineering for development workers: water, sanitation, and indoor air, 2009, https://www.academia.edu/73112295/Field_guide_to_environmental_engineering_for_development_workers_water_sanitation_and_indoor_air

Title of the course: **Geoinformatics (GIS)**	**NEPTUN-code:** RKXTI1ABNF	**Weekly teaching hours:** l+cw+lw 2+0+2	**Credit:** 4 **Exam type**: tm
Course leader: Krisztina Demény Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:**	

Curriculum:

The teaching aim of the course is to introduce the basic theory and practice of GIS. The course will highlight the development of GIS, it will present the database model of GIS, the basic data management techniques and the data analyses method. The course will also demonstrate the data visualisation methods and possibilities of GIS.

Curriculum Description:

Weeks	**Topics of lectures and practices**
1.	Lecture: Basic concepts of GIScience and Geoinformatics Practice: Basics of QGIS
2.	Lecture: The history of GIS Practice: GIS operations
3..	Lecture: Components of GIS Practice: vector mode
4.	Lecture: Basic GIS operations Practice: raster model
5.	Lecture: Different type of GIS applications Practice: Basic GIS operation in QGIS I.
6.	Lecture: Modelling of Real World I. Practice: Basic GIS operation in QGIS II.
7.	Lecture: Modelling of real world II. Practice: Thematic maps with QGIS I.
8.	Lecture: Vector model Practice: Thematic maps with QGIS II.
9.	Lecture: Raster model Practice: Creating database in QGIS
10.	Lecture: 3D and DDM Practice: Interpolation in QGIS
11.	Lecture: Object oriented model Practice: Project work I.
12.	Lecture: Creating of Spatial database, Some visualizations method, the concepts of map Practice: Project work II.
13.	Written test
14.	Replacement test

Mid-term requirements:

Attendance:

Compulsory

Mid-terms, protocols, reports, etc.:

Written tests (lectures + practice work) and project work

The method of obtaining a signature / mid-term mark:

Basis of marking: attendance at lectures and laboratory works/practice.

Written tests min. and project work min. = 2 (pass) (separately).
In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- In possession of state-of-the-art IT skills, being able to use professional databases and certain design, modelling, and simulation software depending on their specialty.
- Knowledge of the learning, knowledge acquisition, and data collection methods of the special fields of environment protection, their ethical limitations and problem-solving techniques.
- Adequate perseverance and endurance of monotony to perform practical operations.

Literature:

1. Tomislav Hengl: Geostatisitcal mapping http://spatial-analyst.net/book/
2. Michael de Smith, Paul Longley, Mike Goodchild: Geospatial Analysis - A comprehensive guide (http://www.spatialanalysisonline.com/)
3. John P. Snyder : Map Projections: A Working Manual http://pubs.er.usgs.gov/publication/pp1395

Title of the course: **Environmental law**	**NEPTUN-code:** RKXKJ1ABNF	**Weekly teaching hours:** l+cw+lw 2+0+0	**Credit:** 3 **Exam type**: e
Course leader: Imre Biczó Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge: -**	

Curriculum:

Introduction to Law: Overview of the main legal traditions of the World. Introduction to the Common law tradition (Introduction to the English Law. Sources of law. English court system, Contracts in English law, the law of torts, Corporate Law), Introduction to the Civil law tradition (German, French law), EC law, Introduction to Hungarian law: Structure, Hungarian law of contracts, corporations, environmental law, Introduction to Environmental protection, history, EC/EU Environmental law: EU Primary legislation, right to environment, Principles, Programmes and Strategies, Legal Instruments I.: Substantive environmental law, Legal instruments II: Procedural rules, Liability measures, Organs, Authority, Environment and development: sustainable development, Environmental protection in EU Funds.

Curriculum Description:

Weeks	**Topics of lectures and practices**
1.	Introduction to Law: Overview of the main legal traditions of the World.
2.	Introduction to the Common law tradition (Introduction to the English Law. Sources of law. English court system, Contracts in English law, the law of torts, Corporate Law)
3.	Introduction to the Civil law tradition (German, French law). EC law
4.	Introduction to the Hungarian law: Structure, Hungarian law of contracts, corporations, environmental law
5.	Introduction to Environmental protection, history, right to environment
6.	International Environmental Law
7.	EC/EU Environmental law: Programmes and Strategies
8.	EU Primary legislation,
9.	Principles of Environmental Law
10.	Legal Instruments I.: Substantive environmental Law
11.	Legal instruments II: Procedural rules Organs, Authority
12.	Liability measures, Environmetal Impact Assessment
13.	Environment and development: sustainable development,
14.	Summary for the test

Mid-term requirements:

Attendance:

Compulsory

Mid-terms, protocols, reports, etc.:

Written test, week 14 (lectures).

The method of obtaining a signature / mid-term mark:

The course requires students to give short presentations on chosen topics and submit an essay. At the end of the semester students will undertake a test, that will contain short questions, essay type questions as well as problem-based questions.
Assessment details: Class attendance 20%, Presentation or Essay: 30%, test: 50%
Marks will be counted as follows: (5): 89%-100%; (4): 73%-88%, (3): 57%-72%, (2): 40%-56%, (1): 0%-39%
In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Able to perform basic tests of the quantity and quality characteristics of environmental elements and systems by state-of-the-art measuring instruments; to draw up and implement measurement plans; and to evaluate data.
- Open to professional cooperation with specialists related to their profession but involved in other areas.

Literature:

1. Nancy E. Marion: Making Environmental Law: The Politics of Protecting the Earth, Praeger Publisher, Santa Barbara, CA, 2011, 376 pages
2. Angelo, Mary Jane: Harnessing the Power of Science in Environmental Law: Why We Should, Why We Don't, and How We Can, Texas Law Review Publisher, 2008

Title of the course: **Environmental managment and impact assessment**	**NEPTUN-code:** RKXKH1EBNF	**Weekly teaching hours:** l+cw+lw 1+2+0	**Credit:** 4 **Exam type**: tm
Course leader: Imre Biczó, Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:** -	

Curriculum:

Environmental management and economic analysis focus on such influences of human activities on natural environment, as the increase in the GHG (greenhouse gas) emission, which led to climate change and the global warming by increasing the pollutions in the air and water resources and decreasing the biodiversity. This study focuses on the connections among the global warming, water management and water resource allocation. Some important problems were raised for both irrigation dams and energy-producing dams. The dam-users should clean the water against the sediments, which could disrupt the works of turbines producing the electric energy.The environmental management and economic analyses became very actual, because of the negative influences of the human activities and the performances of the economies of the world economy including the EU-28 member states on the nature. The salinization process can be considered almost on 3,8 million ha areas of Europe. Also, the soil contaminations included heavy metal and mineral oil widely extended in 3 million sites of Europe. The EU has a considerable problem concerning the Generation of waste by economic activity from point of view of the environmental conservation strategy. The EU should considerably decrease either Generation of waste and Municipal waste accompanying with decreasing GHG emission. The Water management, renewable freshwater resource issues should be developed in the EU, because this water management is very costly with very considerable waste and pollution around water resources.
Environmental economics is the subset of economics that is concerned with the efficient allocation of environmental resources. The environment provides both a direct value as well as raw material intended for economic activity, thus making the environment and the economy interdependent. The “law of diminishing returns” is one of the best-known principles outside the field of economics. It was first developed in 1767 by the French economist Turgot in relation to agricultural production, but it is most often associated with Thomas Malthus and David Ricardo. Changes in population can have a variety of economic, ecological, and social implications. One population issue is that of carrying capacity – the number of individuals an ecosystem can support without having any negative effects. English economist Thomas Malthus who stated that continued population growth would cause over-consumption of resources. Malthus further argued that population was likely to grow at an exponential rate while food supplies would increase at an arithmetic rate, not keeping up with the exponential population growth. United Nation's World Commission on Environment and Development commissioned a study on the subject by what is now known as the Brundtland Commission. The resulting report, Our Common Future (1987), defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," which has become the accepted standard definition. Two basic terms that are used most often by economists are supply and demand.

Curriculum Description:

Weeks	**Topics of Lectures and Practices**
1.	Basics of environmental economics and environmental management. I. and II. Sustainable development. The relationship between economic growth and environmental quality. The relationship between economic growth and environmental quality.
2.	Economics of environmental pollution. I. and II. EU environmental protection policy. I. and II. The Brundtland Commission's interpretation of sustainable development (Oslo, future generation, indebtedness of countries, interdependent nature of development). The opinion of Robert Solow, Nobel Prize-winning American economist. Environment, resource management, environmental protection. Grouping of natural resources.

3.	Environmental economics, waste, atmosphere. Environmental protection policy of Hungary. Soil, hydrosphere Environmental economics soil, hydrosphere. Sustainable development in an ecological approach: the relationship between the natural environment and human society. Concept of natural capital.
4.	The characterization of the development of the industrial structure in relation to the change in the ratios between the extractive industry and the processing industry. Material consumption. Raw material supply. The four main topics of sustainable economic development, what are their characteristics. The role of the most important global environmental risk factors and in which areas the environmental damage caused by human activities is most felt. Sustainable yield in the use of renewable resources.
5.	The role of international companies in raw material supply. The evolution of the structure of energy consumption, previously the structure of fossil energy consumption and now the proportion of renewable energy sources. Changes in energy consumption needs in each period based on international supply and demand. Level of demand, energy forecasts, development of stocks. The 1972 document of the Club of Rome entitled "Limits to Growth" (responsibility between generations, development of a new legal system, global and local nature in the field of sustainability and environmental protection). Balance of world production and consumption. American demographer Joel Cohen raises the question: How many people does our planet have to prepare to support? (material well-being, distributional conditions). To what extent can the question be solved? Economics of non-renewable resources. Socio-economic material flow.
6.	The evolution of the internationalization of the oil industry, its institutional characteristics and organizations, periods of oil crises. Factors influencing the security of oil supply. Factors ensuring the efficiency of energy use depending on alternative energy sources. The need for electricity supply and the contradiction of this industry in energy supply. Development and future prospects of the nuclear energy sector depending on its costs. The destruction of free goods, the introduction of the use costs of free goods and its essence. International debates and measures taken within national frameworks in relation to economic incentives and penalties applicable in environmental policy. Environmental crisis. Model experiments to deal with the environmental crisis.
7.	The impact of agro-industrial complexes on agricultural employment and the share of production from the world's total production. Development of factors promoting the development of world agriculture. Characteristics of agricultural production systems in developed countries and other major country groups. The connection of agricultural production to other economic branches. Structural evolution of agricultural production and food processing (small, medium and large farms). What international economic factors does global food security depend on? The development of global food security in the case of some important products (plants, animal products). Debates about the economic measurability of ecological problems. External costs, environmental balance sheet. Responses to an environmental crisis. EU. Environmental activity.
8.	Conditions for sustainable agricultural development. Technical transformation and ecological damage. More important factors of sustainable agriculture in connection with production and production technology Ecological economics, environmental economics. The relationship between economy and the biosphere.
9.	The needs of land use, chemicals, and water use (fresh water, irrigation water supplies). Economic growth, social development. Measurability of natural capital and its different interpretations.
10.	The biological revolution in agriculture. The concept of sustainable development and its interpretations. UN system of sustainable development indicators.

11.	Ecological footprint, the index of human development. The need for monetary environmental assessment and its areas of application.
12.	Grouping of environmental assessment methods. Cost-benefit analysis.
13.	Concept and characteristics of external economic effects (externalities). Environmental pollution at your own risk. The need for environmental regulation and its appearance in economic theories (Pigou's tax). Some thoughts on A.C. About Piguo.
14.	The importance of a strategic approach. Can the transition to sustainability be planned?

Mid-semester requirements:

Attendance:

Participation in the sessions is a condition for obtaining the exam ticket (the student will be banned due to exceeding the permitted absences according to the TVSZ).

Theses, minutes, reports, etc.:

Short lectures are held continuously during the exercises.

The method of obtaining a signature/creating a mid-semester ticket:

The thesis and literature processing separately min. It should be 40%. The grade is issued based on these two tasks.
If the grade is insufficient (1), it is possible to replace it according to the provisions of Article 24 (5) of the TVSZ.

Professional competencies:

- Able to perform basic tests of the quantity and quality characteristics of environmental elements and systems by state-of-the-art measuring instruments; to draw up and implement measurement plans; and to evaluate data.
- Able to solve tasks of water, soil, air, radiation, and noise protection, as well as of waste treatment and processing at proposal level; to participate in preparing decisions; to perform authority audits; and to take part in the operation of these technologies.
- Performing environmental tasks individually and managing special environment protection work independently even in unexpected decision-making situations.
- Cooperation with qualified experts from other special areas (primarily economic and legal) while completing professional tasks.

Literature:

1. Alan Gilpin: Environmental Impact Assessment Cutting Edge for the 21st Century Cambridge University Press, ISBN: 9781139166539, https://doi.org/10.1017/CBO9781139166539
2. Edited by Peter Wathern: Environmental Impact Assessment, Theory and Practice, ISBN: 9781138137448, eBook ISBN: 9780203409978, Adobe ISBN: 9781134897728, 10.4324/9780203409978
3. Charles H., Eccleston: Environmental Impact Assessment: A Guide to Best Professional Practices 1st, Kindle Edition,
4. C.J. Barrow; Environmental Management for Sustainable Development, 2nd edition, Routledge
5. S. Schaltegger, R Burritt, H. Petersen; An Introduction to Corporate Environmental Management, Greenleaf Publishing
6. Tim Everett, Mallika Ishwaran, Gian Paolo Ansaloni and Alex Rubin March (2010): Economic Growth and the Environment. Evidence and Analysis Series Paper 2. DEFRA (Development for Environment Food and Rural Affairs) PB13390, UK, March 2010, p. 52.
7. Economic growth and the environment - GOV.UK, https://assets.publishing.service.gov.uk › PDF
8. Zsarnóczai, J. Sándor and Editing Board (edited by, 2010): Economics of Sustainable Agriculture (Fenntartható mezőgazdaság közgazdaságtana) Gödöllő, p. 151, ISBN 978 963 269 145 9

9. Zsarnóczai, Sándor (edited by, 2021): ENVIRONMENTAL IMPACT ASSESMENT. Notebook. ÓBUDA University, Rejtő Sándor Faculty of Light Industrial and Environmental Engineering, Environmental Engineering Institute.
10. Federica Cimato and Michael Mullan (2010): Adapting to Climate Change: Analysing the Role of Government, Paper 1, UK, January 2010, DEFRA (Development for Environment Food and Rural Affairs)
11. Environmental Literacy Council (2007): Environmental Economics.Volume 1 Essential. Washington DC, US. P. 43.
12. Zsarnóczai, J. Sándor and Editing Board (edited by, 2010): Economics of Sustainable Agriculture (Fenntartható mezőgazdaság közgazdaságtana) Gödöllő, p. 151, ISBN 978 963 269 145 9
13. Zsarnóczai, J. Sándor (edited by, 2021): ENVIRONMENTAL MANAGEMENT. Notebook. ÓBUDA University, Rejtő Sándor Faculty of Light Industrial and Environmental Engineering, Environmental Engineering Institute

Title of the course: **Risk analysis**	**NEPTUN-code:** RKXKO1ABNF	**Weekly teaching hours:** l+cw+lw 1+2+0	**Credit:** 4 **Exam type**: e
Course leader: Sándor Pekker, Ph.D.	**Position:** research professor	**Required preliminary knowledge:** -	

Curriculum:

Main topics of the subject: Definition and types of risk, The risk-taking, Risk measures, The controllability of risk, Environmental risks and environmental functions of companies, Health Risk Assessment (HRA), Ecological Risk Assessment (ERA), The risk of natural hazards, disasters, The environmental risk of toxic elements, Environmental risks in the information society, Special and border areas.

***Curriculum Description*:**

Weeks	**Topics of lectures and practices**
1.	The concept, essence and structure of crisis management. Way to crisis management: a concrete example. What is crisis management good for? Steps of crisis management. To ensure liquidity and bankruptcy protection sincerely exploring the causes, facing. Creating a business plan, implementation. What is not good for what is crisis management not suitable for?
2.	The main characteristics and socio-economic foundation of the EU-15s agricultural cooperative system. Establishment of the German farm management system after the 1992 unification. The development of 25 most significant agricultural cooperatives for the EU-15s between 2003 and 2008. Hungarian lessons in connection with the EU-15s cooperative system
3.	Support for agricultural production in Hungary in 2008-2020. Support for agricultural production in sector
4.	Agriculture Innovation Development in Hungary in the 2010s. Short -term extensive environmental solutions consumed the last reserves of the establishment of an environmentally friendly technology that has a long -term solution. Domestic experience shows that our business practice has not properly supported intensive environmental protection. Investment tools were generally available to companies, so there was no question of replacing largely polluting technologies and equipment, but in cases causing severe problems, minor investment, but more expensive extensive methods were used in the longer term. Usually modern cleaning equipment were installed along with outstanding or medium technical production equipment. This has largely resigned from the innovation performance we could have gained through new waste technologies through increasing productivity and reducing specific material and energy use.
5.	Economics of environmental pollution. Externalities. Types of external economic effects, two basic types of environmental pollution, distribution (flow) and stock -type contamination. Economic consequences of externalities. Economically optimal levels of environmental pollution. The optimum size of externalities. Environmental risks. Environmental risks and management responsibility of companies. *First writing exam*.
6.	Treatment of externalities in economic theories. The size of the Pigou tax. The Coase Theorem. Some environmental consequences of Pigou and Coase's theory. Two ways to reduce pollution in the case of a pollutant. Cost-effective sharing of contamination obligations between multiple contaminants or multiple contamination options. The choice between environmental policy tools (taxes and quantitative regulation).
7.	Impact of externalities in the monopolistic market. Case of combined use of direct and indirect tools. It is a matter of inflation and price elasticity in green taxes. Environmental regulation is not for stationary contamination
8.	Tools for environmental policy, regulation of environmental protection. Requirements for the regulatory system. Students' papers to be submitted to keep reports.
9.	Direct (or normative) regulation. The system of norms. Means of direct regulation. Disadvantages of direct regulation. Indirect (or economic) regulation. Tax, environmental use fee, fee, contribution, etc. Support (subsidy), positive encouragement. Deposit system. Market creation (combining market and official assets). *Students' papers to be submitted to keep reports.*

10.	Market for "pollution rights". Operating experiences of the market for pollution rights. Flexible compensation regulation. Overview of economic instruments. Experiences of economic regulation of environmental protection. European experience of regulating environmental protection. *Students' papers to be submitted to keep reports*.
11.	Environmental risks. Environmental risks and management responsibility. Estimating the environmental risks of companies. The environmental responsibility of corporate executives in industrial states. A hypothesis about what \ "customized \" environmental management is. Endogenous and exogenous components of the environmental risk of businesses. *Students' papers to be submitted to keep reports.*
12.	The role of environmental function in the company depending on the changing environmental risk of the activity. In the role of corporate environmental function support (support). The corporate environmental function is in a plant, factory role (Factory). The corporate environmental function is constantly changing, changing (turnaround). The corporate environmental function is a strategic role (strategic). *Students' papers to be submitted to keep reports.*
13.	The characteristics of the environmental function as assumed in different roles. Characteristics of the environmental function in supportive role. Characteristics of environmental function in a strategic role. *Second writing exam.*
14.	Environmentally friendly technologies, environmentally friendly products. What can we consider environmentally friendly? Environmental evaluation of technology change. Environmental foundation of corporate decisions. *Students' papers to be submitted to keep reports*.

Mid-term requirements:

Attendance:

Compulsory

Mid-terms, protocols, reports, etc.:

2 written test

Students lecture from a chosen topic

The method of obtaining a signature / mid-term mark:

In the written ZH exam, students have to answer two or three essay questions. The written exam will be based on questions from the subjects indicated in the tables of contents of the two university notes
In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Professional competencies:

- Knowledge of general and specific mathematical, natural and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Able to perform basic tests of the quantity and quality characteristics of environmental elements and systems by state-of-the-art measuring instruments; to draw up and implement measurement plans; and to evaluate data.
- Open to professional cooperation with specialists related to their profession but involved in other areas.

Literature:

1. Marvin Rausand: Risk Assessment: Theory, Methods, and Applications (Statistics in Practice), 1st Edition, Wiley, 2011, ISBN-13: 978-0470637647; ISBN-10: 0470637641
2. Thomas Simon: Edition: Fundamentals of Applied Risk Assessment – eBook, Edition: 2; Copyright: 201 , Kendall Hunt, Pages: 532; ISBN 9781465229373
3. Ian Lerche,Walter Glaesser: Environmental Risk Assessment: Quantitative Measures, Anthropogenic Influences, Human Impact, Springer Science & Business Media, 2007, 343 pages; ISBN: 9783540297093

SUSTAINABLE ENERGY MANAGEMENT, GREEN ENERGY SPECIALISATION

Title of the course: **The source of renewable energies I. (The application of solar and geothermal energy)**	**NEPTUN-code:** RKWMF1ABNF	**Weekly teaching hours:** l+cw+lw 2+2+0	**Credit:** 5 Exam type: e
Course leader: Lóránt Szabó, Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:** RKXEL1EBNF, RKXKM2ABNF	

Curriculum:

The educational objective of the course is to introduce students to solar and geothermal energy technologies, presenting their potential, advantages, disadvantages, and limitations. In addition, the history of solar energy utilisation, passive and active methods of utilisation will be presented. The operating principles and types of solar collectors and solar panels, their efficiency and payback period are described. The energy analysis of a specific domestic solar panel, domestic, small power plant as a function of the variation of different parameters is presented. Within the framework of the course, the students will learn about the physical and geological characteristics of geothermal energy sources, the generation and the surface transport of geothermal heat. Geothermal energy applications are covered: thermal water, electricity generation (steam turbines), geothermal heat pumps.
The environmental impacts, the problem of disposal of thermal water (purification or reinjection) and the domestic potential (spas, agriculture, etc.) are presented.

Curriculum Description:

Week	**Topics of lectures and practices**
1.	Categorization of renewable energies. Distribution of solar energy on Earth. Passive and active solar energy application. Determination of solar constant. Elements of active solar thermal systems.
2.	Elements of active solar thermal systems. Solar collectors. Solar collector efficiency.
3.	Working principle of photovoltaic (PV) systems.
4.	Solar cell efficiency. Types of solar cells. Solar cell production.
5.	Mechanical design of supporting structures for solar power plants. Sizing for self-shielding.
6.	Solar thermal power plants (solar chimney).
7.	Legislation on solar power plants. Connecting solar panels to the national grid. Summary.
8.	Writing and solving a written test from solar energy application.
9.	Determining geothermal energy. Earth's structure. Inner core temperature.
10.	Temperature gradient and heat flux.
11.	The potential of geothermal energy for heat recovery. Use of geothermal heat in heat pumps. Coefficient of performance (COP) of heat pumps.

12.	Generating electricity from geothermal energy. Advantages and possible disadvantages of geothermal energy.
13.	Replacements. Summary. Writing the second ZH (from geothermal energy application).
14.	Summary of full semester. Replacement paper. Discussion of replacement test. Workshop.

Mid-semester requirements:

Attendance:

It is compulsory to attend the lectures. The rules of education and exam directory (TVSZ) are the guidelines.

Methods of qualification:

Requirement of signature minimum result (40%) from written test. Exam mark from written exam test. Total points: 100.
Exam marks: 85-100%: excellent (5), 70-84%: good (4), 55-69%: average (3), 40-54%: pass (2), 0-39%: fail (1).
If the student has not met the requirements of obtaining the term mark (e.g. has not written or failed the in-class test, has not submitted the measurement report, etc.), he/she must be given one opportunity to make up for the term mark in the study period. If the student is still unable to obtain the term mark through this opportunity and the requirements of the course give an opportunity for it, then the student can make an attempt to obtain the term mark on one occasion on one of the first ten work days of the examination period against a fee specified in the "Regulations of ÓU on possible benefits for students and on fees and charges payable by them" (hereinafter RBF).

Professional competencies:

- Knowledge of general and specific mathematical, natural, and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- Knowledge of the learning, knowledge acquisition, and data collection methods of the special fields of environment protection, their ethical limitations, and problem-solving techniques.
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Knowledge of the concepts and tools of economics and environmental economics, project, and environment management in environment protection.
- Knowledge of the basics of energy management, options for energy production, their advantages, and disadvantages, as well as the concept and feasibility options of sustainable development.
- Able to participate in project and proposal implementation and audit tasks based on their knowledge.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.
- Able to take part in environment expertise, advisory, and decision preparation work.
- Monitoring regulatory, technical, technological, and administrative changes related to the special field and enforcing them in their professional work.

Literatures:

1. Michaelides, Efstathios E. Stathis: Alternative Energy Sources, ISBN 978-3-642-20951-2
2. Yunus A. Cengel: Fundamentals and Applications of Renewable Energy, McGraw-Hill Education, 2019, ISBN: 1260455300
3. John Tabak: Solar and Geothermal Energy, Infobase Publishing, 2009, ISBN: 9780816070862
4. Elizabeth Raum: Water and Geothermal Energy, Heinemann-Raintree, 2008. pp. 32.

Title of the course: **The source of renewable energies II. (The application of wind power, water energy and hydrogen cell)**	**NEPTUN-code:** RKWMF2ABNF	**Weekly teaching hours:** l+cw+lw 2+2+0	**Credit:** 5 Exam type: e
Course leader: Lóránt Szabó, Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:** RKXEL1EBNF	

Curriculum:

The educational objective of the course is to introduce students to wind, hydroelectric and hydrogen cell technologies, showing their potential, advantages, disadvantages, and limitations. In particular, the history of wind turbines, their types (horizontal, vertical axis), wind turbine parts and their operation will be introduced. Students will learn about the calculation of the efficiency and payback time of wind turbines. The second part of the course introduces the history of hydropower (water wheel irrigation systems, water mills, etc.), the types of water wheels and water turbines. Students will be given an explanation of the tidal phenomenon through some examples (estuarine tidal power plants e.g., Severn, England). The course will also cover the principles of hydrogen cells and the attempts of car manufacturers to replace the former petrol and diesel cars.

Curriculum Description:

Week	**Topics of lectures and practices**
1.	A historical overview of the use of wind energy. Physical description of wind generation.
2.	Types and design of wind turbines, characteristics of wind turbine development.
3.	Harnessing the kinematic energy of wind, efficiency. Betz formula. Flow and force relations of a wind blade.
4.	Construction and operation of a three-bladed horizontal axis wind turbine. Wind turbine operation and connection to the national grid.
5.	Onshore, offshore, floating wind turbines. Wind turbine development and prospects for reducing carbon dioxide emissions, environmental impacts of wind power.
6.	Wind turbine development and prospects for reducing carbon dioxide emissions, environmental impacts of wind power.
7.	Writing and solving a final paper on wind energy applications.
8.	Water cycle. Energy chain of hydroelectric power plants. International hydropower potential.
9.	Hydroelectric power plant output. Life cycle of hydropower plants.
10.	Types of hydroelectric power plants and turbines. Bánk turbine. The world's largest hydroelectric power plants. Pumped energy storage (PES). Environmental aspects of hydroelectric power plant installation. Hydropower situation in Hungary.
11.	Hydrogen production. Electrolysis. Hydrogen storage and transport.
12.	Classification of fuel cells. How PEM works. When is hydrogen considered renewable, green energy? Accelerating the hydrogen revolution.

13.	Replacements. Summary. Writing the second ZH.
14.	Replacement paper. Discussion of second test. Workshop.

Mid-semester requirements:

Attendance:

It is compulsory to attend the lectures. The rules of education and exam directory (TVSZ) are the guidelines.

Methods of qualification:

Requirement of signature minimum result (40%) from written test. Exam mark from written exam test. Total points: 100.
Exam marks: 85-100%: excellent (5), 70-84%: good (4), 55-69%: average (3), 40-54%: pass (2), 0-39%: fail (1).
If the student has not met the requirements of obtaining the term mark (e.g. has not written or failed the in-class test, has not submitted the measurement report, etc.), he/she must be given one opportunity to make up for the term mark in the study period. If the student is still unable to obtain the term mark through this opportunity and the requirements of the course give an opportunity for it, then the student can make an attempt to obtain the term mark on one occasion on one of the first ten work days of the examination period against a fee specified in the "Regulations of ÓU on possible benefits for students and on fees and charges payable by them" (hereinafter RBF).

Professional competencies:

- Knowledge of general and specific mathematical, natural, and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- Knowledge of the learning, knowledge acquisition, and data collection methods of the special fields of environment protection, their ethical limitations and problem-solving techniques.
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Knowledge of the concepts and tools of economics and environmental economics, project, and environment management in environment protection.
- Knowledge of the basics of energy management, options for energy production, their advantages, and disadvantages, as well as the concept and feasibility options of sustainable development.
- Able to participate in project and proposal implementation and audit tasks based on their knowledge.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.
- Able to take part in environment expertise, advisory, and decision preparation work.
- Efforts to improve knowledge by on-going self-education and continuously update their knowledge of the world.
- Monitoring regulatory, technical, technological, and administrative changes related to the special field and enforcing them in their professional work.

Literature:

1. Michaelides, Efstathios E. Stathis: Alternative Energy Sources, ISBN 978-3-642-20951-2
2. Robert Gasch, Jochen Twele: Wind Power Plants: Fundamentals, Design, Construction and Operation, Springer Science & Business Media, 2011. okt. 12. - 548 pp.
3. Arnold, Guy: Wind, Water and Solar Power: New Energy Possibilities (Facts on), Hachette Children's Group, ISBN: 0749603682

4. Tony L. Burton- Nick Jenkins- Ervin Bossanyi - David Sharpe - Michael Graham: Wind Energy Handbook, ISBN: 978-1-119-45109-9, Wiley, 2021
5. Sherry Neuwirth Payne: Wind and Water Energy, Heinemann/Raintree, 1983, ISBN: 978-0817214180
6. Elizabeth Raum: Water and Geothermal Energy, Heinemann-Raintree, 2008. pp. 32.
7. Edited by Detlef Stolten: Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications, 2010. Wiley VCN, ISBN: 978-3-527-32711-9

Title of the course: **Biomass production and recovery**	**NEPTUN-code:** RKWMU1EBNF	**Weekly teaching hours:** l+cw+lw 2+2+0	**Credit:** 6 **Exam type**: tm
Course leader: Csaba Ágoston, Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:** -	

Curriculum:

During the semester all biomass raw materials that are used energetically in domestic and / or foreign biomass power plants will be presented.
One of these is herbaceous and woody plants grown specifically for biomass use. These raw materials cover not only the basic aspects of cultivation, but also other environmental technology linkages such as brownfield revitalization, phytoremediation, etc.
Wastes that can be used as biomass feedstock, waste from the biological industries, and rdf and srf from the fraction of municipal waste sorting, as feedstock for biomass and / or power plant boilers, or from so-called municipal waste. Raw materials for the "dry" biogas process will be presented in the second half of the semester. The standards, legal requirements and technical aspects of these materials as well as the technological and organizational aspects of production will also be introduced during the course.
In addition to the main mechanical / mechanical parameters of each type of biomass firing equipment, the course material is detailed along with the main material groups.

Curriculum Description:

Training week	**Topics of lectures and practices**
1.	Definition of biomass, kinds of biomass. Biomass in natural circulation. Important of biomass in circular economy.
2.	Plant biomass production. Energy plantations.
3.	Energetic utilization of biomass in combustion plants.
4.	Biological components of municipal waste, used vegetable oil and municipal green waste collection.
5.	Energetic utilization of municipal waste. RDF and SRF. Energetic utilization in cement industry.
6.	Treatment and processing of animal carcasses.
7.	Productions and groups of biofuels. The first, second, third and fourth generations of biofuels. I
8.	Productions and groups of biofuels. The first, second, third and fourth generations of biofuels. II
9.	Aerobic treatment of biomass, composting and utilization of composts.
10.	Community and residential composting. The importance of composting in shaping public attitudes.
11.	Anaerobic treatment of biomass. Production, quality and utilization of biogas.
12.	Biomass pyrolysis, resulting products and their utilizations.
13.	Environmental effect of biomass treatment. Environmental emissions from biogas plants, composting plants and animal waste treatment facilities.
14.	Semester evaluation. Semester test.

Mid-term requirements:

Participation in occupations:

It is compulsory to attend the lectures. The rules of education and exam directory (TVSZ) are the guidelines.

Midterms, protocols, reports, etc.:

Written test 1 on the week 13.
Replacement (supplementary) written test on the week 14.

The method of obtaining a signature / mid-term mark:

One written test. Total points: 100, if the score is > 40 points (successful) → signature.
If the student has not met the requirements of obtaining the term mark (e.g. has not written or failed the in-class test, has not submitted the measurement report, etc.), he/she must be given one opportunity to make up for the term mark in the study period. If the student is still unable to obtain the term mark through this opportunity and the requirements of the course give an opportunity for it, then the student can make an attempt to obtain the term mark on one occasion on one of the first ten work days of the examination period against a fee specified in the "Regulations of ÓU on possible benefits for students and on fees and charges payable by them" (hereinafter RBF).

Professional competencies:

- Knowledge of the learning, knowledge acquisition, and data collection methods of the special fields of environment protection, their ethical limitations and problem-solving techniques.
- Knowledge of the basics of energy management, options for energy production, their advantages, and disadvantages, as well as the concept and feasibility options of sustainable development.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.

Literature:

1. Erik Dahlquist: Biomass as Energy Source: Resources, Systems and Applications, March 31, 2017 by CRC Press, ISBN 9781138073227

Title of the course: **Alternative energy usage in practice I. (System of energetics - transport and residential application)**	**NEPTUN-code:** RKWAE1EBNF	**Weekly teaching hours:** l+cw+lw 2+2+0	**Credit:** 6 **Exam type**: tm
Course leader: Konrád Lájer Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** -	

Curriculum:

The purpose of the subject is to introduce alternative energy conversion drives used in transport. (LPG, CNG, hydrogen, electric drives). During the semester, students conduct an environmental risk assessment of each drive. They will learn the interactive control options that coordinate transport systems (eg public transport alternatives; 'self-driving vehicles'; 'smart' roads). It also describes the principles of operation of additional transport related infrastructures. (Street lighting ("Smart" lighting, traffic control). Within the framework of the course, the modern energy management capabilities of household appliances and the benefits of networked equipment (eg IOT [Internet of Things] application technology) are introduced. The course has the task of developing attitudes as well as learning about economics calculations used in practice.

Curriculum Description:

Weeks	**Topics of Lectures**
1.	Introduction to residential energy use (and production). Elements of residential energy use. Introduction to the semester requirements. Comparison of energy sources in residential use. Cost analysis of energy carriers.
2.	Non-industrial renewable heat (energy) production methods. Solar: solar panels, collectors; latent heat recovery (heat pumps); biomass-based systems (biogas reactor; energy grass-wood-wood waste solutions).
3.	The principle of operation of photovoltaic systems. Types of solar cells. Analysis of their efficiency. Methods of energy storage (recharging, storage). Ecological footprint of additional batteries.
4.	Modern non-renewable heating systems (gas, wood, coal boilers, electric heating panels). Options to reduce heat losses (insulation methods). Agreeing tasks to be submitted.
5.	Advanced lighting systems. LED as a light source. Modern "white-light" LEDs, their construction and principle of operation. Home control, energy saving methods. Remote monitoring of dwellings and its state of the art equipment.
6.	Energy sources and technical solutions in transport, from the industrial revolution to the present day (steam, petrol, diesel). Why the use of renewable energy sources has declined.
7.	Use of renewable energy in petrol and diesel vehicles ("evolution of engine propellants" today)
8.	The history of electromobility from the beginning to today. What makes a technical solution competitive in practice? The electric car today, opportunities and challenges. How can it compete with internal combustion engines?
9.	Wastes from household and small-scale electrical power generation and their management. Wastes from electric vehicles and their recycling.
10.	Cycling. Difficulties, opportunities. When is an e-bike environmentally friendly? (Online test at any time during the day, 45 minutes...)

11.	Influencing the microclimate of settlements. Mitigating the effects of global warming. Textile shading, living walls, vertical gardens.
12.	The concept of a "smart" living environment. Home control, energy saving methods. Remote home monitoring and its state-of-the-art tools. Building a "smart" street.
13.	"Future-proof" home heating and energy systems. Specific, experimental energy production methods that are not yet widespread. Future transport technologies, developments, current research programmes and problems.
Weeks	**Topics of Practices**
1.	Topic matching for Project Task.
2.	Selecting topics, setting up small group projects.
3.-6.	Independent task development, consultation if necessary.
7.-12.	Presentation of the project in the form of small presentation's groups.
13.-14.	Replacements.

Mid-semester requirements:

Attendance:

Attendance at lectures and tutorials is compulsory (according to the schedule). The number of absences and the method of making up for them is determined by the current Study and Examination Regulations (TVSZ).

Test papers, measurement records, reports, etc. (number, date):

1. ZH (1x45 min) short quiz (online test).
2. Presentation of short presentations (4 rounds).
3. Substitution according to the principles set out in the TVSZ.

Methods of qualification:

During the semester, the assignments to be completed are: 1 ZH, and a project on a topic of your choice in a small presentation. The maximum number of participants per project is 3.
Submission and presentation of the presentations will take place from week 9 to week 13.
Formal requirements for the project:
1 presentation of 15-20 slide cubes in size (with annotated slides) + 1 homework paper in reading format (illustrated with pictures) explaining the content of the PPT in more detail.
Papers must be uploaded to eLearning platform prior to presentation, only once per mini-project.

Professional competencies:

- Knowledge of the concepts and tools of economics and environmental economics, project and environment management in environment protection.
- Knowledge of major environmental technologies, equipment and structures associated with each technology, including the functioning and operation thereof.
- Knowledge of the basics of energy management, options for energy production, their advantages and disadvantages, as well as the concept and feasibility options of sustainable development.
- Able to participate in project and proposal implementation and audit tasks based on their knowledge.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.

Literature:

1. Eds.: Management Association, Renewable and Alternative Energy: Concepts, Methodologies, Tools, and Applications, IGI Global, 2016, ISBN13: 9781522516712
2. Ali Sayigh: Comprehensive Renewable Energy, 1st Edition, Imprint: Elsevier, Published Date: 2nd May 2012, Page Count: 4422, eBook ISBN: 9780080878737, Hardcover ISBN: 9780080878720
3. Michaelides, Efstathios E. Stathis: Alternative Energy Sources, Springer Press, 2012, Buy eBook, ISBN: 978-3-642-20951-2

Title of the course: **Alternative energy usage in practice II. (System of energetics -Building energy)**	**NEPTUN-code:** RKWAE2EBNF	**Weekly teaching hours:** l+cw+lw 2+1+0	**Credit:** 5 **Exam type**: e
Course leader: Konrád Lájer Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** -	

Curriculum:

The subject addresses one of the burning issues of our time, sustainability, through a complex approach. Learning about the disciplines of human ecology, building ecology and building biology is an important part of developing an ecological approach. The central theme of the subject is the human-home-environment relationship, how the built environment affects the natural environment and human health. It analyses the impact of the current civilisation crisis on nature and society. It presents the emergence of sustainable development and construction as a response to the environmental, social and economic crisis. It presents the building as an ecosystem within the framework of sustainable architecture and its typical problems, drawing parallels with the functioning of natural systems. In this context, it details the technical content and functioning of buildings, the climatic conditions of interiors, building energetics, building materials and structures. In this context, it discusses the possibilities of ecological design and building rehabilitation, including the principles of passive and other low-energy houses, and focuses on houses built using environmentally friendly technologies (earth and straw construction, timber buildings).

Curriculum Description:

Weeks	**Topics of Lectires and Practices**
1.	Lecture: Interconnectedness of scientific disciplines - current state of the biosphere (environmental crisis, climate change, global warming, biodiversity loss) and its consequences. Practice: Sustainable development - the unsustainability of sustainable architecture.
2.	Lecture: finding a way out - crisis management: principles and possibilities of model change, ecological thinking. Sustainable space and land use - sustainable retreat - nature, people, building. Practice: sustainable enterprises
3.	Lecture: building housekeeping - the science of building ecology - nature, building Air housekeeping - the science of building biology - man, building Practice: invited speaker
4.	Lecture: energy management - building energy ecology - Passive houses abroad and at home Practice: invited speaker
5.	Lecture: The basics of ecological design. Exercise: Mother house - ecological building materials, building structures.
6.	Lecture: Ecological building rehabilitation - A different approach to wood architecture. Practice: invited speaker
7.	Lecture: Earthen and straw construction technologies. Practical: invited speaker
8.	Student Presentations
9.	Student Presentations
10.	Student Presentations
11.	Student Presentations
12.	Student Presentations

13.	Student Presentations
14.	Student Presentations

Mid-semester requirements:

Attendance and methods of qualification:

Attendance at lectures and practises is compulsory (absence is allowed according to the TVSZ), presentation material (ppt) completed and presented to an acceptable level.
A preferential study regime for the subject can be requested ONLY if the conditions set out in § 29 of the TVSZ are fulfilled.

Professional competencies:

- Knowledge of major environmental technologies, equipment and structures associated with each technology, including the functioning and operation thereof.
- Knowledge of the basics of energy management, options for energy production, their advantages and disadvantages, as well as the concept and feasibility options of sustainable development.
- Able to perform public administrative and authority tasks related to environment protection after getting acquainted with the duty assigned to them.

Literature:

1. Eds.: Management Association, Renewable and Alternative Energy: Concepts, Methodologies, Tools, and Applications, IGI Global, 2016, ISBN13: 9781522516712
2. Ali Sayigh: Comprehensive Renewable Energy, 1st Edition, Imprint: Elsevier, Published Date: 2nd May 2012, Page Count: 4422, eBook ISBN: 9780080878737, Hardcover ISBN: 9780080878720
3. Michaelides, Efstathios E. Stathis: Alternative Energy Sources, Springer Press, 2012, Buy eBook, ISBN: 978-3-642-20951-2

Title of the course: **Knowledge of sustainability, environmental ethics**	**NEPTUN-code:** RKWFK1EBNF	**Weekly teaching hours:** l+cw+lw 2+0+0	**Credit:** 4 **Exam type**: e
Course leader: Rita Kendrovics-Boda, Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** -	

Curriculum:

The educational aim of the subject is to integrate environmental awareness into everyday activities and to show opportunities and methods for sustainability. To identify opportunities to consciously shape needs according to environmental expectations. Optimal use of available resources. Developing individual and community environmental awareness and orienting others towards environmental awareness. Students will learn about the principles of sustainability, and the semester assignments will help them to acquire the key competences of sustainability education. An important part of the course is to familiarise students with the environmental dependency of humans and human societies, the environmental, economic, and social problems that result from our environmental dependency and the ways to address them. The course addresses the moral problems of right human action towards living beings/nature within the disciplinary boundaries of bioethics. It introduces the economic, social, ethical, and ecological problems of globalisation; it describes the different theoretical orientations of ecophilosophy and eco-ethics (anthropocentric, pathocentric, biocentric and ecocentric ethics). It describes the basic principles of environmental ethics.

Curriculum Description:

Week	**Topics of lectures and practical works**
1.	The concept and main principles of sustainable development. UN Sustainable Development Goals (SDGs)
2.	Environmental indicators for sustainable development.
3.	Indicators of "well-being" - indicators of environmental quality.
4.	Energy consumption. Energy sources and their finiteness.
5.	Dilemmas of economic growth. The impact of innovation on our environment.
6.	Basics of circular economy.
7.	Domestic examples of circular economy. Case study.
8.	Engineering for sustainable development. - Eco-design.
9.	ESG is the sustainable business indicator. Case study.
10.	Smart cities. Case studies.
11.	Concept and trends in environmental ethics.
12.	Science and technology as an ethical problem.
13.	Ecopsychology - the links between environmental awareness, well-being and the natural environment.
14.	Summary, final test, end of semester

Mid-semester requirements:

Attendence:

Attendance at the lectures is compulsory. Project work must be prepared in groups, submitted in writing and presented orally.

Test papers, measurement records, reports, etc. (number, date):	
1.	Project work 1: Putting sustainable development into practice. Case study 15 points
2.	Project work 2: Applying sustainable development in engineering practice. Case study 15 points
3.	Project work 3: Science and technology as an ethical problem (essay max. 5 pages) 15 points
4.	Final test 55 points

Methods of qualification:

Attendance at lectures (according to the Education and Examination Regulations - TVSZ) and written and oral completion of case studies and essay group work are required for signature.

Examination: written exam maximum of 55 points, plus a maximum of 45 points for case studies completed during the semester. Total points achievable 100 points. Examination grading: 0-40 fail; 41-55 pass; 56-70 satisfactory; 71-85 good; 86-100 excellent.

If total points of the final test at the end of the semester plus the marks obtained in the case studies are min. 71, a proposed mark of examination may be obtained (good and excellent).

Professional competencies:

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- Knowledge of learning, knowledge acquisition and data collection methods, their ethical limitations and problem-solving techniques in the environmental field.
- Comprehensive knowledge of the basic characteristics and interrelationships of environmental elements and systems and the pollutants that affect them.
- Knowledge of the properties of environmental elements and their interactions.
- Ability to apply a holistic approach to environmental tasks environmental issues.
- Demonstrates responsible behaviour towards the environment.
- Multidisciplinary knowledge enables them to participate creatively in engineering work and to adapt to constantly changing requirements.

Literature:

1. Thompson Allen: The Oxford Handbook of Environmental Ethics, Oxford University Press Inc, 2019, ISBN: 9780190933388
2. Mackenzie Davis: Principles of Environmental Engineering & Science, McGraw-Hill Education, 2019, ISBN: 9781260548020
3. Emma Hutchinson - Sari Kovats: Environment, Health and Sustainable Development, Open University Press, 2017, ISBN:9780335245376
4. M.H. Fulekar - Bhawana Pathak - R K Kale: Environment and Sustainable Development, Springer Nature, 2014, ISBN: 978-8132211655

Title of the course: **Complex environmental engineering project work**	**NEPTUN-code:** RKWPR1ABNF	**Weekly teaching hours:** l+cw+lw 0+0+3	**Credit:** 5 **Exam type**: tm
Course leader: Rita Kendrovics-Boda, Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** RKXKE1ABNF, RKXKE2ABNF, RKXKE3ABNF, RKXKZRABNF, RKXKA1ABNF	

Curriculum:

The aim of the course is to enable students to apply the theoretical knowledge acquired in the vocational subjects and the theoretical knowledge acquired in the current semester in practice, by participating in field work and visits to factories. Sampling and measurements in the field and in the laboratory will provide students with experience that they can build on when solving problems in the future. The main aim of the course is to complement the high level theoretical scientific training by creating a competence-based environmental engineering education. During the semester, students will carry out research on a specific environmental problem in small groups (max. 4 students), guiding the workflow from problem identification to solution. At the end of the semester, they present their work to a professional committee, prepare a written report (detailed description of the work carried out) and an oral report (presentation to a professional committee), and prepare a portfolio. The field work also provides an opportunity for environmental education, thus shaping the students' ecological thinking and environmental awareness. The project work and research carried out by the students prepares the choice of the thesis topic. The research tasks and works can be continued as an independent thesis.

Curriculum Description:

Week	***General topics (specific weekly themes according to the content of the projects)***
1.	Discussion, creating group modules using the concept map.
2.	Formulating environmental problems, setting objectives and specific tasks.
3.	Task-related field visit, field work, assessment of conditions.
4.	Reporting of partial research results, discussion.
5.	Field visits, field measurements and sampling, measurements in the laboratory depending on the project topic.
6.	Factory visits, field work.
7.	Discussion of partial research results.
8.	Literature review, discussion, debate.
9.	Discussion on sustainability, analysing presentations given at the Mindentudás Egyeteme presentation series. Guided talk on sustainability.
10.	Field visits, sampling, laboratory testing of samples.
11.	Discussion of partial research results.
12.	Measurement in the laboratory, sampling, testing of samples, depending on the project.
13.	Discussion of the content of the reports, finalisation of the project programmes, preparation for the project closure (final project presentation).
14.	Final project presentation.

Mid-semester requirements:

Active participation in the chosen project, giving a solution of the problem chosen within the topic, presentation of the workflow and results to the committee at the end of the semester in the final project evaluation presentation. The grade obtained here is equivalent to a final mark.
Requirement:
- A written report of the semester's work,

- oral presentation on,
- portfolio of individual work.

Methods of qualification:

The basis for the grade:
- participation and activity in consultations,
- active participation in group work,
- active participation in fieldwork,
- the project report,
- presentation of research results to a professional committee.

The grade will be awarded based on these criteria, taking into account the following scores:
- final project presentation (oral presentation) jury score: 50 points,
- group work (written presentation): 25 points,
- individual work (portfolio): 25 points,

total 100 points (0-40 insufficient, 41-55 sufficient, 56-70 satisfactory, 71-85 good, 86-100 excellent).

Professional competencies:

- Knowledge of general and specific mathematical, natural, and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- Knowledge of the learning, knowledge acquisition, and data collection methods of the special fields of environment protection, their ethical limitations, and problem-solving techniques.
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Knowledge of the main methods to examine the quantity and quality features of environmental elements and systems, their typical measuring instruments, and limitations thereof, as well as methods for the evaluation of data measured.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.
- Open to professional cooperation with specialists related to their profession but involved in other areas.
- Taking responsibility towards society for their decisions made in the scope of environment protection.
- Cooperation with qualified experts from other special areas (primarily economic and legal) in the course of completing professional tasks.

Literature:

1. e-learning system’s curriculums

Title of course: Basics of EHS (Environmental, Health and Safety)	**NEPTUN-code:** RKWBT1EBNF	**Weekly teaching hours:** l+cw+lw 1+2+0	**Credit:** 4 **Exam type:** tm
Course leader: Lóránt Szabó, Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge: -**	

Curriculum:

The goals of the course are to make the prospective engineers know with work conditions that is safe and not harmful for the health in order to be able diagnosing dangers and apply measures for risks reduction based on their knowledge. The participants' rights and duty in triparty reconciliation. The concept of accidents and work accidents, the importance of investigation of work accidents. The goals, methodology and application of risk analysis of occupational safety and health (EHS). The role of ergonomics in EHS. The safe formation of work tools, dangers of maintenance, optimizing work environment in accordance with executed activity. Safety regulations for dangerous materials. Defensive capabilities of individual protective equipment that is used for reduction residual dangers of collective protection. Security technology of electricity, protection against electric shocks. Material handling and storage, security technology of pressure vessels. Concept and task of fire protection.

Curriculum Description:

Week of Semester	**Topics of lectures and practices**
1.	The history, concepts and regulation of occupational safety and health. Principles and practical applications of the OSH Act. Description of the purpose of the project tasks.
2.	Rights and obligations of employer and employee.
3.	Defining accident and accidents at work. Investigation of accidents at work.
4.	Purpose, methodology and application of occupational safety and health risk assessment.
5.	Chemical safety, reduction of environmental damage and occupational health and safety risks when handling dangerous substances. Presentation of the typical environmental and occupational safety risks of the chemicals used in the chosen technologies.
6.	Options of protection: importance of collective protection, types of personal protective equipment, choice, obligations.
7.	The importance of ergonomics in occupational safety. Safety of work equipment: built-in safety, protective equipment.
8.	The optimal design of the working environment. a. Characteristics of air pollution, optimal levels of climatic factors, ventilation methods.
9.	The optimal design of the working environment. b. Electromagnetic radiation, lighting of workplaces. c. Workplace noise and vibration characteristics.
10.	Electrical safety engineering. Physiological effects of electricity, first aid. Contact protection methods.
11.	Safety techniques for handling and storage of materials. Pitch of the project work.
12.	Pressure equipment design, hazards, fittings.
13.	Fire protection concepts and tasks. Fire safety rules, extinguishing fires. Final presentation on the project work.
14.	Evaluation of the semester, option for submitting the missed-out tasks.

Mid-semester requirements:

Attendance:

It is compulsory to be prepared for the practical sessions and to solve the test questions of the theoretical material.

Test papers, measurement records, reports, etc. (number, date):

Presentation of the project team's chosen topic (technology).

1. environmental
2. examining health and safety issues
3. submitting the project documentation

Successful completion of the final test.

Methods of qualification:

To receive a grade, the final test and the project assignment must be passed with at least a satisfactory level. The grade is based on the simple mathematical average of the 2 submissions.

Professional competencies:

- Knowledge of requirements and methods for health and safety, fire protection, safety engineering and remediation as related to the field of environment protection.
- Able to apply in practice as well the regulations and requirements of health and safety, fire protection, and safety engineering as related to their special field.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.
- Able to reveal deficiencies in the technologies applied and process risks and to initiate mitigation measures after getting familiarized with the technology concerned.
- Efforts to solve tasks and make management decisions by being aware of the opinions of the colleagues supervised, possibly in cooperation therewith**.**

Literature:

1. Gayle Woodside: Environmental, Health, and Safety Portable Handbook, ISBN: 978-0070718487
2. EHS directives
3. Forney Susan Zummo: Environmental Risk Communication, Taylor & Francis Ltd, 2021, ISBN: 9780367469771
4. Framework Directive 89/391/EEC

SUSTAINABLE LAND DEVELOPMENT, WATER MANAGEMENT SPECIALISATION

Title of the course: **Knowledge of land and urban development**	**NEPTUN-code:** RKWGT1EBNF	**Weekly teaching hours:** l+cw+lw 2+1+0	**Credit:** 5 **Exam type**: e
Course leader: Krisztina Demény Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge: -**	

Curriculum:

The subject synthesises the knowledge learned in the basic subjects of industry, agriculture, services, and the impact of urbanisation on the environment. It analyses the environmental impact of economic activity and the positive trends in technological development and the need for sustainable use of natural resources. It deals with the concept of sustainable development, the interpretation and feasibility of sustainability in relation to urban planning and development. Describes the concepts, aims and tasks of spatial and urban development, including basic knowledge of urban development. It describes the stages of development of settlements with the most important influencing factors, the historical development of settlement development, the practices used today at international and national level, and the main financial, legal, etc. instruments of those involved in settlement development.

Curriculum Description:

Weeks	**Topics of lectures and practices**
1.	The concept, aims and tasks of land/spatial and urban development; the relationship between land and urban development and spatial planning. Talking general topics, requirements
2.	The development of the settlement system in Hungary, the development of settlements, their impact factors (natural, social, economic)
3.	Settlement hierarchy (central functions, Christaller, Lösch, Vance models, rank-size rule)
4.	Urbanisation today, internal structure of cities (urban ecology models), characteristics of rural settlements
5.	Current settlement patterns in Hungary, trends in their development
6.	Participants and institutions in spatial and urban development
7.	Spatial planning for land and urban development.
8.	Financial instruments for spatial and urban development, EU support system
9.	Presentation of student project work I.
10.	Presentation of student project work I.
11.	Sustainable spatial and urban development, smart cities, liveable cities I – current issues, current challenges
12.	Sustainable spatial and urban development, smart cities, liveable cities II – current issues, current challenges
13.	Written test and evaluation of project work
14.	Replacement test

Mid-term requirements:

Participation in occupations:

Compulsory

Mid-terms, protocols, reports, etc.:

- Written test
- Project work
-

The method of obtaining a signature / mid-term mark:

Basis of marking: attendance at lectures and practice
Written test and project work min. = 2 (pass) (separately).

In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Exam: based on oral topics

Professional competencies:

- Knowledge of the general and specific mathematics, nature and social science policies, rules and coherencies, which are needed to cultivate the environmental protection field.
- Knowledge of the definitions of economy, environmental economy, project and environmental management, their devices in the field of environmental protection.
- Students will be able to assume administrative responsibilities and execute official tasks.
- They take responsibility for the made decisions in the field of environmental protection against society.
- During the execution professional work, the students cooperate other (primarily economic and legal) profession's trained specialists.
- They keep under review and endorse the legal, technical, technological, and administrative changes during their professional work.

Literature:

1. Tamás Csapó – András Balogh (2013): Development of the Settlement Network in the Central European Countries (Past, Present and Future), Springer
2. Rajiv R. Thakur, Ashok K. Dutt, Sudhir K. Thakur, George M. Pomeroy (2020): Urban and Regional Planning and Development (20th Century Forms and 21st Century Transformations), Springer
3. Eddie N. Laboy-Nieves, Fred C. Schaffner, Ahmed Abdelhadi, Mattheus F.A. Goosen: Environmental Management, Sustainable Development and Human Health, 2008 by CRC Press, ISBN 9780415469630
4. Human Settlement Development - Volume I Editor Saskia Sassen ISBN 978-1-84826-044-3
5. Sustainable Preservation Practices for Managing Storage Environments Funding provided by the National Endowment for the Humanities, Division of Preservation and Access, Education & Training Grant Program

Title of the course: Hydrology and hydraulics	**NEPTUN-code:** RKWHH1EBNF	**Weekly teaching hours:** l+cw+lw 1+2+0	**Credit:** 4 **Exam type**:e
Course leader: Lóránt Szabó, Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:** RKXKE1ABNF	

Curriculum:

The hydrographical conditions of the country, the natural water provision and the variability of water resources based on location and time. Domestic water management practices, the environmental effects which influence the natural waters. The hydrological basics of the water resource management. The water balance. The main elements of the hydrological cycle: rainfall, evaporation, infiltration, procession; measurement, adaptation and forecast of the previously mentioned factors. The hydrology of the diffuse and concentrated pollution in natural waters (assembling of the catchment, mixing and pollution spread). Stream laws, under pressure flow and the gravitational flow. Statics of the fluids – communicating vessels, Pascal's thesis. Fluid pressure on plane surfaces. The dynamical basics of movement of the fluids, flow line, streamline, humid coupon, fluid output, middle speed, hydraulic radius, continuity. Bernoulli's equation and equation of continuity, speed measurement with Pitot tube. Laminal and turbulent flow, the Reynolds number. The oozing low of Darcy.

Curriculum Description:

Training week	**Topics of lectures and practices**
1.	The hydrogeography of Hungary (Carpathian Basin), the development and evolution of the present-day water network
2.	Hydrology: definition, basics and tasks
3.	Hydrological cycle, water balance I: precipitation (theory, calculation and measurement)
4.	Hydrological cycle, water balance II: evaporation (theory, calculation and measurement)
5.	Hydrological cycle, water balance III: runoff and infiltration (theory, calculation and measurement)
6.	Diffuse and concentrated contamination of natural waters (surface and groundwater).
7.	Written test I. from hydrology
8.	Statics of the fluids. Density of substances.
9.	Pascal's thesis. Fluid pressure on plane surfaces. Force on dam.
10.	The dynamical basics of movement of the fluids, flow line, streamline, humid coupon, fluid output, middle speed, hydraulic radius.
11.	Bernoulli's equation and equation of continuity, speed measurement with Pitot-Prandtl tube.
12.	Determination of flow speed and mass by Venturi's tube.
13.	Laminal and turbulent flow, the Reynolds number. The oozing low of Darcy.
14.	Summary. Written test II. from hydraulics.

Participation in occupations:

Participation in occupations:
It is compulsory to attend the lectures. The rules of education and exam directory (TVSZ) are the guidelines.

Midterms, protocols, reports, etc.:
Two written tests minimum 40%→signature.

The method of obtaining a signature / mid-term mark:
Written exam test. Total points: 100 (2x50). Exam marks: 85-100%: excellent(5), 70-84%: good(4), 55-69%: average(3), 40-54%: pass(2), 0-39%: fail(1)

Professional competencies:

- Knowledge of water appearance forms, the characteristic of these in our country and their proportion. The students will be able to enumerate the elements of the water balance, also able to apply the water balance equation. Knowledge of the elements of the hydrological cycle and the principles of their measurement. The students will learn the main sources of pollutions in the natural waters, also the main processes of the spread of these pollutants.
- Knowledge of applying the energy equations for ideal and real fluids in simple calculation examples.
- The students will know the characteristics of the laminal and turbulent water flows and will be able to interpret and characterize the local and frictional energy losses. They will determine the pressure loss in a simple pipe system, furthermore the speed of the water and the water flow.

Literatures:

1. Prof. Dawei Han: Concise Hidrology, 2010, DaweiHan&bookboon.com (download free eBooks at bookboon.com)
2. Raymond A. S., John W. J.: Physics for Scientists and Engineers with Modern Physics, 2004 6th and 9th edition
3. Prasuhn, Alan L. Fundamentals of Hydraulic Engineering. Holt, Rinehart, and Winston: New York, 1987.
4. Cassidy, John J., Chaudhry, M. Hanif, and Roberson, John A. "Hydraulic Engineering", John Wiley & Sons, 1998
5. E. John Finnemore, Joseph Franzini "Fluid Mechanics with Engineering Applications", McGraw-Hill,2002
6. Lóránt Szabó: Physics for students of engineering (electronic book)
7. Further reading can be used: Vincent J. Zipparro, Hans Hasen (Eds), Davis' Handbook of Applied Hydraulics, Mcgraw-Hill, 4th Edition (1992)

Title of the course: **Spatial water planning, protection, and regulation of the aquatic environment**	**NEPTUN-code:** RKWVJ1EBNF	**Weekly teaching hours:** l+cw+lw 2+1+0	**Credit:** 4 **Exam type**: e
Course leader: Zoltán Juvancz Prof.	**Position:** Professor Emeritus	**Required preliminary knowledge: -**	

Curriculum:

Types of water habitats. The types and treatment of river stream regulation. Types of still waters (natural and artificial), and its protection and treatment possibilities. Type of founts, fens, swamps and reeds, its protection and treatment. The domestic water habitats reconstruction in significance of nature protection and its condition on international aspect. Floodplain management.
Lowland, hilly-country regulations (tasks, methods, interventions, possibilities).
The protection and usage of the superficial and groundwaters and its legal control.

Curriculum Description:

Weeks	**Topics of lectures and practices**
1.	The development of the water network of Hungary (Carpathian Basin). Talking general topics, requirements
2.	Wetlands: Types, characteristics and importance
3.	Conservation of wetland habitats, their role in nature conservation
4.	Floodplain management
5.	Lowland regulation (methods, interventions of surface water and groundwater)
6.	Hilly-country regulation (slope soil protection, gully drainage, valley bottom drainage, valley bottom land management) I.
7.	Presentation of student project work I.
8.	Presentation of student project work I.
9.	Hilly-country regulation (slope soil protection, gully drainage, valley bottom drainage, valley bottom land management) II.
10.	River management
11.	Settlement water management (tasks, interventions)
12.	Legal regulation of surface and groundwaters
13.	EU WFD (Water Frame Directive)
14.	Evaluation of project work

Mid-term requirements

Participation in occupations:

Compulsory

Mid-terms, protocols, reports, etc.:

Project work

The method of obtaining a signature / mid-term mark:

Basis of marking: attendance at lectures and practice
Project work min. = 2 (pass)

In case of mid-semester mark fail (1), correction opportunities are available according to 17§(6) of Education and Examination Regulations (TVSZ).

Exam: based on oral topics

Professional competencies:

- Knowledge of the forms and peculiarity of the water habitats, their demands and possibilities.
- Knowledge of the treatment and utilization of the water habitats, their environmental aspects, the ongoing processes, the roe of nature protection to preserve water habitats.
- The students will be able to interpretate and apply independent the legalisation of the specialization, furthermore they will know the legal requirements of water protection.
- They will become committed to the environment and nature protection, and also to the sustainable resource utilization.

Literature:

1. P. S. Maitland, N. C. Morgan (1997): Conservation Management of Freshwater Habitats (Lakes, rivers and wetlands), Springer Netherlands
2. Hurford, Clive, Schneider, Michael, Cowx, Ian (Eds.) (2010): Conservation Monitoring in Freshwater Habitats (A Practical Guide and Case Studies), Springer
3. Paul Mac Berthouex, Linfield C. Brown (2013): Pollution, Prevention and Control: Part I. Human health and Environmental Quality, Paul Mac Berthouex, Linfield C. Brown&bookboon.com
4. Michael Kidd, Loretta Ferus, Tumai Murando and Alejandro Iza (2019): Water and the Law: Towards Sustainability (IUCN Academy of Environmental Law series) .pdf, E-book

Title of the course: **Watershed and stormwater management**	**NEPTUN-code:** RKWCG1EBNF	**Weekly teaching hours:** l+cw+lw 2+2+0	**Credit:** 5 **Exam type**:e
Course leader: Rita Kendrovics Boda Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** RKXKE1ABNF	

Curriculum:

„Water Framework Directive" and „River Basin Plan". The effect of urbanization on the hydrological circular process and its connection with the natural circular process. Flow, covert areas, and greeneries effects in the life of settlements. Water demands (social, ecological, and natural demands). Drinking water demand, usage demand, immediate and indirect demands, virtual demand. Moisture proportion. The quality and quantity characterisation of the flow. Moisture economy. The effects of climate change on the settlement hydrological circular process.

Curriculum Description:

Week of Semester	**Topics of Lectures and Practices**
1.	The concept and development of integrated river basin management, the Water Framework Directive, and the River Basin Management Plan. A strategic approach to urban stormwater management.
2.	Hydrological characterisation of the river basin. Quantitative and qualitative characterisation of runoff.
3.	Impact of urbanisation on the hydrological cycle. Climatic impacts.
4.	Laws of precipitation; runoff, paved surfaces, green surfaces, environmental impacts of urban areas.
5.	Effect of climate change on precipitation. The water balances. Task 1: Calculate the water balance.
6.	Determining the amount of precipitation, measurement, analysing the data.
7.	Determination of precipitation load, its effects, and methods to reduce it. Drainage and collection of rainwater. Urban drainage systems and integrated management.
8.	Stormwater quality, pollutant sources and pathways, changes in pollutant quantity.
9.	Stormwater quality management.
10.	Role of green infrastructure - storage, retention. Local regulation.
11.	Task 2: Design of domestic stormwater demand, collection, and sizing of storage. Sizing a rainwater harvester for a house.
12.	Options for local storage and/or domestic use of stormwater. Task 3: Rainwater harvesting inside and outside buildings - collecting practical examples - field work.
13.	Final test.
14.	Summary, evaluation of the assignments through the semester.

Mid-semester requirements:

Attendance:

Attendance at lectures and exercises is compulsory.

Test papers, measurement records, reports, etc. (number, date):

1.	Task 1 – 15 points
2.	Task 2 – 15 points
3.	Task 3 – 15 points
4.	Test – 55 points

Methods of qualification:

Each task and the test should be completed at least 40%.
Oral exam based on the pre-assigned topics. Examination grade offered based on the results of the mid-term assignments and the final examination.

Professional competencies:

- The students know the catchment-economy and the definition of the integrated water management and its principles, furthermore they know the main domestic water economy tasks.
- Knowledge of the settlement's main hydrological parameters, the possible effect of the climate change on the water management and the condition of the rainwater drainage in the inner-city areas.
- The knowledge of the possible technological solutions of the rainwater drainage and the quality of the rainwater, furthermore the recovery regulations.
- The students will be able to cooperate other professions trained experts in their own field. They keep under review and endorse the legal, technical, technological, and administrative changes during their professional work.

Literature:

1. Walter Lükenga: Water Resource Management, free download from bookboon.com
2. Watershed Hydrology Management and Modelling
3. David A. Lloyd Owen (2018): Smart Water Technologies and Techniques: Data Capture and Analysis for Sustainable Water Management, WILEY Blackwell,
4. Walter Leal Filho (2012): Climate Change and the Sustainable Use of Water Resources, Springer-Verlab Berlin Heidelberg
5. Stormwater Management Guide https://info.buildingsolutions.com/hubfs/Stormwater-Management-Guide.pdf
6. Hlavínek, Petr, Zelenáková, Martina (2015): Storm Water Management, Springer

Title of the course: **Water utility distribution and urban drainage**	**NEPTUN-code:** RKWVH1EBNE	**Weekly teaching hours:** l+cw+lw 2+1+0	**Credit:** 5 **Exam type**: tm
Course leader: Rita Kendrovics Boda Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** -	

Curriculum:

The tasks of the drainages and its orders are also conventional and improved systems. Municipal and regional drainage. The EU directives connected to sewerage, the Water Framework Directive and the Settlement Wastewater Directive, wastewater agglomerations. The drainage systems in settlements and industrial plants and their effects on the wastewater treatment. The connection of the drainage and the wastewater treatments. The effects of climate change on the sewerage systems. The design and the parts of drainage systems. Typical operating conditions. The scaling of the drainage systems, the integrated drainage and drainage management. The operational questions of drinking water supply.

Curriculum Description:

Week of Semester	**Topics of Lectures and practices**
1.	The water supply function, water supply networks. Requirements for water supply networks.
2.	Characteristics of water consumption. Measurement of water consumption. Operational aspects of drinking water supply.
3.	Connection to public water supply, plumbing fittings and equipment.
4.	Sizing aspects of the water supply network. Task 1
5.	EU Directives, Water Framework Directive, Urban Wastewater Directive.
6.	Urban drainage systems. Sewerage network, design aspects.
7.	General rules for sewage and storm water drainage. Impact of climate change on drainage systems.
8.	Sewer sizing with calculations, diagrams. Calculating the metering loads. Task 2
9.	Typical operating conditions of sewerage systems. Ventilation solutions for sewer networks.
10.	Sewerage systems fittings.
11.	Sizing of storm water network. Principles of sizing, basic data, main concepts. Task 3.
12.	Wastewater collection and recovery.
13.	Modern materials in water supply and sewerage networks.
14.	Final test.

Mid-semester requirements:

Attendance:

Attendance at lectures is compulsory.

Test papers, measurement records, reports, etc. (number, date):

1. Task 1 – 15 points
2. Task 2 – 15 points
3. Task 3 – 15 points
4. Test – 55 points

Methods of qualification:

The assignments and the final test are graded separately and should be at least 40%.
Total points available: 100 points.
Grades: 0-40 insufficient; 41-55 sufficient; 56-70 satisfactory; 71-85 good; 86-100 excellent.

Professional competencies:

- Knowledge of the important characteristic of the piped public utilities, their connections taxonomy and design basic knowledge in the water supply sector.
- Knowledge of the design and operation aspects of the settlement public utilities.
- Knowledge of the domestic and international directives related to sewerage.
- The students will have the basic knowledge needed for carry out integrated water management.

Literature:

1. Subhash Verma, Varinder Kanwer, Siby John (2015): Water supply Engineering, VIKAS Publishing Hous
2. Rangwala: Water Supply and Sanitary Engineering, e-book, free download
3. Mihret Dananto Ulsido (2013): Water Supply and Urban Drainage Engineering, LAMBERT Academic Publishing
4. Ernest W.Steel, Terence J.McGhee: Water supply and sewerage, book free download by EasyEngineering.net

Title of the course: **Wastewater and sewage sludge management and recycling**	**NEPTUN-code:** RKWSZ1EBNF	**Weekly teaching hours:** l+cw+lw 2+1+0	**Credit:** 5 **Exam type**:tm
Course leader: Imre Biczó Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge:** RKXKM1ABNF	

Curriculum:

The recycling of the used water. The European and domestical requirements of the wastewater treatment. The undrained areas wastewater emplacement, local and individual installations.
The recycling of wastewater slit – biogas recycling and agricultural recovery. The possibility of using wastewater slit, the European and domestic regulations and conditions of the possible placements. The choice of slit treatment in the light of the placement and utilization. The wager and treatment of the settlement fluid wastes.

Curriculum Description:

Weeks	**Topics of lectures and practices:**
1.	Fundamentals of recirculating water management - Sustainable water management.
2.	Options and requirements for treated wastewater recycling.
3.	Sewage sludge generation and composition.
4.	Technological elements of sludge treatment - thickening, conditioning, stabilisation, disinfection. Sizing exercise 1: Sizing of digesters
5.	Reducing the moisture content of sludge - dewatering by natural means, mechanical dewatering (centrifuge, press belt, chamber filter press, vacuum dewatering. Sizing exercise 2: Sizing of a continuous gravity thickener
6.	Reducing the moisture content of sludge - treatment with polyelectrolyte, lime, drying, incineration.
7.	Site visit - sludge thickening, dewatering.
8.	Preparation for agricultural use. Measurement task 3: Determine the annual sewage sludge load based on N content, determine the area needed.
9.	Sewage sludge as a raw material for compost. Agricultural disposal of sludge.
10.	Preparation and pre-treatment of sewage sludge for landfill. Sludge incineration.
11.	Other potential uses of sewage sludge.
12.	Site visit - see sludge composting, disposal, recovery.
13.	Technical and economic conditions for the transport of sludge.
14.	Written exam

Mid-semester requirements:

Attendance:

Attendance at the lectures is compulsory. Project work must be prepared in groups, submitted in writing and presented orally.

Test papers, measurement records, reports, etc. (number, date):

1.	Task 1	15 points
2.	Task 2	15 points
3.	Task 3	15 points
4.	Written exam	55 points

Methods of qualification:

Tasks separately min. 40% level. Final examination min. at least 40%.
Total points available 100 points. Intermediate grade: 0-40 unsatisfactory; 41-55 satisfactory; 56-70 intermediate; 71-85 good; 86-100 excellent.

Professional competencies:

- Knowledge of the main technologies for environmental protection and recycling, the devices within the given field of technology, how to operate and maintain them.
- Knowledge of exploring the deficiencies of the applied technologies, the risks of the procedures and launch the making of the decreasing policies.
- To know the domestic and international regulations for this field of science, their connections and the main elements of the regional water management.

Literature:

1. Donald L. Rowe, Isam Mohammed Abdel-Magid (1995): Handbook of Waste Water Reclamation and Reuse, CRC Press\Lewis Publishers
2. Paul Bishop (1995): Municipal Sewage Sludge: Management, Processing and Disposal, Publisher CRC Press
3. EPA:Preparing Sewage Sludge For Land Application Or Surface Disposal, free download as ebook
4. Juan M. Lema, Sonia Suarez Martinez (2017): Innovative Wastewater Treatment & Resource Recovery Technologies: Impacts on Energy, Economy and Environment, ebook: www.iwaponline.com

Title of the course: **Knowledge of sustainability, environmental ethics**	**NEPTUN-code:** RKWFK1EBNF	**Weekly teaching hours:** l+cw+lw 2+0+0	**Credit:** 4 **Exam type**: e
Course leader: Rita Kendrovics-Boda, Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** -	

Curriculum:

The educational aim of the subject is to integrate environmental awareness into everyday activities and to show opportunities and methods for sustainability. To identify opportunities to consciously shape needs according to environmental expectations. Optimal use of available resources. Developing individual and community environmental awareness and orienting others towards environmental awareness. Students will learn about the principles of sustainability, and the semester assignments will help them to acquire the key competences of sustainability education. An important part of the course is to familiarise students with the environmental dependency of humans and human societies, the environmental, economic, and social problems that result from our environmental dependency and the ways to address them. The course addresses the moral problems of right human action towards living beings/nature within the disciplinary boundaries of bioethics. It introduces the economic, social, ethical, and ecological problems of globalisation; it describes the different theoretical orientations of ecophilosophy and eco-ethics (anthropocentric, pathocentric, biocentric and ecocentric ethics). It describes the basic principles of environmental ethics.

Curriculum Description:

Week	**Topics of lectures and practical works**
1.	The concept and main principles of sustainable development. UN Sustainable Development Goals (SDGs)
2.	Environmental indicators for sustainable development.
3.	Indicators of "well-being" - indicators of environmental quality.
4.	Energy consumption. Energy sources and their finiteness.
5.	Dilemmas of economic growth. The impact of innovation on our environment.
6.	Basics of circular economy.
7.	Domestic examples of circular economy. Case study.
8.	Engineering for sustainable development. - Eco-design.
9.	ESG is the sustainable business indicator. Case study.
10.	Smart cities. Case studies.
11.	Concept and trends in environmental ethics.
12.	Science and technology as an ethical problem.
13.	Ecopsychology - the links between environmental awareness, well-being and the natural environment.
14.	Summary, final test, end of semester

Mid-semester requirements:

Attendence:

Attendance at the lectures is compulsory. Project work must be prepared in groups, submitted in writing and presented orally.

Test papers, measurement records, reports, etc. (number, date):	
1.	Project work 1: Putting sustainable development into practice. Case study 15 points
2.	Project work 2: Applying sustainable development in engineering practice. Case study 15 points
3.	Project work 3: Science and technology as an ethical problem (essay max. 5 pages) 15 points
4.	Final test 55 points

Methods of qualification:

Attendance at lectures (according to the Education and Examination Regulations - TVSZ) and written and oral completion of case studies and essay group work are required for signature.

Examination: written exam maximum of 55 points, plus a maximum of 45 points for case studies completed during the semester. Total points achievable 100 points. Examination grading: 0-40 fail; 41-55 pass; 56-70 satisfactory; 71-85 good; 86-100 excellent.

If total points of the final test at the end of the semester plus the marks obtained in the case studies are min. 71, a proposed mark of examination may be obtained (good and excellent).

Professional competencies:

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- Knowledge of learning, knowledge acquisition and data collection methods, their ethical limitations and problem-solving techniques in the environmental field.
- Comprehensive knowledge of the basic characteristics and interrelationships of environmental elements and systems and the pollutants that affect them.
- Knowledge of the properties of environmental elements and their interactions.
- Ability to apply a holistic approach to environmental tasks environmental issues.
- Demonstrates responsible behaviour towards the environment.
- Multidisciplinary knowledge enables them to participate creatively in engineering work and to adapt to constantly changing requirements.

Literature:

5. Thompson Allen: The Oxford Handbook of Environmental Ethics, Oxford University Press Inc, 2019, ISBN: 9780190933388
6. Mackenzie Davis: Principles of Environmental Engineering & Science, McGraw-Hill Education, 2019, ISBN: 9781260548020
7. Emma Hutchinson - Sari Kovats: Environment, Health and Sustainable Development, Open University Press, 2017, ISBN:9780335245376
8. M.H. Fulekar - Bhawana Pathak - R K Kale: Environment and Sustainable Development, Springer Nature, 2014, ISBN: 978-8132211655

Title of the course: **Complex environmental engineering project work**	**NEPTUN-code:** RKWPR1ABNF	**Weekly teaching hours:** l+cw+lw 0+0+3	**Credit:** 5 **Exam type**: tm
Course leader: Rita Kendrovics-Boda, Ph.D.	**Position:** associate professor	**Required preliminary knowledge:** RKXKE1ABNF, RKXKE2ABNF, RKXKE3ABNF, RKXKZRABNF, RKXKA1ABNF	

Curriculum:

The aim of the course is to enable students to apply the theoretical knowledge acquired in the vocational subjects and the theoretical knowledge acquired in the current semester in practice, by participating in field work and visits to factories. Sampling and measurements in the field and in the laboratory will provide students with experience that they can build on when solving problems in the future. The main aim of the course is to complement the high level theoretical scientific training by creating a competence-based environmental engineering education. During the semester, students will carry out research on a specific environmental problem in small groups (max. 4 students), guiding the workflow from problem identification to solution. At the end of the semester, they present their work to a professional committee, prepare a written report (detailed description of the work carried out) and an oral report (presentation to a professional committee), and prepare a portfolio. The field work also provides an opportunity for environmental education, thus shaping the students' ecological thinking and environmental awareness. The project work and research carried out by the students prepares the choice of the thesis topic. The research tasks and works can be continued as an independent thesis.

Curriculum Description:

Week	***General topics (specific weekly themes according to the content of the projects)***
1.	Discussion, creating group modules using the concept map.
2.	Formulating environmental problems, setting objectives and specific tasks.
3.	Task-related field visit, field work, assessment of conditions.
4.	Reporting of partial research results, discussion.
5.	Field visits, field measurements and sampling, measurements in the laboratory depending on the project topic.
6.	Factory visits, field work.
7.	Discussion of partial research results.
8.	Literature review, discussion, debate.
9.	Discussion on sustainability, analysing presentations given at the Mindentudás Egyeteme presentation series. Guided talk on sustainability.
10.	Field visits, sampling, laboratory testing of samples.
11.	Discussion of partial research results.
12.	Measurement in the laboratory, sampling, testing of samples, depending on the project.
13.	Discussion of the content of the reports, finalisation of the project programmes, preparation for the project closure (final project presentation).
14.	Final project presentation.

Mid-semester requirements:

Active participation in the chosen project, giving a solution of the problem chosen within the topic, presentation of the workflow and results to the committee at the end of the semester in the final project evaluation presentation. The grade obtained here is equivalent to a final mark.
Requirement:
- A written report of the semester's work,

- oral presentation on,
- portfolio of individual work.

Methods of qualification:

The basis for the grade:
- participation and activity in consultations,
- active participation in group work,
- active participation in fieldwork,
- the project report,
- presentation of research results to a professional committee.

The grade will be awarded based on these criteria, taking into account the following scores:
- final project presentation (oral presentation) jury score: 50 points,
- group work (written presentation): 25 points,
- individual work (portfolio): 25 points,

total 100 points (0-40 insufficient, 41-55 sufficient, 56-70 satisfactory, 71-85 good, 86-100 excellent).

Professional competencies:

- Knowledge of general and specific mathematical, natural, and social scientific principles, rules, relations, and procedures as required to pursue activities in the special field of environment protection.
- Knowledge of the learning, knowledge acquisition, and data collection methods of the special fields of environment protection, their ethical limitations, and problem-solving techniques.
- Comprehensive knowledge of the basic features and interrelations of environmental elements and systems, as well as of the environmentally harmful substances affecting them.
- Knowledge of the main methods to examine the quantity and quality features of environmental elements and systems, their typical measuring instruments, and limitations thereof, as well as methods for the evaluation of data measured.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.
- Open to professional cooperation with specialists related to their profession but involved in other areas.
- Taking responsibility towards society for their decisions made in the scope of environment protection.
- Cooperation with qualified experts from other special areas (primarily economic and legal) in the course of completing professional tasks.

Literature:

2. e-learning system’s curriculums

Title of course: **Basics of EHS (Environmental, Health and Safety)**	**NEPTUN-code:** RKWBT1EBNF	**Weekly teaching hours:** l+cw+lw 1+2+0	**Credit:** 4 **Exam type:** tm
Course leader: Lóránt Szabó, Ph.D.	**Position:** senior lecturer	**Required preliminary knowledge: -**	

Curriculum:

The goals of the course are to make the prospective engineers know with work conditions that is safe and not harmful for the health in order to be able diagnosing dangers and apply measures for risks reduction based on their knowledge. The participants' rights and duty in triparty reconciliation. The concept of accidents and work accidents, the importance of investigation of work accidents. The goals, methodology and application of risk analysis of occupational safety and health (EHS). The role of ergonomics in EHS. The safe formation of work tools, dangers of maintenance, optimizing work environment in accordance with executed activity. Safety regulations for dangerous materials. Defensive capabilities of individual protective equipment that is used for reduction residual dangers of collective protection. Security technology of electricity, protection against electric shocks. Material handling and storage, security technology of pressure vessels. Concept and task of fire protection.

Curriculum Description:

Week of Semester	**Topics of lectures and practices**
1.	The history, concepts and regulation of occupational safety and health. Principles and practical applications of the OSH Act. Description of the purpose of the project tasks.
2.	Rights and obligations of employer and employee.
3.	Defining accident and accidents at work. Investigation of accidents at work.
4.	Purpose, methodology and application of occupational safety and health risk assessment.
5.	Chemical safety, reduction of environmental damage and occupational health and safety risks when handling dangerous substances. Presentation of the typical environmental and occupational safety risks of the chemicals used in the chosen technologies.
6.	Options of protection: importance of collective protection, types of personal protective equipment, choice, obligations.
7.	The importance of ergonomics in occupational safety. Safety of work equipment: built-in safety, protective equipment.
8.	The optimal design of the working environment. a. Characteristics of air pollution, optimal levels of climatic factors, ventilation methods.
9.	The optimal design of the working environment. b. Electromagnetic radiation, lighting of workplaces. c. Workplace noise and vibration characteristics.
10.	Electrical safety engineering. Physiological effects of electricity, first aid. Contact protection methods.
11.	Safety techniques for handling and storage of materials. Pitch of the project work.
12.	Pressure equipment design, hazards, fittings.
13.	Fire protection concepts and tasks. Fire safety rules, extinguishing fires. Final presentation on the project work.
14.	Evaluation of the semester, option for submitting the missed-out tasks.

Mid-semester requirements:

Attendance:

It is compulsory to be prepared for the practical sessions and to solve the test questions of the theoretical material.

Test papers, measurement records, reports, etc. (number, date):

Presentation of the project team's chosen topic (technology).

1. environmental
2. examining health and safety issues
3. submitting the project documentation

Successful completion of the final test.

Methods of qualification:

To receive a grade, the final test and the project assignment must be passed with at least a satisfactory level. The grade is based on the simple mathematical average of the 2 submissions.

Professional competencies:

- Knowledge of requirements and methods for health and safety, fire protection, safety engineering and remediation as related to the field of environment protection.
- Able to apply in practice as well the regulations and requirements of health and safety, fire protection, and safety engineering as related to their special field.
- Able to participate creatively in engineering work based on their multidisciplinary skills, as well as to adapt to continuously changing circumstances.
- Able to reveal deficiencies in the technologies applied and process risks and to initiate mitigation measures after getting familiarized with the technology concerned.
- Efforts to solve tasks and make management decisions by being aware of the opinions of the colleagues supervised, possibly in cooperation therewith**.**

Literature:

5. Gayle Woodside: Environmental, Health, and Safety Portable Handbook, ISBN: 978-0070718487
6. EHS directives
7. Forney Susan Zummo: Environmental Risk Communication, Taylor & Francis Ltd, 2021, ISBN: 9780367469771
8. Framework Directive 89/391/EEC

CRITERIA

Title of the course: **Mentoring**	**NEPTUN-code:** RKIPTKEBNF	**Weekly teaching hours:** l+cw+lw 0+1+0	**Credit:** 0 **Exam type**: s
Course leader: Lajos Norbert Berecz	**Position:** assistant lecturer	**Required preliminary knowledge:** -	

Curriculum:

The aim of the patronage teaching system is to help first-year students integrate into university education and support them in continuing their studies successfully. Ongoing contact with students helps to solve problems that arise during their studies. The aim of the sessions and discussions is to introduce the structure of the University, the main departments, the life of the student organisations and, above all, to help students find their way around the regulations.

Curriculum Description:

Week	Topics of practical works
1.	The purpose of the patronage system, basic differences between secondary school and university studies. Information on the Disability Equality Committee (assistance to those concerned, organisation of mentors).
2.	Getting to know each other: brief introduction of the students.
3.	Subjects and their requirements: overview of curricula content, importance of prerequisites (specifics of online and blended courses).
4.	Presentation of the faculty (RKK) and institute websites, information accessibility and tracking. Use of Moodle system, facilitating online learning, the importance of regularity.
5.	Consultation opportunities. Knowledge of learning methods, importance of meeting deadlines, repeat options.
6.	Presentation of students' study and research organisations (e.g. College of Integrated Sciences), Student mobility: Erasmus, IAESTE, IASEC, CC USA. Representatives of student organisations introduce their organisations.
7.	Visit to the university's surroundings, professional theme visits (e.g. exhibition, educational trail, labs).
8.	Current issues, preparation for final exams, the importance of peer support between students. University communication: drafting and sending letters and requests.
9.	Fee payment obligations, preparation for the necessary transfers, available scholarships, applications, other funding opportunities, invitation of a representative from the Study Office.
10.	Issues related to training, education, getting to know senior students.
11.	Opportunities for professional development outside the classroom (TDK, internships, project work) by inviting a member of the Library staff.
12.	The role and importance of student feedback about lecturers.
13.	How to register for exams, options. Summary of experiences and opinions.
14.	End-of-semester final meeting with senior students.

Mid-semester requirements:

Attendence:

Attendance at the meetings is compulsory.

Methods of qualification:

Attendance at the sessions is pre-requisite for the signature, absence in compliance with the Education and Examination Regulations - TVSZ.

Professional competencies:

- Know the relationship between individual, pair and group learning and the functioning of learning communities.
- Ability to participate in the management of a learning organisation in a supportive and guided way.
- Ability to independently develop a self-critical plan based on the knowledge required for a career,
- skills and attitudes, based on the learning outcomes of the occupation.
- He/she is ready to continuously seek supportive resources, to develop his/her professional responsibility and knowledge.
- Ability to work on a project basis, with a collaborative approach based on the division of labour.
- ability to work in a collaborative environment, sees individual contributions to shared success.
- Open to research-based problem solving.

Literature:

1. Education and Examination Regulations and other Regulations