Course Descriptions for the Joint Study Programme
"International Master of Science in Engineering, Entrepreneurship and Resources (MSc. ENTER)

Version 07.2024

Courses at **University of Miskolc**
with the Specialization "**Environmental Engineering" with the focus on Waste Management**

Module Name	**Environmental geology**
ECTS Credits	**4**
Responsible	Dr. Ferenc Mádai, PhD, associate professor
Duration	1st semester
Teaching Language	English
Learning Outcome (Competencies)	The main objective of the course is to make the students familiar with the effects of geological medium on the state and changes of the environment, and prepare them for revealing the geological background of environmental problems as well as mitigating or minimizing these problems. **Competencies to evolve:** T1 - The environmental engineer knows, and apply the scientific and technical theory, and practice. K1 – The environmental engineer is able to apply the acquired general, specific rules, contexts, processes, and principles of mathematical-, natural-, and social sciences. K2 – The environmental engineer is able to publish, and negotiate in his/her specialization, using his/her mother language, and at least one foreign language. A1 – Open and receptive to the knowledge and acceptance of professional, technological development and innovation in the field of environmental protection, and its authentic mediation. F1 – Can solve environmental engineering tasks independently, takes decisions carefully, in consultation with the representatives of other (mainly legal, economic, energy) fields, independently, takes responsibility for the decisions. F4 – Shares the acquired knowledge and experience with formal, non-formal and informal information transfer with practitioners in their field.
Contents	System approach in geology, changes in the four main systems of the Earth. The objects, methods and legal background of environmental geology. Environmental minerals, their characteristics and role in causing and mitigating of environmental problems. Geological hazards (volcanism, earthquakes, mass movements). The role of geological medium in the anthropogenic contamination and pollution (processes of environmental geochemistry, interactions between soil, rocks and contamination, geological conditions effecting on the spreading of contamination). Geological and geochemical concerns of the effects of mining on the environment. Geological background

	of the radioactive waste disposal. Geology in nature protection. Geological tasks in the environmental assessment. Practical work: self-made solutions of simple case-study problems.
Teaching Methods	Lecture: 2 contact hours per week Seminar: 1 contact hour per week
Pre-requisites	Not mentioned
Assessment Methods	Exam Students will be assessed with using the following elements. Attendance 15 % Individual report 10 % Midterm exam 40 % Final exam 35 % Total 100%
Grading	Grading scale: % value Grade 90 -100% 5 (excellent) 80 – 89% 4 (good) 70 - 79% 3 (satisfactory) 60 - 69% 2 (pass) 0 - 59% 1 (failed)
Materials/literature	F. G. Bell: Geological Hazards: their assessment, avoidance and mitigation. E & FN Spon, London, 1999 L. W. Lundgren: Environmental Geology. Prentice-Hall Inernational, London, 1999. C. W. Montgomery: Environmental Geology. McGraw-Hill Companies, Boston, New York, San Francisco, 2005
Note	Compulsory

Module Name	**Basics of environmental processing**
ECTS Credits	**2**
Responsible	Prof. Dr. József Faitli habilitated doctor, PhD, DSc, professor
Duration	1st semester
Teaching Language	English
Learning Outcome (Competencies)	Environmental processing deals with the processes, machines and technologies of cleaning and keeping clean the air, water and soil. The aim of the course is let the students learn the mainly mechanical processing theoretical and practical fundamental knowledge necessary for the design, sizing and operation of the processes, machines and technologies of environmental processing. **Competencies to evolve:** T1 - The environmental engineer knows, and apply the scientific and technical theory, and practice. K1 – The environmental engineer is able to apply the acquired general, specific rules, contexts, processes, and principles of mathematical-, natural-, and social sciences. Active professional English language skills.

	A1 – Open and receptive to the knowledge and acceptance of professional, technological development and innovation in the field of environmental protection, and its authentic mediation. A2 – Assumes the professional and moral values related to the field of environmental protection. A3 – Seeks to plan and carry out tasks independently or in a working group at a professional level. F1 – Can solve environmental engineering tasks independently, takes decisions carefully, in consultation with the representatives of other (mainly legal, economic, energy) fields, independently, takes responsibility for the decisions. F3 – Takes the initiative in solving environmental problems, identifies the shortcomings of the applied technologies, the risks of the processes and initiates the measures to reduce them. F4 – Shares the acquired knowledge and experience with formal, non-formal and informal information transfer with practitioners in their field.
Contents	Physical characterization of coarse disperse systems. Rheological properties of one- and multiphase media. Steady-state and unsteady-state particle motion in Newtonian and non-Newtonian media. Motion of particles bulks. Flow through a particles bulk. Permeability tests. Particle motion in electrostatic field. Particle motion in centrifugal field. Forming of bubbles in liquids and their motion. Forming of droplets in gases and their motion. *Phase separation of solid – liquid coarse disperse systems.* Liquid bonds in particulate materials. Solid – liquid phase separation by mechanical processes. Settling in gravitational and centrifugal fields. Filtration in gravitational and centrifugal fields and by pressure difference supplied by pumps. Solid – liquid phase separation by pressing. *Phase separation of solid – gas coarse disperse systems* in gravitational, centrifugal and electrostatic fields. Phase separation of solid – gas coarse disperse systems by the application of filtering media and the wet dust separation.
Teaching Methods	Lecture: 1 contact hour per week Seminar: 1 contact hour per week
Pre-requisites	Not mentioned
Assessment Methods	Practical mark (exam. / pr. mark. / other) **Assessment and grading** Requirements of the practical mark: Less than 20 % class missing; Presenting the laboratory measurements reports; Writing the classroom test successfully **Assessment:** Five grades scale Assessment according to a five grade scale: Missing basic knowledge – unacceptable Student demonstrates basic knowledge – acceptable Student demonstrates basic knowledge and can apply it in practice – intermediate Student demonstrates system level knowledge in contexts – good Student demonstrates outstanding system level knowledge in contexts - excellent
Grading	88 – 100: excellent (5), 75 – 87: good (4), 63 – 74: intermediate (3), 51 – 62: acceptable (2), ≤50: unacceptable (1).

Materials/literature	Lecture notes Tarján I.: A mechanikai eljárástechnika alapjai. Miskolci Egyetemi Kiadó, 1997. Faitli J. – Mucsi G. – Gombkötő I. – Nagy S. – Antal G.: Mechanikai eljárástechnikai praktikum. Miskolci Egyetemi Kiadó, 2017. Faitli J. - Tarján I.: Mérési Gyakorlatok (A mechanikai eljárástechnika alapjai II.) Jegyzet. Miskolc, 1997. ME Eljárástechnikai Tanszék Stieβ, M: Mechanische Verfahrenstechnik 1,2. Springer (Lehrbuch) 1995. Tarján G.: Mineral Processing (Vol. 1, 2). AK. Bp.1981.
Note	Compulsory

Module Name	**Ecology and nature protection**
ECTS Credits	**3**
Responsible	Dr. András Hegedűs, PhD, associate professor
Duration	1st semester
Teaching Language	English
Learning Outcome (Competencies)	To familiarize students with ecology, one of the bases of nature protection sciences. It is followed by laying the foundations and practicing field work introducing the living and non-living elements (objects) of nature, taking the ecological viewpoint into consideration; the work is completed by documenting its results. Emphasizing the necessity of practical activity for the students, and preparing them to use the basic nature protection approach in a creative way in their future professional activities. **Competencies to evolve:** T1- The environmental engineer knows, and apply the scientific and technical theory, and practice. T9 – The environmental engineer knows the publicizer, and opinion leader methods related to environmental engineer activity. K6 - The environmental engineer is able to plan, implement, and maintain engineering interventions, occured on the field of soil-, geological formation-, water-, air-, vibration-, and noise-protection, wildlife-protection, remediation, and waste management. Active professional English language skills.
Contents	Objects, factors and definition of ecology. Biotic and abiotic ecological factors. Elements of the ecosystem and its greater units. Characteristics and loadibility of ecosystems. Material cycles and food chain, energy flow. The circuit of biogeochemical cycles (C, nitrogene, water, phosphor, sulphur, biogenic elements). Anthropogenic effects and their roles. The relationship system of ecology and nature protection (nature conversation). Connection of nature protection (nature conversation) to environmental protection, complementing each other. Elements and tasks of nature protection. Emphasizin mind shaping, presentation and research activities among the practice-centred ecological-nature protection tasks. The organizations of the Hungarian and international nature protection. International nature protection values in Hungary. International law of nature protection, the system of Hungarian nature protection laws. Legal and economics connections of nature protection.
Teaching Methods	Lecture: 1 contact hour per week Seminar: 2 contact hours per week
Pre-requisites	Not mentioned

Assessment Methods	**pr. mark** **Assessment and grading:** **Signature:** Participation in lessons and field trips. **Grade:** nature protection description of a certain area (course) during the semester. Assessments (tests, exam, documentation, etc.).
Grading	> 80%: excellent, 70-79%: good, 60-69%: medium, 50-59%: satisfactory, < 50%: unsatisfactory.
Materials/literature	Michael Begon, John L. Harper, Colin R. Townsend: ECOLOGY. Individuals, Populations and Communities. Second Edition. Blackwell Scientific Publications, 1990. Scott Ferson and Mark Burgman (Eds.): Quantitative Methods for Conservation Biology. Springer, 2002, 322 p. Malcolm Hunter and James Gibbs: Fundamentals of Conservation Biology - 3rd Edition. Blackwell Publishers, 2006, 497 p. Richard B Primack: Essentials of Conservation Biology - sixth edition. Sinauer Associates, 2014, 603 p. Stephen B Glass, Evelyn A Howell and John A Harrington: Introduction to Restoration Ecology. Island Press, USA, 2011, 464 p.
Note	Compulsory

Module Name	**Waste processing machines and their operation**
ECTS Credits	**5**
Responsible	Dr. Ádám Rácz, PhD, associate professor
Duration	3rd semester
Teaching Language	English
Learning Outcome (Competencies)	The aim of the subject is to learn knowledge about the design, operation and selection of machines used in waste processing (comminution machines, classifiers, separators, biological, thermal and chemical processing equipment (eg. reactors). **Competencies to evolve:** T4 - The environmental engineer knows the operation, and the equipment of environmental protection facilities (water, and waste water treatment plants, hazardous, and non-hazardous landfill, waste incineration plant), and the ability of their innovation. K10 – The environmental engineer is able to apply integrated knowledge in aspects of environmental protection equipment, processes, technologies, and informatics. Active professional English language skills.
Contents	Comminution machines for brittle and non-brittle materials, design, operation and selection. Classifier (screens, grizzly) design, operation and selection. Separator (magnetic, eddy current, electrostatic, air-flow separators) design, operation and selection. Biological thermal and chemical processing equipment (eg reactors) design, operation and selection.
Teaching Methods	Lecture: 2 contact hour per week Seminar: 3 contact hours per week
Pre-requisites	Not mentioned

Assessment Methods	Requirements of the signature: - Less than 20 % class missing - Presenting the laboratory measurements reports - Writing the classroom test successfully
Grading	Examination: Written and oral exam Five grades scale Assessment according to a five grade scale: Missing basic knowledge – unacceptable Student demonstrates basic knowledge – acceptable Student demonstrates basic knowledge and can apply it in practice – intermediate Student demonstrates system level knowledge in contexts – good Student demonstrates outstanding system level knowledge in contexts - excellent Assessment: 85 – 100: excellent (5), 75 – 84: good (4), 63 – 74: intermediate (3), 51 – 62: acceptable (2), ≤50: unacceptable (1).
Materials/literature	Lecture presentation slides and notes • Ernst Worrell And Markus A. Reuter Handbook Of Recycling State-Of- The-Art For Practitioners, Analysts, And Scientists ISBN: 978-0- 12-396459- 5 • Tarján G.: Mineral Processing (Vol. 1, 2). AK. Bp.1981.
Note	Compulsory

Module Name	**Soil and water chemistry**
ECTS Credits	**4**
Responsible	Dr. habil Endre Dobos, habilitated PhD, professor
Duration	1st semester
Teaching Language	English
Learning Outcome (Competencies)	To highlight the colloidal, and chemical structure of the soil, the main equilibriums take place in the soil and which has govern the possible transformation of inorganic and organic substances are present or placed into the soil. The goal is to provide a skill to solve the environmental protection problems related to the soils. **Competencies to evolve:** T1- The environmental engineer knows, and apply the scientific and technical theory, and practice. T3 – The environmental engineer knows, and apply the environmental protection, and remediation processes (operations, equipments, appliances), damage control methods. K6 - The environmental engineer is able to plan, implement, and maintain engineering interventions, occurred on the field of soil-, geological formation-, water-, air-, vibration-, and noise-protection, wildlife-protection, remediation, and waste management. K7 – The environmental engineer is able to perform and plan the environmental sampling, to perform a comprehensive laboratory testing, to apply monitoring systems, the evaluation, and documentation of test results.
Contents	Definition and classification of soils. Characterization of the solid, solution and

	gas phase of the soils. Sorption, dissolution, acid-base equilibriums in the soils. Red-ox reactions. Inorganic and organic substance transformation in the soil environment. Contamination of soils and remediation possibilities. Importance of soil protection.
Teaching Methods	Lectures: 2 contact hours per week Seminars: 1 contact hour per week Oral lectures with slides, five 2 h laboratory practice focused to investigate the structure and composition of the soils (Study the soil suspensions, humidity, organic content determination of soils, investigation of acid-base character and buffer capacity of soils, preparation and investigation of soil extracts).
Pre-requisites	AKKEM 6003 equivalent
Assessment Methods	During the semester the following tasks should be completed: take part the lecture min 60%, Fulfil the laboratory practice work. One missing is allowed. Answer the minimum questions properly min. 50 %, must be correct. Writing the the test from the subject of lecture. Mark: (final test mark 2x + lab practice mark 1x)/3
Grading	> 80%: excellent, 70-79%: good, 60-69%: medium, 50-59%: satisfactory, < 50%: unsatisfactory.
Materials/literature	D. L. Sparks: Environmental Soil Chemistry, Acad. Press, London (2002). Elsevier BV, ISBN: 978-0-12-656446-4 B. Yaron, R. Calvet, R. Prost: Soil pollution, Springer, (1996). M.R. Ashaman and G. Puri: Essential Soil science, Blackwell Publ,(2002.) Kim H. Tan : Principles of Soil Chemitry, CRC Press, (1998) Hinrich L. Bohn, Rick A. Myer, George A. O'Connor: Soil Chemistry, 2nd Edition, ISBN: 978-0-471-27497-1, E book, Wiley (2002). Orbán Vera: Vízkémia, PMMF, Baja, 1980. Orbán Vera: Vízkémiai parktikum, Egyetemi jegyzet, Tankönyvkiadó, 1976. Papp Sándor, Rolf Kümmel: Környezeti Kémia, Tankönyvkiadó, Budapest, 1992. Kirnerné Kiss Andrea: A víz kémiája, Kémia Műszakiaknak, 3. 1 fejezet. Szerk. Berecz E. Tankönyvkiadó, Budapest, 1991. Stanley E. Manahan: Environmental Chemistry, 7.th ed. Lewis Publishers, 2000.
Note	Compulsory

Module Name	**Environmental and Waste Management Law**
ECTS Credits	**2**
Responsible	Prof. Dr. Ede János Szilágyi habilitated PhD, professor
Duration	3rd semester
Teaching Language	English
Learning Outcome (Competencies)	Students awareness of the environmental assessment procedures, the methods can be used to make the study. **Competencies to evolve (see Appendix 1):** T6 - The environmental engineer knows the organization, and motivation equipment related to management, and the necessary laws. K14 – The environmental engineer is able to plan, and transact complex

	(environmental, economical, and social) works. Active professional English language skills. A2 – Assumes the professional and moral values related to the field of environmental protection. F1 – Can solve environmental engineering tasks independently, takes decisions carefully, in consultation with the representatives of other (mainly legal, economic, energy) fields, independently, takes responsibility for the decisions. F2 – In making decisions, takes into account the basic requirements of occupational health and safety, technical, economic and legal regulations, and engineering ethics. F4 – Shares the acquired knowledge and experience with formal, non-formal and informal information transfer with practitioners in their field.
Contents	The course introduces the complex legal framework of the environmental protection, nature conservation as well as the that of the environmental industry. Knowledge obtained by this course is essential for a practicizing environmental engineer. Since the group is composed of Hungarian and also international students, the course focuses on the general framework of environmental legislation, not the specific rules applied in Hungary. 1. A brief introduction to law I. 2. A brief introduction to law II. 3. The concept of sustainable development 4. The development, the subject and the system of environmental law 5. The sources and the methods of environmental law 6. International environmental law I 7. International environmental law II 8. The EU's environmental law I 9. The EU's environmental law II 10. Constitutional aspects of environmental law 11. Waste management law I 12. Waste management law II 13. The presentation of the course participants I 14. The presentation of the course participants II 15. The presentation of the course participants III
Teaching Methods	Lectures: 2 contact hours per week
Pre-requisites	Not mentioned
Assessment Methods	**exam.** The examination includes: a, an oral presentation on a topical issue of environmental law and b, a written exam. The presence is compulsory on the course.
Grading	> 80%: excellent, 70-79%: good, 60-69%: medium, 50-59%: satisfactory, < 50%: unsatisfactory.
Materials/literature	Bell, Stuart – McGillivray, Donald – Pedersen, Ole.: Environmental law, Oxford, Oxford University Press, 2013 Krämer, Ludwig: EU environmental law, London, Sweet & Maxwell, 2012

	Kubasek, Nancy – Silverman, Gary: Environmental law, Boston [etc.], Pearson, 2014 Raisz Anikó: A Constitution's Environment, Est Europa, 2012/special edition 1, pp 37-70
Note	Compulsory

Module Name	**Methods of environmental assessment**
ECTS Credits	**2**
Responsible	Dr. Balázs Zákányi, PhD, associate professor
Duration	3rd semester
Teaching Language	English
Learning Outcome (Competencies)	Students awareness of the environmental assessment procedures, the methods can be used to make the study. **Competencies to evolve (see Appendix 1):** T2 - The environmental engineer is in posession of knowledge in respect of environmental measuring technology, and measuring theory. T5 - The environmental engineer knows the rules of preparing environmental impact assessment, and environmental protection technical documentation. K6 - The environmental engineer is able to plan, implement, and maintain engineering interventions, occurred on the field of soil-, geological formation-, water-, air-, vibration-, and noise-protection, wildlife-protection, remediation, and waste management. K8 - The environmental engineer is able to apply environmental protection methods, and damage control methods, prepare and coordinate the damage control. Active professional English language skills.
Contents	The history of environmental impact assessment. The legal regulation of the environmental impact assessment. Environmental assessment, environmental impact assessment, uniform environmental permit. The qualification of environmental test activities can be combined with the functionality and connectivity of the procedures. The phases of environmental testing, the method of the official method. The preliminary environmental study. The detailed requirements for environmental compatibility studies. Acting factors stakeholders, impact processes, the spread effects. The effect areas, control areas. The main aspects of recruitment procedures and environmental standards. In the effectiveness test methods and procedures. Impact Assessment. Monitoring. The impact assessment public of the hearing, public hearing. Analysis of practical examples. Preparation of an impact test, study management, presentation, public discussions. Practical work: self-made solutions of simple case-study problems.
Teaching Methods	Seminars: 2 contact hours per week
Pre-requisites	Not mentioned
Assessment Methods	**pr. mark** Students will be assessed with using the following elements. Attendance: 15 % Individual report 40 %

	MFinal exam 55 % Total 100%
Grading	% value Grade 90 -100% 5 (excellent) 80 – 89% 4 (good) 70 - 79% 3 (satisfactory) 60 - 69% 2 (pass) 0 - 59% 1 (failed)
Materials/literature	Charles H. Eccleston: Environmental Impact Assessment: A Guide to Best Professional Practices. CRC Press, 2011 John Glasson: Methods of Environmental Impact Assessment. Routledge, 2009. M. Schmidt, J. Glasson, L. Emmelin, H. Helbron: Standards and Thresholds for Impact Assessment Springer, 2008. EU directives
Note	Compulsory

Module Name	**Basics of waste management**
ECTS Credits	**3**
Responsible	Prof. Dr. Gábor Mucsi, habilitated PhD, professor
Duration	1st semester
Teaching Language	English
Learning Outcome (Competencies)	Students will know the fundamentals of waste management and the generation of wastes. Furthermore, they will be able to characterize – from process engineering and chemical point of view – and utilize the various wastes. **Competencies to evolve (see Appendix 1):** T1 – The environmental engineer knows, and apply the scientific and technical theory, and practice. K10 - The environmental engineer is able to apply integrated knowledge in aspects of environmental protection equipments, processes, technologies, and informatics. Active professional English language skills.
Contents	The aim of the subject for students is to learn knowledge about the waste management. History and development of waste management. Generation and types of industrial and municipal wastes. Introduction, position and aim of the subject in the course. Generation, types, composition, environmental effect of wastes. Definition and basics of sustainable development and sustainable raw material management. Determination of material characteristics (chemical and physical properties) and evaluation of the results. Material flow of production and consumption wastes. Relationship of waste management and environmental protection. Product and production integrated environmental protection. Treatment and preparation of wastes based on various utilization needs. Processes of mechanical waste preparation. General waste preparation technologies.
Teaching Methods	Lectures: 2 contact hours per week Seminars: 1 contact hour per week
Pre-requisites	Not mentioned

Assessment Methods	**exam.** Students will be assessed with using the following elements. Attendance: 5 % Homework: 10 % Short quizzes: 10 % Midterm exam: 40 % Final exam: 35 % Total: 100%
Grading	Grading scale: % value Grade 90 -100% 5 (excellent) 80 – 89% 4 (good) 70 - 79% 3 (satisfactory) 60 - 69% 2 (pass) 0 - 59% 1 (failed)
Materials/literature	Bernd Bilitewski: Waste management. 1997. Springer Science & Business Media Jacqueline Vaughn: Waste Management: A Reference Handbook. 2009 Ramesha Chandrappa: Solid Waste Management: Principles and Practice. 2012. Springer Lecture PowerPoint
Note	Compulsory

Module Name	**Waste incineration, air quality control**
ECTS Credits	**4**
Responsible	Dr. Arnold András Kállay, PhD, associate professor
Duration	3rd semester
Teaching Language	English
Learning Outcome (Competencies)	Students are trained for waste incineration technological solutions and applications and the related effect on air quality control. **Competencies to evolve (see Appendix 1):** T2 - The environmental engineer is in possession of knowledge in respect of environmental measuring technology, and measuring theory. T4 - The environmental engineer knows the operation, and the equipment of environmental protection facilities (water, and waste water treatment plants, hazardous, and non-hazardous landfill, waste incineration plant), and the ability of their innovation. K6 - The environmental engineer is able to plan, implement, and maintain engineering interventions, occurred on the field of soil-, geological formation-, water-, air-, vibration-, and noise-protection, wildlife-protection, remediation, and waste management. K7 - The environmental engineer is able to perform and plan the environmental sampling, to perform a comprehensive laboratory testing, to apply monitoring systems, the evaluation, and documentation of test results Active professional English language skills.

Contents	1.) Flow diagram of waste processing; basic regulations for thermal treatment and disposal. 2.) Combustion parameters of wastes: physical state (solid, liquid, gaseous), particle composition, density, moisture and ash content; chemical composition (C, H. N, S, Cl), calorific value. 3.) Calculation of combustion parameters: the chemical reactions of combustion, minimum oxigen and air requirement of fules, optimal air excess necessary for complete combustion. 4.) Gaseous wastes, normal burning velocity of fuels, flame velocity, flammability and explosion limits, operating conditions for safe combustion; methods for flame stabilization. 5.) Flame and flue gas characteristics: specific volume, chemical composition, specific heat capacity; combustion temperature (theoretical and actual), dissociation and adiabatic flame temperature (definition, calculation methods); methods for increasing/reducing combustion temperature. 6.) Technical parameters of waste incineration, auto-ignition range; grid types and grid structures, combustion chamber geometry, the construction of refractory walls (design and structure). 7.) Hazardous waste disposal (by incineration), required minimum incineration temperature, the thermal treatment of halogenated waste, present-day waste incinerators, determination of post-combustion chamber ('afterburners'). 8.) Characterization of solid combustion residues: physical-chemical properties, mineral composition, thermal behaviour, sintering and ash fusion characteristics, melting temperature. Treatment and disposal of slags and fly ash. 9.) Burners: classification, geometry, sizing, fuel injection by spray nozzles (oil burners). 10.) Air pollution control: regulatory measures and provisions for waste incineration; possible allowed emission and emission concentrations (EU target values). 11.) Gaseous pollutants: CO, radicals, sulphur oxides, NOx formation (conditions, intensity), primary reduction methods, determination of gas emission concentrations. 12.) Characterization of gaseous pollutants; options for secondary emission reduction; flue gas cleaning methods and equipment. 13.) Definition of dust (for environmental regulations), properties of particulate matter (PM), separation and collection mechanisms, design and operation of dust collection systems (separators). Practical work: self-made solutions of simple case-study problems.
Teaching Methods	Lectures: 2 contact hours per week Seminars: 1 contact hour per week
Pre-requisites	Not mentioned
Assessment Methods	**Exam.** Students will be assessed with using the following elements. Attendance: 15 % Individual report 10 % Midterm exam 40 %

	Final exam 35 % Total 100%
Grading	> 80%: excellent, 70-79%: good, 60-69%: medium, 50-59%: satisfactory, < 50%: unsatisfactory.
Materials/literature	C. Baukal Jr.: Industrial Combustion Pollution and Control, Oklahoma, 2004, ISBN 0-8247-4694-5 M. Döing: Waste to Energy, Cologne, http://www.ecoprog.com, 2014 Godfrey Boyle: Renewle Energy, Oxford, 2004, ISBN 0-19-926178-4
Note	compulsory

Module Name	**Water and waste water treatment**
ECTS Credits	**2**
Responsible	Dr. Sándor Nagy, PhD, associate professor
Duration	3rd semester
Teaching Language	English
Learning Outcome (Competencies)	The students will be familiar with the basic elements and concepts of modern water and waste water purification technology and processes. The students will be able to choose the right purification technology concerning environmental protection aspects. **Competencies to evolve (see Appendix 1):** T4 - The environmental engineer knows the operation, and the equipment of environmental protection facilities (water, and waste water treatment plants, hazardous, and non-hazardous landfill, waste incineration plant), and the ability of their innovation. K6 - The environmental engineer is able to plan, implement, and maintain engineering interventions, occurred on the field of soil-, geological formation-, water-, air-, vibration-, and noise-protection, wildlife-protection, remediation, and waste management. K7 - The environmental engineer is able to perform and plan the environmental sampling, to perform a comprehensive laboratory testing, to apply monitoring systems, the evaluation, and documentation of test results Active professional English language skills
Contents	Contamination and pollution processes in water. Pollution limits in water and in groundwater. The most typical contaminants and their physical and chemical properties. Sampling, and preparations of samples. Cleaning and purification technology for municipal and industrial waste water. Technology design.
Teaching Methods	Lectures: 1 contact hour per week Seminars: 1 contact hour per week
Pre-requisites	Water quality protection
Assessment Methods	**pr. mark** Students will be assessed with using the following elements. Attendance: 15 %

	Short quizzes 10 % Midterm exam 40 % Final exam 35 % Total 100%
Grading	% value Grade 90 -100% 5 (excellent) 80 – 89% 4 (good) 70 - 79% 3 (satisfactory) 60 - 69% 2 (pass) 0 - 59% 1 (failed)
Materials/literature	Klaus Görner- Kurt Hübner: Gewaesserschutz und Abwasserbehandlung; Springer-Verlag Berlin heidelberg, 2002. M Henze; P Harremoes; J la C Jansen; E Arvin: Wastewater Treatment; Springer-Verlag Berlin heidelberg, 2002 M. Sperling: Biological Wastewater Treatment Series (Volume two): Basic Principles of Wastewater Treatment, IWA 2007 R. Ramalho: Introduction to Wastewater Treatment Processes. Academic Press, 2013
Note	compulsory

Module Name	**Handling and processing of Biodegradable Wastes**
ECTS Credits	**3**
Responsible	Dr. Ljudmilla Bokányi, associate professor, PhD
Duration	1st semester
Teaching Language	English
Learning Outcome (Competencies)	To introduce the sustainable biological treatment systems for the conversion of biowastes into marketable materials or energy, or safe disposal. **Competencies to evolve (see Appendix 1):** Knows and applies scientific and technical theory and practice related to the profession of environmental engineering. Knows the promotion and opinion-forming methods related to environmental engineering Can apply the acquired general and specific mathematical, natural and social science principles, rules, connections and procedures in solving problems arising in the field of environmental protection. Able to conduct publications and negotiations in his/her field in his/her mother tongue and at least one foreign language. Able to design, implement and operate environment-focused management systems. Assumes the professional and moral values related to the field of environmental protection Shares experiences with co-workers, thus helping their development. Shares the acquired knowledge and experience with formal, non-formal and informal information transfer with practitioners in their field.
Contents	Quality and quantity biowastes according to the EU List. Microbiological and thermodynamic fundamentals of aerobic and anaerobic biodegradation. Composting processing systems, technology, equipment, quality assurance and control. Production of biogas: technological solutions, reactors, quality

	assurance and control, application of biogas. Technological design and dimensioning. Economics of the technologies. Innovative biotreatment of bio-wastes for the sake of “green chemistry”. Sustainability and environmental aspects.
Teaching Methods	Lectures: 2 contact hours per week Seminars: 1 contact hour per week
Pre-requisites	Not mentioned
Assessment Methods	**Exam** During the semester the following tasks should be completed: laboratory work and report, written test.
Grading	> 80%: excellent, 70-79%: good, 60-69%: medium, 50-59%: satisfactory, < 50%: unsatisfactory.
Materials/literature	Heribert Insam, Nuntavun Riddech, Susanne Klammer Microbiology of Composting. Springer Science & Business Media, 2002. Paul T. Williams Waste Treatment and Disposal John Wiley & Sons, 2013
Note	elective

Study schedule MSc. ENTER (from October 2024)

Modules	1st term L/E/S/P	2nd term L/E/S/P	3rd term L/E/S/P	4th term L/E/S/P	CP
Compulsory modules					
Environmental geology	2/0/1/0 ME				4
Basics of environmental processing	1/0/1/0 ME				2
Ecology and nature protection	2/0/1/0 ME				3
Waste processing machines and their operation	2/0/3/0 ME				5
Soil and water chemistry	2/0/1/0 ME				4
Environmental and Waste Management Law	2/0/0/0 ME				2
Methods of environmental assessment	0/0/2/0 ME				2
Basics of waste management	2/0/1/0 ME				3
Waste incineration, air quality control	2/0/1/0 ME				4
Water and waste water treatment	1/0/1/0 ME				2
Handling and processing of Biodegradable Wastes	1/0/1/0 ME				3
Compulsory modules					
Current Issues in Enabling Technologies for Circular Economy		LUT Online Teaching			5
Knowledge Discovery and Process Data Analysis		LUT Online Teaching			5
Process Intensification		LUT Blended Teaching			5
Academic Entrepreneurship		LUT Blended Teaching			6
Start-ups and venture formation		LUT Blended Teaching			6
Elective modules: Students must choose at least **3 CP** to achieve 30 CP in total.					
Simulation, Laboratory Course		LUT Online Teaching			5
Advanced Course in Life Cycle Assessment		LUT Blended Teaching			8
Integration of Product's Design, Sustainable Production and Material Selection		LUT Blended Teaching			5

Modules	1st term L/E/S/P	2nd term L/E/S/P	3rd term L/E/S/P	4th term L/E/S/P	CP
Bioeconomy		LUT Blended Teaching			5
Development of New Sustainable Products and Solutions		LUT Blended Teaching			5
Power-to-X processes		LUT Online Teaching			5
Fluid Dynamics in Chemical Engineering		LUT Contact Teaching			5
Compulsory modules					
Training in Particle Technology			1/2/0/0 TUBAF		4
Training in Endurance and Design			1/2/0/1 TUBAF		6
Conception of Process Equipment			2/1/0/0 TUBAF		5
Sustainable Engineering			2/1/0/0 TUBAF		4
Project - Process Design Mineral Processing / Recycling			0/0/2/8 TUBAF		5
Elective modules: Students must choose at least **6 CP** to achieve 30 CP in total.					
Maintenance Engineering *			2/1/0/0 TUBAF		4
Process Development in Mechanical Process Engineering *			2/0/1/0 TUBAF		4
Recycling - Secondary Raw Materials *			3/0/1/0 TUBAF		6
Master Thesis (Mechanical and Process Engineering)				22 Wo (ME/ *LUT / TUBAF*)	30

Legend - Teaching Methods:

In contact hours per week

L= Lecture
E= Exercise
S= Seminar
P= Practical application

Appendix: Competences according to learning outcomes of the environmental engineering master programs accredited in Hungary.

Training objectives and professional competences for MSc in Environmental Engineering

The objective of the programme is to train environmental engineers who, in possession of an up-to-date knowledge of natural sciences, ecology, engineering and management, are able to identify and assess existing and potential environmental hazards, to prevent or reduce environmental damage, as well as to devise and manage damage control plans. In possession of a modern IT knowledge they are able to perform complex engineering and scientific planning and analyses using planning, modelling and simulation software. They work out and apply appropriate technological solutions to prevent environmental pollution, and they perform engineering planning and control tasks in the field of waste processing and recycling. They are able to optimise environmental protection technologies and environmental use. They are prepared to continue their studies at postgraduate level.

Professional competences to be acquired (Environmental Engineers'):

a) Knowledge

- Knows and applies scientific and technical theory and practice related to the profession of environmental engineering.

- Has a comprehensive knowledge of measurement technology and measurement theory related to the field of environmental engineering.

- Knows and applies environmental and remediation procedures (operations, equipment, devices), environmental remediation methods.

- Knows the operation of environmental protection facilities (especially water and wastewater treatment plants, hazardous and communal landfills, waste incinerators), their structures and the possibilities of their development.

- Knows and applies the rules of environmental impact assessment and preparation of environmental technical documentation.

- Knows the organizational and motivational tools and methods related to management, as well as the legislation necessary for practicing the profession.

- Knows and applies the methodology and tools of environmental informatics and modeling in a complex way.

- Knows the basics, boundaries, and requirements of the fields of work, as well as fire protection, safety technology, information technology, law, economics and management related to environmental engineering.

- Knows the promotion and opinion-forming methods related to environmental engineering.

b) Skills

- Can apply the acquired general and specific mathematical, natural and social science principles, rules, connections and procedures in solving problems arising in the field of environmental protection.

- Able to conduct publications and negotiations in his/her field in his/her mother tongue and at least one foreign language.

- Able to perform environmental management tasks.

- Able to complete tasks arising in international or cross-border projects and to present his/her research results and developed design documentation before social and professional forums.

-During work, examines the possibility of setting research, development and innovation goals and strives to achieve them.

- Able to plan in a complex way, implement and maintain engineering interventions in the fields of soil, subsurface, water, air, noise and vibration protection, wildlife protection, remediation and waste reduction, treatment, and processing.

- Able to plan and conduct environmental sampling works, comprehensive laboratory testing and analysis, to apply monitoring systems, evaluate and document test results.

- Able to apply complex environmental remediation methods, to prepare for remediation and to coordinate remediation.

- Able to plan, conduct and design environmental impact assessments and conduct impact assessments.

- Able to apply integrated knowledge of environmental equipment, processes, technologies, and related electronics and informatics.

- Able to model, operate and control environmental technology systems and processes.

- Able to design, implement and operate environment-focused management systems.

- Able to perform energy efficiency analyzes, surveys, audits, identify measures and support their implementation.

- Able to plan and support the execution of complex (environmental-economic-social) works.

c) Competence in terms of attitude

- Open and receptive to the knowledge and acceptance of professional, technological development and innovation in the field of environmental protection, and its authentic mediation.

- Assumes the professional and moral values related to the field of environmental protection.

- Seeks to plan and carry out tasks independently or in a working group at a professional level.

-Strives to carry out the required work in a complex approach based on a systems-based and process-oriented way of thinking.

-Strives to improve the knowledge of both him/herself and subordinated employees through continuous training.

-Committed to high-quality work and strives to communicate this approach to subordinated employees.

- Shares experiences with co-workers, thus helping their development.

d) Competence in terms of autonomy and responsibility

- Can solve environmental engineering tasks independently, takes decisions carefully, in consultation with the representatives of other (mainly legal, economic, energy) fields, independently, takes responsibility for the decisions.

- In making decisions, takes into account the basic requirements of occupational health and safety, technical, economic and legal regulations, and engineering ethics.

- Takes the initiative in solving environmental problems, identifies the shortcomings of the applied technologies, the risks of the processes and initiates the measures to reduce them.

- Shares the acquired knowledge and experience with formal, non-formal and informal information transfer with practitioners in their field.

- Evaluates the work of subordinated employees, promotes their professional development by sharing critical remarks, educates employees and subordinates on responsible and moral professional practice.

- Monitors legislative, technical, technological and administrative changes in the field of profession.