University of Debrecen Faculty of Agricultural and Food Sciences and Environmental Management

Agricultural Engineering Management Engineering MSc Program

2022

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**DEAN’S WELCOME**

On January 1, 2000, the University of Debrecen was born with the need for international competitiveness, which is now the oldest continuously operating higher education institution in the country. It is one of the excellent universities in Hungary, with its 14 faculties and 24 doctoral schools, offering the widest domestic training. Today, the University of Debrecen carries out its agricultural training, research and development activities in three organizational units: the Faculty of Agriculture, Food Science and Environmental Management (MÉK), the Faculty of Economics (GTK) and the Institutes for Agricultural Research and Educational Farm (AKIT). The Faculty of Agriculture, Food Science and Environmental Management - adapting to today's scientific challenges - formulates both its training and research activities according to the circular bioeconomy model, which is based on the recycling of materials and values, by increasing the added value of the produced product, through services and smart solutions. In the ranking of agricultural and higher education institutions in the world, Debrecen is always in the most prominent place, currently it is among the best between 150-200.

The Faculty of Agriculture, Food Science and Environmental Management of the University of Debrecen currently has nearly 1,400 students, and in addition to our Hungarian-language courses, more and more foreign students attend our courses taught in English. Our undergraduate and master's programs, our talent management colleges, and our doctoral schools all play a decisive role in higher agricultural education and scientific supply. It is especially important for us to maintain a wide-ranging system of professional and economic relations with the enterprises of the region, which, on the one hand, provides the conditions for practical training and, on the other hand, helps to utilize the scientific results created at the University. Following the good example of our predecessors, we try to provide students with up-to-date knowledge and practice-oriented knowledge, so that they can enhance and improve the reputation of our institution and Hungarian agriculture.

Dr. László Stündl

associate professor

dean

**HISTORY OF THE UNIVERSITY**

The University of Debrecen, the oldest institution of higher education in the country operated continuously in the same city, is one of the research universities of national excellence in Hungary offering the widest spectrum of educational programs in 14 faculties and 24 doctoral schools.

The roots of higher education in the city reach all the way back to the 16th century and the foundation of the Reformed College of Debrecen in 1538. The College played a central role in Hungarian education and culture for centuries. This is the date featured on the symbol of the university as well, the *gerundium,* a tool originally used by the students of the Reformed College to put out fires, showing respect for ancestors and traditions.

In 1912 with Act XXXVI, originally submitted as a bill by Count János Zichy, Minister of Religion and Public Education, the Hungarian Parliament decided on the establishment of two universities, one in Pozsony [Bratislava] and the other in Debrecen. Thus the Hungarian Royal University of Debrecen was established in the *cívis* town with five faculties (Faculty of Reformed Theology, Faculty of Law, Faculty of Medicine, Faculty of Arts, Linguistics and History, and the Faculty of Mathematics and Science). However, the university opened only two years later, in 1914 with three faculties. First, students studied in the building of the Reformed College, which soon proved to be too small. The city of Debrecen granted a huge (112 acre) land in the Great Forest for the university, and also provided first 5 then an additional 3 million Golden Koronas for the construction of a new building. In 1918 Charles IV inaugurated the central building of the newly founded Faculty of Medicine. The teaching of mathematics and natural sciences started within the Faculty of Arts from the 1923/24 academic year. The independent Faculty of Sciences was opened only in 1949.

In 1921 the university was named after Count István Tisza, former prime minister and statesman who also studied in the Reformed College and who was assassinated on October 31, 1918. Thus the name of the institution was changed to István Tisza Hungarian Royal University of Debrecen.

The construction of the main building of the university started in the 1920s and it was officially opened in 1932. At the time it was the third largest investment project of the country after the building of the Parliament and the Buda Castel Palace. Construction lasted for four years, even so only one third of the original plans could be realized.

After the Second World War the fragmentation of the university (then already having five faculties) was started in 1949 due to political reasons. In the same year the Faculty of Law was temporarily suspended, in 1950 the Faculty of Theology was separated from the university, and it returned to the College with support from the church. Making medical training independent, the Medical University of Debrecen was organized in 1951. The university bore the name of István Tisza until 1945, then it was named University of Debrecen, then from 1952 it operated under the name of Lajos Kossuth University.

In the 1980s negotiations already started about the reunification of fragmented higher education in Debrecen. Events leading to integration, however, accelerated only after 1996 when an amendment stipulated that after December 31, 1998 universities had to provide educational programs of adequate quality in several disciplines.

Finally, on January 1, 2000 the University of Debrecen was established with the integration of the Agricultural University of Debrecen, the Medical University of Debrecen, Lajos Kossuth University, and the István Wargha Teacher Training College of Hajdúböszörmény. The university having an important role and position in Hungarian higher education started its operation with five university and three college faculties organized into three centers, the Center for Agricultural and Applied Economic Sciences, the Medical and Health Science Center, and the Center of Arts and Sciences.

Section 26 of Act CCIII of 2013 on the amendment of particular acts establishing the central budget of Hungary for 2014 included provisions concerning the organizational structure of the university, thus the centers were no longer used as organizational units as of January 1, 2014.

Today the University of Debrecen is a leading and prominent institution of higher education in Hungary. It is not only at the forefront of Hungarian and international education but also active in the fields of research, innovation and development, and enjoys fruitful links with the business sector. The ever-changing social and economic environment demands continuous renewal from the institution and there is a constant need to adapt to new requirements. The University of Debrecen’s mission is to contribute to the education of future generations in cooperation with Hungarian and international partners, with high-quality interdisciplinary programs, and research built on versatile and practical experience.

Besides education, the institution also provides European-quality patient care with comprehensive services to fulfil its obligations in the city, county, and region and often on the national level as well. As of July 1, 2017, with the merger of the Kenézy Gyula Hospital and Clinic, the University of Debrecen Kenézy Gyula Teaching Hospital was established, expanding the capacities of the institution both in patient care and education.

**HISTORY OF THE FACULTY**

The Great Plain and, more broadly, the Tisza River Basin is the center of Hungary's agri-food economy. That is why it was a logical decision from our predecessors to have a higher education and research center in the region to support the production and processing of raw materials, which helps to create and maintain a competitive agriculture by continuously providing qualified human resources and putting scientific results into practice.

In Eastern Hungary, agricultural higher education started in 1868 with the establishment of the Debrecen National Higher School of Economics. Between 1874 and 1906, the institution operated as the Secondary School of Economics, and until 1944 under the name of the Royal Hungarian Academy of Economics. Between 1945 and 1949, our institution operated under the name of the Debrecen Department of the Hungarian University of Agricultural Sciences, Faculty of Agricultural Sciences. In 1953, training resumed at the Debrecen Agricultural Academy. Between 1962 and 1970, specialist training rose to university level at the College of Agricultural Sciences. Between 1970 and 1999, the institution received the “university rank”, the University of Agricultural Sciences in Debrecen served two rural faculties (Szarvas, initially Hódmezővásárhely, later Mezőtúr).

On January 1, 2000, the University of Debrecen was established with five university faculties, three college faculties and three research institutes. The Faculty of Agricultural Economics and Rural Development was established in 2002 and by 2006 the number of faculties of the University had increased to 15. The Faculty of Agriculture, Food Science and Environmental Management (MÉK) and the Faculty of Economics and Rural Development (GVK), as well as three research institutes, formed the Center for Agricultural and Management Sciences (AGTC) until 2014.

# **ADMINISTRATION UNITS FOR INTERNATIONAL PROGRAMMES**

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

# **INTERNATIONAL OFFICE AT THE FACULTY OF AGRICULTURAL AND FOOD SCIENCES AND ENVIRONMENTAL MANAGEMENT**

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

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[**Institute of Animal Science, Biotechnology and Nature Conservation**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22240)

[Department of Animal Husbandry](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22245)

Agricultural Genomics and Biotechnology Center, Animal Genomics Research Team

Department of Animal Nutrition and Food Biotechnology

[Department of Nature Conservation, Zoology and Game Management](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22247)

[**Institute of Crop Sciences**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22210)

Department of Applied Plant Biology

Department of Crop Production, Applied Ecology and Plant Breeding

[**Institute of Food Science**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22209)

**Institute of Food Technology**

[**Institute of Horticulture**](http://www.agr.unideb.hu/etk/xsearch.php?lstDep=22250)

[**Institute for Land Use, Engineering and Precision**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22203) **Farming Technology**

Department of Agricultural Engineering and Robotics

Department of Land Use

Department of Precision Technology

**Institute of Nutrition**

[**Institute of Plant Protection**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22211)

[**Institute of Water and Environmental Management**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22214)

**Agricultural Laboratory Center**

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# **Department of Agricultural Engineering and Robotics**

# **Department of Land Use**

# **Department of Precision Technology**

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| Ms. Zsuzsanna DorogiAdministrative Assistant | dorogizs@agr.unideb.huroom 11, building E |

**INSTITUTE OF NUTRITION**

138, Böszörményi str., Debrecen H-4032, Tel: +36-52-508-444 / 88433

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| Dr Péter SiposProfessor | siposp@agr.unideb.huroom V8, building D |
| Judit SzepesiAdministrative Assistant | szepesi@agr.unideb.huroom V1, building D |

#  **INSTITUTE OF PLANT PROTECTION**

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**AGRICULTURAL LABORATORY CENTRE**

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**INSTITUTE OF WATER AND ENVIRONMENTAL MANAGEMENT**

138, Böszörményi str., Debrecen H-4032, Tel: +36-52-508-444 / 88146

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**ACADEMIC CALENDAR**

# General structure of the academic year:

|  |  |  |  |
| --- | --- | --- | --- |
| Fall semester | 1st – 2nd week  | Registration\* | 2 weeks |
| 1st – 14th week | Study Periodfor non-graduating students | 14 weeks |
| 1st – 9th week | Study Periodfor graduating students | 9 weeks |
| directly after the study period | Exams for non-graduating students | 7 weeks |
| directly after the study period | Exams for graduating students | 3 weeks |
| Spring semester | 1st – 2nd week  | Registration\* | 2 weeks |
| 1st – 14th week | Study Periodfor non-graduating students | 14 weeks |
| 1st – 10th week | Study Periodfor graduating students | 10 weeks |
| directly after the study period | Exams for non-graduating students | 7 weeks |
| directly after the study period | Exams for graduating students | 5 weeks |

**ACADEMIC CALENDAR OF THE FACULTY OF AGRICULTURAL AND FOOD SCIENCES AND ENVIRONMENTAL MANAGEMENT**

The academic calendar for the given semester can be found on the faculty's website: https://www.edu.unideb.hu/tartalom/downloads/University\_Calendars\_2022\_23/University\_calendar\_2022-2023-Faculty\_of\_Agricultural.pdf?\_ga=2.136620661.41633129.1657530581-1615460094.1657530581

# **THE AGRICULTURAL ENVIRONMENTAL MANAGEMENT ENGINEERING GRADUATE PROGRAM**

INTRODUCTION OF THE PROGRAM

|  |  |
| --- | --- |
| Name of graduate program: | Agricultural Environmental Management Engineer Graduate Program |
| Level: | MSc |
| Qualification: | Agricultural Environmental Engineer |
| Mode of attendance: | Full-time |
| Faculty: | Faculty of Agricultural and Food Sciences and Environmental Management |
| Program coordinator: | Csaba Juhász, associate professor |
| Program length: | 4 semesters |
| Credits total: | 120 credits |

The MSc in Agricultural Environmental Management Engineering is designed to develop your undergraduate knowledge and improve it through application and research. The field of Agricultural Environmental Management Engineering is broad and the programme reflects this diversity, with emphasis on Natural Resource Management, Environmental Impact Assessment, Environmental Technologies, Environmental Informatics, which are the key research areas of the Department of Water and Environmental Management responsible for the course.

Throughout your stay at Debrecen University, which is the second largest university in Hungary, with 30 000 students, as a postgraduate student, you will have a personal academic tutor to guide you through your studies and to meet your individual goals and interests. We also offer you a 4 week field practice in summer.

Areas of Study: Public Administration, Organization Environmental Law, Natural Resource Management, Sustainable Agricultural Systems and Technologies, Land Use and Regional Planning, Environmental Impact Assessment, Environmental Laboratory Measurement Techniques, Ecotoxicology, Environmental Technologies, Nature Protection, Water Resource Management and Water Quality Protection, Landscape Management, Environmental and Quality Management, Environmental Informatics, Agri-Environmental Politics, Environmental Economy, Agricultural Remote Sensing, Agro-hydrology-Agricultural, Watershed Management, Precision Agriculture, Environmental Health, Agri-Environmental Protection.

Postgraduates may progress to PhD or find employment in Agricultural Environmental Management Engineering, lecturing, consultancy, or other sectors where Agricultural Environmental Management Engineering is involved.

**COURSE DESCRIPTIONS FOR AGRICULTURAL ENVIRONMENTAL MANAGEMENT ENGINEERING MSC**

[Academic language skills (scientific language), MTM7NY1A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtm7ny1a.docx)

[Agricultural and Environmental Economics, MTMKG7024A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7024a.docx)

[Agricultural and environmental policy, MTMGK7022A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7022a.docx)

[Agricultural engineering, precision agricultural systems and technologies, MTMKG7014A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7014a.docx)

[Agricultural forestry, MTMKG 7016A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7016a.docx)

[Agro-environmental management I, MTMKG7007A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7007a.docx)

[Agro-environmental management II - Ecotoxicology, environmental risk assessment, MTMKG7020A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7020a.docx)

[Drainage engineering, MTMKG7028A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7028a.docx)

[Drought management, MTMKG7026A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7026a.docx)

[Environmental impact assessment and environmental modelling, MTMKG7009A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7009a.docx)

[Environmental informatics – Environmental monitoring, MTMKG7003A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7003a.docx)

[Environmental Measurement Techniques, MTMKG7006A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7006a.docx)

[Environmental planning, land consolidation, landscape conservation, MTMKG7021A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7021a.docx)

[Environmental technologies I: Soil remediation, soil protection, biotechnology in agriculture, MTMKG77013A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7013a.docx)

Environmental technologies II - Water Quality Protection, Sewage Treatment, Waste Management in Agriculture and Food Industry, MTMKG7017A

[Farm business management and project management, MTMKG7018A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7018a.docx)

[Food chain safety, MTMKG7010A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7010a.docx)

[Hydrobiology, MTMKG 7027A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7027a.docx)

[Management systems (EMS, QMS, FSMS), MTMKG7023A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7023a.docx)

[Natural sciences I: Soil science - Agrochemistry, MTMKG 7001A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7001a.doc)

[Natural sciences II - Nature conservation ecology, MTMKG 7008A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7008a.docx)

[Professional language skills (business language), MTM7NY2A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtm7ny2a.docx)

[Remote sensing, MTMKG7025A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7025a_0.docx)

[Research methodology, scientific communication, MTMKG7015A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7015a.docx)

[Sectoral administration and environmental law, MTMKG 7005A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7005a.docx)

[Sustainable agricultural systems and technologies I: Crop production, MTMKG7004A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7004a.docx)

[Sustainable agricultural systems and technologies II: Animal breeding, MTMKG7012A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7012a.docx)

[Watermanagement I: Agrohydrology, MTMKG7002A](file:///%5C%5Cdunkelzahn.agr.unideb.hu%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7002a.docx)

[Water management II - excess water management and irrigation techniques, MTMKG 7011A](file:///%5C%5C193.6.128.21%5Csites%5Cdefault%5Cfiles%5Cupload_documents%5Cmtmkg7011a.docx)

**Academic Language Skills, MTM7NY1A**

ECTS Credit Points: 3

0 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: practical course mark

Requirements:

- for signature: Absence as regards class attendance (3 allowed absences per semester).

- for a grade: Continuous tests orally and written. A term mark to be given at the end of the semester.

**Summary of content - theory**:

To provide students with the knowledge and the skills with which they can confidently and effectively complete their courses. The students get to know the basic grammatical and stylistic requirements and peculiarities of the written genres in higher education, as well as acquire the essential structural and linguistic formulas of debate and sharing of opinions.

 **lectures:**

|  |
| --- |
| 1. Effective source handling (information filtering and evaluation)
 |
| 1. The purpose, audience, and structure of the writing assignment
 |
| 1. The most important form requirements of writing assignments (report, thesis, academic article)
 |
| 1. Punctuation usage
 |
| 1. Structure, paragraphs, and conjunctions
 |
| 1. The abstract and the introduction
 |
| 1. Midterm exam
 |
| 1. Clear, logically constructed expression of opinion
 |
| 1. Constructive debate, reasoning (support of the argument), counter-arguments
 |
| 1. Brief problem-solving exercises in the foreign language to improve debate skills
 |
| 1. Complex case studies Part 1
 |
| 1. Complex case studies Part 2
 |
| 1. Sources and possibilities of independent study
 |
| 1. End term, Evaluation
 |

**practices:**

|  |
| --- |
| 1. Academic writing, speaking, reading comprehension and listening comprehension
 |
| 1. Academic vocabulary building, writing, speaking listening and reading comprehension
 |
| 1. Presentation skills, reading comprehension and listening comprehension, academic writing
 |
| 1. Developing academic literacy, speaking, reading and listening comprehension,
 |
| 1. Speaking and presenting,, reading comprehension and listening comprehension tasks, and academic writing.
 |
| 1. The situational dialogues, reading comprehension and listening comprehension tasks, and writing a formal letter regarding a given topic
 |
| 1. A survey of the skills and knowledge acquired thus far
 |
| 1. Poster and presentation, reading comprehension and listening comprehension tasks, and academic writing.
 |
| 1. Effective presentation, reading comprehension and listening comprehension tasks, and academic writing
 |
| 1. Time management, critical thinking, reading comprehension and listening comprehension tasks, and writing essays.
 |
| 1. Presentation, reading comprehension and listening comprehension tasks, and academic writing
 |
| 1. Speaking and presentation, reading comprehension and listening comprehension tasks, and academic writing
 |
| 1. Essay writing, speaking, reading comprehension and listening comprehension
 |
| 1. A survey of the skills and knowledge acquired throughout the semester
 |

**Literature**

[Martin Hewings](http://www.cambridge.org/gb/cambridgeenglish/authors/martin-hewings): Cambridge Academic Skills B2 Upper Intermediate. CUP, 2012. ISBN 97 80521165204

REID, Joy M. *The Process of Composition.* 3rd Edition. Longman: White Plains, NY., 2000. ISBN: 0-13-021317-9.

WIWCZAROSKI, Troy B. *Writing and Professional Communication*. Debrecen, 2007.

**Agricultural and environmental economics, MTMKG7024A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Completing assignments / exercises.

- for a grade: written exam

**lectures:**

1. Introduction to Environmental Economics, and Economic Growth and the Environment
2. Sustainable Development
3. The Theory of Externalities
4. Common Property Resources and Public goods
5. Resources Allocation over Time
6. Valuing the Environment
7. Ecological Economics: Basic Concepts
8. National Income and Environmental Accounting
9. Population and the Environment

**practices:**

1. Recognition of ecological crisis; To connect economic and ecological concerns of the world development
2. Knowledge on wide range of sustainability concepts
3. Examples of externalities
4. An example – the tragedy of commons; Knowledge on environmental management of public goods
5. Knowledge on role of time in management of resources
6. Tools and examples of monetary valuation
7. Knowledge on ecological economics
8. Information of environmental performance of states
9. Knowledge on dynamics of the population and insights of food demand and supply

**Literature, handbooks**

**Compulsory readings:** Harris, Jonathan M. – Roach, Brian: Environmental and Natural Resources Economics: A Contemporary Approach (3rd Edition), Routledge, 2013, 584 p.

**Recommended readings:** Costanza, R., Norgaard, R., Daly, H., Goodland, R., & Cumberland, J. (2007). An Introduction to Ecological Economics (e-book). Available at: <http://www.eoearth.org/view/article/150045>

Perman, R., Ma, Y., McGilvray, J., & Common, M. 2003. Natural resource and environmental economics. Pearson, 726 p.

Common,M. & Stagl, S. Ecological Economics. An introduction. 2005, Cambridge University Press, 560 p.

**Agricultural and Environmental Policy, MTMKG7022A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: colloquium

Requirements:

- for signature: Completing exercises, giving presentation and preparing a report.

- for a grade: Colloquium

**Summary of content – theory**

The general aim of the course is to increase the knowledge on rural development and agricultural policy in favour of environmentally responsible farming based on sustainable use of natural resources. Additionally, agricultural environmental management engineering students get information on agro- and environmental policies of the European Union and Hungary. Students understand the work of agricultural and environmental policy systems, and the connections among the different actions.

**lectures:**

1. History and future of the Common Agricultural Policy.
2. Common Agricultural Policy and rural development. SPS and SAPS systems, sectoral policies, organisation of agricultural market, cross-compliance.
3. Application of CAP at national level. Review of agricultural policy regulation for selected countries.
4. Definition and principles of agricultural policy. Tools of agricultural policy. The agricultural policy of the European Union.
5. Environmental protection and policy in Hungary.
6. National Environmental Protection Programmes.
7. Environmental policy and other related sectoral policies (climate, energy, transport, etc.)
8. Structural and institutional system of agricultural policy.
9. Environmental policy in the business sector, EP at company level.

**practices:**

1. Introduction into Agricultural Policy
2. Formulating Agricultural Policy in EU
3. Direct payment
4. Cross compliance
5. Agri-Environmental Scheme, measures
6. Agriculture and climate change
7. Organic Farming
8. Organic livestock production
9. Presentation and report

**Literature, handbooks**

[Tom Delreux](https://he.palgrave.com/authors/author-detail/Tom-Delreux/?sf1=name_exact&st1=TOMDELREUX&DS=Tom%20Delreux), T.-[Sander Happaerts](https://he.palgrave.com/authors/author-detail/Sander-Happaerts/?sf1=name_exact&st1=SANDERHAPPAERTS&DS=Sander%20Happaerts), S.:(2016). Environmental Policy and Politics in the European Union. Palgrave. 320.p. ISBN: 9780230244269.

Jordan, A.-Adelle, C.:(2012). Environmental Policy in the EU: Actors, institutions and processes. Rautledge, Abington. 392.p. ISBN: 978-1849714693

OECD (2016), Agricultural Policy Monitoring and Evaluation 2016 (Summary), OECD Publishing, Paris. 136.p. ISBN: 9789264253537 (PDF); 9789264259126 (EPUB); 9789264208933 (print).

Tangermann, S.-von Cramon-Taubadel, S.:(2013). Agricultural Policy in the European Union. Universität Göttingen. 75.p. ISSN 1865-2697.

Tropea, F.:(2016). Common Agricultural Policy 2014- 2020. European Parliamentary Research Service. 36.p. ISBN: 978-92-823-9357-4.

**Agricultural engineering, precision agricultural systems and technologies, MTMKG7014A**

ECTS Credit Points: 3

14 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Active participation in lectures and exercises, is a successful fulfilment of the tasks defined by the lecturer.

- for a grade: Completing assignments / exercises, submitting essay, giving presentation, written exam.

**Summary of content – theory**

The main aim of this course is to acquire theoretical and practical skills of precision agriculture. Students learn the precision technologies of data collection, data integration, and spatial decision support methods, including precision arable agriculture, precision horticulture and precision livestock farming. Students will be qualified for the application of the precision agriculture principles in environmental management and/or agriculture.

**lectures:**

1. Historical and theoretical background of precision agriculture. Parts and integration of precision agriculture into the practice.
2. Reasons of spatial variability in agriculture
3. Global Positioning System and its complementary systems
4. The role of GIS in precision agriculture
5. Usability of remote sensing data in precision agriculture
6. Databases, data infrastructure and map servers
7. Sensors, monitors, additional instruments
8. Precision plant protection
9. Precision nutrient management
10. Precision water management
11. Precision horticultural
12. Precision animal husbandry
13. Yield monitoring, site specific information after harvest
14. Economical aspects of precision agriculture

**Summary of content - practice**:

Students use spatial data from different data acquisition devices and mapping the soil and vegetation spatial and temporal heterogeneity by GIS software and evaluate the maps. Created maps could help in decision support in precision agriculture.

An important part of the practice is that student learn the most relevant members of Hungarian precision agricultural corporations and their locations throughout the world. Student can visit the service and the precision agriculture tools of the integrators, which can be provided for farmers.

**practices:**

1. Job computer – tractor mounted sensors – big data
2. Database management
3. Spatial heterogeneity in self-created digital maps I.
4. Spatial heterogeneity in self-created digital maps II
5. Spatial heterogeneity in self-created digital maps III.
6. Geo-statistically examination for more effective decision support
7. Processing of airborne survey (LiDAR and spectral remote sensing) data for precision agriculture I.
8. Processing of airborne survey (LiDAR and spectral remote sensing) data for precision agriculture II.
9. Processing of airborne survey (LiDAR and spectral remote sensing) data for precision agriculture III.
10. Processing of satellite remote sensing data for precision agriculture I.
11. Processing of satellite remote sensing data for precision agriculture II.
12. Processing of satellite remote sensing data for precision agriculture III.
13. Field exercise/farm visit I.
14. Field exercise/farm visit II.

**Literature, handbooks**

Brase, T. (2005): Precision agriculture. Delmar Cengage Learning. 1st edition. 288 p.

Kennedy, H. (2009) Introduction to 3D Data: Modelling with ArcGIS 3D Analyst and Google Earth. Wiley. 360 p.

Kennedy, H. (2009) Introduction to 3D Data: Modelling with ArcGIS 3D Analyst and Google Earth. Wiley. 360 p.Qin, Z. (2015): Precision Agriculture Technology for Crop Farming. Taylor & Francis. 374 p.

Srinivasan, A. (2006): Handbook of precision agriculture: Principles and applications. CRC Press. 683 p. (ISBN: 978-156-022-954-4)

Tamás, J. (2011): Precision Agriculture. University of Debrecen. Centre for Agricultural and Applied Economic Sciences. Debrecen. 126 p.

(<http://www.tankonyvtar.hu/hu/tartalom/tamop425/0032_precizios_mezogazdasag/adatok.html>

**Agricultural Forestry, MTMKG7016A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: exam mark

Requirements:

- for signature: Attending the lectures and practices. Completing exercises, submitting essay.

- for a grade: Completing assignments / exercises. Continuous tests orally and written. A term mark to be given at the end of the semester

**Summary of content - theory**:

The main aim of the course is to provide basic knowledge on the priorities and tasks of forest management as well as on the main management directions and forest administration.

 **lectures:**

1. Priorities and characteristics of forest management.
2. Criteria of forest site classification.
3. Ecological and silvicultural characteristics of the main stand-forming tree species.
4. Forest tree improvement and forest stand establishment techniques.
5. Agro-forestry systems.
6. Nature-like forest management.
7. Wood utilization and forest subsidiary use.
8. Introduction to forest mensuration.
9. Forest administration and forest management planning.

**practices:**

 Identify common tree species.

1. Identify the abiotic and biotic factors in a forest ecosystem.
2. Introduction to forest breeding and improvement.
3. Know the plant propagation material management.
4. Understand silvicultural terms, and be able to explain the uses of the following techniques: cleaning, thinning, shelterwood, clearcutting.
5. Explain the plantation forestry and agro-forestry techniques.
6. Explain the nature-like forest management techniques.
7. Know how to use forestry tools and equipment in order to measure single trees and forest stands.
8. Understand why trees and forests are important to recreation, wildlife, and watershed quality.

**Literature, handbooks**

Hibberd, B. G. ed. 1986: Forestry Practice. Forestry Commission Bulletin. 14. London, pp. 104. (ISBN 0 11 710156 7).

Savill, P. et al. 1997. Plantation Silviculture in Europe. Oxford University Press. pp 297.

(ISBN 0 19 854909 1).

West, P.W. 2006. Growing Plantation Forests. Springer. pp.303. (ISBN-13 978-3-540-32478-2).

**Agro-environmental management I., MTMKG7007A**

ECTS Credit Points: 5

42 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: colloquium

Requirements:

- for signature: Completing exercises, giving presentation.

- for a grade: Colloquium

**Summary of content – theory**

The aim of the course is to introduce the theoretical concepts and applications of agro-environmental management. Completing the subject, students get to know the main steps of development of environmental management, the connection between environmental management and agriculture, international and national environmental management programs, the regulation of environmental management, the practice of sustainable agriculture, and the applied procedures. After accomplishing the course, students will keep and follow the regulations of environmental protection, and apply the principles of agricultural production.

**lectures:**

1: Recent social and economic processes as the original factors forming the condition of environment. Direct factors controlling the quality of environment, emissions. State of the environment.

2: Characterization of the relationships between agriculture and environment: Environmental aspects of crop production.

3: Evaluation and environmental aspects of nutrition management.

4: Characterization of the relationships between agriculture and environment: Environmental aspects of animal husbandry.

5: Environmentally aspects of livestock farm establishment.

6: Natura 2000 Program. Agriculture in protected and vulnerable natural regions.

7: Renewable energy sources in the agriculture.

8: The agro-environmental aspects of climate change.

9: Proper agricultural practice.

10: Organic farming.

11: Legal and administrative regulation in connection to agro-environmental management in the EU and Hungary.

12: Agro-environmental management and rural development programs.

13: Agro-environmental management target programs.

14: Professional trip

**Summary of content - practice**:

Skills to be learnt: Students will be able to evaluate and discuss specific cases using their knowledge gained about theory on lectures.

**practices:**

1. Introduction into Agro-environmental management
2. Land Parcel Identification
3. Soil and soil degradation – causes and effects
4. Environmental effects of tillage systems
5. Crop Residue Management
6. Nutrient supply forms, fertilizers in plant production and environmental impacts I
7. Nutrient supply forms, green manure, compost, manure, slurry in plant production and environmental impacts
8. Environmental aspects of Pest control
9. Integrated Pest Control
10. Greening in EU
11. Organic farming
12. Organic livestock husbandry
13. Environmental aspects of poultry husbandry
14. Presentation

**Literature, handbooks**

Birol, E. – Koundouri, P. (2008): Choice Experiments Informing Environmental Policy. Elgar, Edward Publishing, Inc. 368.p. ISBN: 978 1 84542 725 2.

Jack, B. (2009): Agriculture and EU Environmental Law. Ashgate Publication. 300.p. ISBN-13: 978-0754645405.

Juhász, Cs.-Zsembeli, J. (2014). Environment and land use.

<http://www.tankonyvtar.hu/hu/tartalom/tamop412A/2011_0009_Juhasz_Csaba-Environment_and_Land_Use/adatok.html>

<https://moodle.agr.unideb.hu/tamop/course/view.php?id=19>

Merrington, G. – Winder, L. – Redman, M. (2005): Agricultural Pollution. Environmental Problems and Practical Solutions. Spon Press. 216.p. ISBN-13: 9780419213901.

Ritter, W. F. – Shirmohammadi, A. (2001): Agricultural nonpoint source pollution. CRC Press LLC. 342.p. ISBN-13: 978-1566702225

Warren, J.-Lawson, C.-Belcher, K. (2008): The Agri-Environment. Cambridge University Press, UK, 224.p. ISBN-13 978-0-521-61488-7.

**Agro-environmental management II-Ecotoxcicology, environmental risk assessment, MTMKG7020A**

ECTS Credit Points: 4

14 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Submitting reports in due time, taking part actively in the practices and field trips and completing home work individually are compulsory. Student may skip class maximum 3 times during the semester.

 - for a grade: Essay type written exam is taken in the examination period of the semester focusing on the knowledge gained. List of the topics is provided below.

**Summary of content – theory**

Fulfilling the course, students will know the potential sources of environmental risks, factors determining and controlling the exposition and transport processes within the ecological systems, and the methodology of environmental risk analysis, assessment and management. The students will be familiar with the EU legislation related to the use of environment, and risk assessment for the sectors of agriculture and food industry, and the relevant best available techniques. As a result of completing practical tasks, they will have the skills to identify the relations between ecotoxicology and environmental risk assessment and management, to measure and interpret proper data and information, as well as to carry out scenario analyses using selected software, required to the ERA. Study trips will also serve to understand the link between theory and practice. Practical tasks serve to apply the theoretical knowledge on ecotoxicology and ERA, as well as to improve skills on software use and reporting, including the followings: mass and energy balances for the agricultural and food sectors; transport modelling and scenario analyses; chemical analyses for selected pollutants in environmental samples, data interpretation linked to ERA, visualization by GIS tools; study trip to natural and agricultural sites where activities posing potential environmental risk are carried out; study trip to sites after clean-up and rehabilitation.

**lectures:**

1. Ecotoxicology – potential pollutants in the environment, fate and transport of pollutants in the ecological systems, expositions
2. Ecotoxicological tests
3. Licensing of new chemicals
4. Environmental risk assessment methodology
5. Transport processes and their modelling in soil and ground water
6. EU legislation for environmental risk assessment (ERA), reduction and management
7. Best available – environmentally responsible – techniques in the agriculture and food industry
8. Planning and designing clean-up technologies based on ERA
9. Latest scientific results in the area of ecotoxicology

**Summary of content - practice**:

Students will practice the implementation of principles, and application of procedures as well as interpretation methods in the field of environmental risk assessment and ecotoxicology in the form of individual case studies using data measured in laboratory and modelling in IT environment.

**practices:**

1. Finding link between environmental/ecological risk assessment and the characteristics of artificial stressors, including their fate and transport in the environment.
2. Assessment of environmental impacts related to a case study using matrices.
3. Assessing conditions for best available techniques (BAT) for a given agriculture related activity.
4. Investigation in the application of the principles of cleaner production (CP).
5. Hydrogeological modelling in IT environment, modelling an unconfined aquifer system with discharge and recharge
6. Carrying out scenario analyses in the hydrogeological modelling
7. Assessing clean up technologies and processes to a case when an accident in production or transportation happens, related to a company in the agriculture and food industry sectors.
8. Laboratory analyses for soil and water samples; measuring parameters considerable from the point of contamination transport; and assessment of the meaning of the values from environmental point of view.
9. Finding the latest scientific articles in relation to environmental risk assessment and management

**Literature, handbooks**

[Whitacre, David M.](http://www.prospero.hu/katalogus/kereso/?form_submit=1&szerzo=Whitacre+David) (2015): Reviews of Environmental Contamination and Toxicology. [Reviews of Environmental Contamination and Toxicology](http://www.prospero.hu/katalogus/kereso/?form_submit=1&cim=Reviews+Environmental+Contamination+and+Toxicology); [225](http://www.prospero.hu/katalogus/kereso/?form_submit=1&cim=225). Springer Verlag. 144 p. ISBN-13: 9781489988201

[Newman, Michael C](http://www.prospero.hu/katalogus/kereso/?form_submit=1&szerzo=Newman+Michael). (2014): Fundamentals of Ecotoxicology. The Science of Pollution, Fourth Edition. CRC Press. 680 p. ISBN-13: 9781466582293

Áine Gormley, Simon Pollard, Sophie Rocks: Guidelines for Environmental Risk Assessment and Management. Cranfield University, 2011: <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69450/pb13670-green-leaves-iii-1111071.pdf>

Best available techniques – guidelines: <http://eippcb.jrc.ec.europa.eu/reference/>

<http://eippcb.jrc.ec.europa.eu/reference/BREF/IRPP_Final_Draft_082015_bw.pdf>

Exercise book: Practical exercises for the course of agro-environmental management II - ecotoxicology, environmental management

**Drainage engineering, MTMKG7028A**

ECTS Credit Points: 3

0 hour(s) lecture and 42 hour(s) seminar per semester

Type of exam: practical course mark

Requirements:

- for signature: Completing the exercises in due time, taking part actively in the practices and field trips and completing homework individually are compulsory. Student may skip class maximum 3 times during the semester.

- for a grade: Oral exam is taken in the examination period of the semester focusing on the knowledge gained.

**Summary of content – theory**

The students attending the course can get acquainted with the importance, methods, tools and effects of surface- and subsurface drainage in hilly and flat areas aiming water management conditions suitable for different land use purposes.

Skills to be gained:

Students will practice the implementation of principles, and application of procedures as well as interpretation methods in the fields of basic hydrology, water resources, watershed management, surface and subsurface drainage, agrometeorology, lysimetry, basics of irrigation, soil-water-plant relations.

**lectures:**

* + - 1. Basics, goals and methods of surface drainage
			2. Water damages, formation of surplus waters, resistance of crops to water surplus
			3. Surface drainage on hilly areas
			4. Surface drainage on flat areas, protection against water loggings
			5. Determination of flow carrying capacity of channels
			6. Channel design calculations
			7. Goals, necessity, importance and history of subsurface drainage
			8. Basics and scientific establishment of subsurface drainage (lysimetry)
			9. Soil- and groundwater sampling and analyses for subsurface drainage
			10. Methods and elements of subsurface drainage
			11. Materials and objects of subsurface drainage
			12. Design of subsurface drainage networks
			13. Subsurface drainage design calculations
			14. Construction, operation and maintenance of subsurface drainage networks

**Literature, handbooks**

Larry W. Mays (2011): Water resources engineering. ISBN-13: 978-0470460641, ISBN-10: 0470460644

Nakagami, Ken’ichi, Kubota, Jumpei, Setiawan, Budi Indra (Eds.) (2016): Sustainable water Management. Springer. ISBN: 9789811012044 9811012040 9811012024 9789811012020

Lambert K. Smedema, Willem F. Vlotman, David Rycroft (2004): Modern Land Drainage: Planning, Design and Management of Agricultural Drainage Systems. CRC Press. ISBN 9789058095541

Waller, Peter, Yitayew, Muluneh (2016): Irrigation and Drainage Engineering. Springer. ISBN 978-3-319-05699-9

**Drought management, MTMKG7026A**

ECTS Credit Points: 3

0 hour(s) lecture and 42 hour(s) seminar per semester

Type of exam: practical course mark in written exam

Requirements:

- for signature: A report, including the objective interpretation of roles, methods and the results of field scale and GIS laboratory exercises. Active participation the lessons (at least 11), completing exercises, submitting report at the end of the semester.

- for a grade: practical course mark in written exam

**Summary of content – theory**

Though there are no theory lectures, the aim of the course is to make students understand and apply the practical application of drought management, including the following: forms, rise, quantitative characteristics, measurement, spatial and periodical dispersions, and density- and dispersion functions of drought. Applying the mechanisms, forms, measurement and calculation of the evapotranspiration. The ability of evaluation of technological practices, activities of drought monitoring concerning agriculture and environmental management. The course provides advanced knowledge on drought monitoring and mitigation techniques, theory and practice of designing, theory of setting and installation, handing over of plant water supply for irrigation systems. As a result of completion of the course, students will be able to apply principles of advanced drought management, as potential managers or professional experts.

**Summary of content - practice**:

The goal of the following exercises is to get the agricultural environmental management engineering MSc students acquainted with the main drought management plans, drought stress monitoring and a method for measurement and calculation of evapotranspiration. The exercises provide advanced knowledge on drought monitoring techniques, plant water supply for irrigation systems. As a result of completion of the exercises, students will be able to apply principles of advanced drought monitoring.

**practices:**

1. Define the concept of water scarcity and drought, drought types

2. Water scarcity and droughts in the international policy and in the EU Water Framework Directive -drought, water quantity on points

3. National Drought Strategy elements, the main steps of drought management plans

4. Agricultural Drought Analysis Methods - traditional drought indices

5. Agricultural Drought Monitoring - Remote sensing data based vegetation indexes in Agricultural Drought Monitoring

6. The possibilities of drought damage prevention in agriculture

7. Options for adaptation to drought in agriculture

8. Soil-water-plant relations The measurement of soil water reservoir

9. Measurement micro-meteorological and climatic factors affecting water supply

10. Field data calibrated hyperspectral data in water stress detection

11. Measuring and analyzing of soil-water-plant relations abiotic stress on canopy based on spectral features

12. Irrigation scheduling and evapotranspiration calculation methods

13. The surface and subsurface water resources utilization periods of drought - Water retention opportunities in agriculture

14. Irrigation development opportunities in arid regions

**Literature, handbooks**

Paul A. DeBarry (2004): Watersheds: Processes, Assessment and Management. John Wiley & Sons, Inc., Hoboken, New Jersey. ISBN-13: 978-0471264231

Isobel W. Heathcote (2009): Integrated Watershed Management: Principles and Practice. John Wiley & Sons, Inc., Hoboken, New Jersey. ISBN-13: 978-0470376256

World Meteorological Organization (WMO) and Global Water Partnership (GWP) (2014) National Drought Management Policy Guidelines: A Template for Action (D.A. Wilhite). Integrated Drought Management Programme (IDMP) Tools and Guidelines Series 1. WMO, Geneva, Switzerland and GWP, Stockholm, Sweden.

World Meteorological Organization (WMO) and Global Water Partnership (GWP), 2016: Handbook of Drought Indicators and Indices (M. Svoboda and B.A. Fuchs). Integrated Drought Management Programme (IDMP), Integrated Drought Management Tools and Guidelines Series 2. Geneva.

Global Water Partnership Central and Easter Europe (2015). Guidelines for the preparation of Drought Management Plans. Development and implementation in the context of the EU Water Framework Directive, Global Water Partnership Central and Eastern Europe, 48pp

**Environmental impact assessment and environmental modeling, MTMKG7009A**

ECTS Credit Points: 4

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Active participation in lectures and exercises is a successful fulfillment of the tasks defined by the lecturer.

- for a grade: Completing assignments / exercises, submitting essay, giving presentation, written exam.

**Summary of content – theory**

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

**lectures:**

1. Principles of modeling
2. Importance of environmental risk assessment
3. Characteristics of soil plant atmosphere system
4. Modeling of the impacts on soil and groundwater effects
5. Modeling of the impacts on surface water effects
6. Modeling of the impacts on atmosphere effects
7. Modeling of the impacts on biomass and landscape effects
8. Modeling of the impacts on the human health effects
9. Socio-economic consequence of the impacts on the environmental effects
10. Preparing of environmental impact studies
11. Practical application of pollution transmission models, processing of remediation and monitoring
12. Remediation of soil, groundwater and surface water
13. Cost-benefit analysis of remediation
14. Development of simulation and modelling software

**practices:**

1. Surfer GUI
2. Surfer colour management
3. Surfer data management
4. Grid DEM
5. Data importing
6. Basic Data statistics
7. DAT data types
8. Griding methods
9. Grid report evaluation
10. Accurate interpolations
11. IDW, TIN
12. Global interpolations
13. Kriging
14. Error propagations

**Literature, handbooks**

Adolf, E., Teimuraz, D. (2007): Air, Water and Soil Quality Modelling for Risk and Impact Assessment. Springer Verlag. 365 p.

Colombo, A. G. (2012): Environmental Impact Assessment. Springer Verlag. 334 p.

Bastmeijer, K., Koivurova, T. (2008): Theory and Practice of Transboundary Environmental Impact Assessment. Martinus Nijhoff Publishers. 397 p.

Wathern, P. (2013): Environmental Impact Assessment. Theory and Practice. Routledge (Taylor and Francis Group). 352 p.

GoldenSoftware(2018) Surfer Manual https://www.goldensoftware.com/products/surfer

**Environmental informatics – Environmental monitoring MTMKG7003A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Active participation in lectures and exercises, is a successful fulfillment of the tasks defined by the lecturer.

- for a grade: Completing assignments / exercises, submitting essay, giving presentation. Written exam.

**Summary of content – theory**

Students are acquainted with and master the renewable and non-renewable natural resources and geospatial assessment, change detection, the theory and practise of spatial decision support systems. They will be able to work in their environmental management work and operate geospatial and remote sensing software. They acquire knowledge related to enhancing environmental monitoring systems.

 **lectures:**

1. Local and international environmental geospatial projects.
2. Environment information systems on the Internet, data warehouses and metadata
3. The construction and operation of environmental management information systems, environmental elements and related IT tasks
4. Characterization, collection and data structures of digital environmental management data related requirements.
5. Modelling the environment.
6. Modelling soil and water
7. Hydrology environmental models
8. Surface and groundwater modelling
9. Landscape protection and landscape evaluation models
10. Space and time change assessment - Geostatistics basics
11. Basics of Remote Sensing.
12. Geoinformatics model of single-factor decision-making systems.
13. Applied, complex multi-factor decision-making systems.
14. Decision support modelling solutions

**practices:**

1. Surfer GUI
2. Surfer colour management
3. Surfer data management
4. Grid DEM
5. Data importing
6. Basic Data statistics
7. DAT data types
8. Griding methods
9. Grid report evaluation
10. Accurate interpolations
11. IDW, TIN
12. Global interpolations
13. Kriging
14. Error propagations

**Literature, handbooks**

Janardhana Raju et al. (2015) Management of natural resources in a changing environment. Springer Publ. ISBN 9783319125589

Lichtfouse E. Goyal A. (2015) Sustainable Agriculture Reviews 16. Spriger Publ. ISBN 9783319169873

GoldenSoftware(2018) Surfer Manual https://www.goldensoftware.com/products/surfer

**Environmental Measurement Techniques, MTMKG7006A**

ECTS Credit Points: 4

14 hour(s) lecture and 42 hour(s) seminar per semester

Type of exam: exam

Requirements:

- for signature: Attendance of the lessons.

- for a grade: Completing assignments / exercises, giving presentation.

**Summary of content – theory**

Students are introduced to the applied classic and modern laboratory measuring techniques. Lab rules will be discussed, basic devices will be presented, weight and volume measuring techniques used in labs will be discussed, and basic chemical calculations will be made.

They will be able to use mobile, rapid water, soil analytical methods and the related water and soil quality protection regulations and legal background. Students will be able to determine food, soil and water quality and thus the likely impact and danger of pollutions and can make a decision if there is need for intervention.

Students acquire specialized knowledge in the measurement of municipal, agricultural and food industrial wastes and by-products and their analytical background. They receive useful knowledge about sampling methods (soil and plant) and sample pre-treatment.

**practices:**

Exercise 1: Lab safety, basic lab equipment

Exercise 2: Chemical calculations

Exercise 3: General introduction to titrimetry, acid-base titration, determination of acetic acid content in canned food samples and sulfuric acid content in industry wastes

Exercise 4: Determination of water hardiness by complexometric titration

Exercise 5: Determination of food salt concentration (Mohr’s method)

Exercise 6: Determination of acidity of milky products

Exercise 7: Environmental analysis: Sampling methods, soil sampling

Exercise 8: Soil analysis: determination of soil pH, nitrate, nitrite and ammonium content

Exercise 9: Soil analysis: determination of soil carbonate and phosphorus and potassium content

Exercise 10: Waste analysis: pre-treatment: extraction methods

Exercise 11: Waste analysis: usage of test methods

Exercise 12: Determination of leaf chlorophyll content by non-destructive and destructive method

Exercise 13: Measurement of Soluble Solids Content of fruits

Exercise 14. Determination of phenol contaminants in water samples by thin layer chromatography

**Literature, handbooks**

W. V. Nazaroff and L. Alvarez-Cohen. 2001. Environmental Engineering Science. 704 pages. Wiley Co.ISBN-13: 978-0471144946

Tamás J., Kovács E. 2008. Environmental technology. University of Debrecen, Institute of Water- and Environmental Management. TÁMOP 4.1.2. http://www.tankonyvtar.hu/en/tartalom/tamop425/0032\_kornyezettechnologia\_en/ch03.html

Environmental Measurements and Modelling https://www.epa.gov/measurements-modeling/collection-methods

**Environmental planning, land consolidation, landscape conservation, MTMKG7021A**

ECTS Credit Points: 4

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: Written exam

Requirements:

- for signature: Active participation in lectures and exercises, is a successful fulfilment of the tasks defined by the lecturer. Submitting essay, giving presentation.

- for a grade: Written exam

**Summary of content – theory**

The general aim of the subject is to present the purposes and the practice of landscape conservation and planning for the students. The role and position of the subject in environmental management, the technologies and methodologies of land consolidation and landscape conservation will be presented during the course. Students will learn the national and international land use systems. This knowledge provides land consolidation, land registration and land evaluation skills in the practice.

**lectures:**

1. Environment planning
2. National and international projects, information systems on the Internet, data warehouses and metadata.
3. Planning strategies, the aim of planning process: protection, rehabilitation, development
4. Landscape level planning – ecological networks, water network, green areas, artificial surfaces
5. Land use categories in the EU (CLC-100)
6. Land registration and land evaluation
7. Agricultural land use, land consolidation
8. Land use modeling: site-optimization, multi-purpose land allocation
9. Land change evaluation

**Summary of content - practice**:

The general aim of the practice is that students get to know modern landscape management. Students adopt landscape architecture, determine landscape indexes, make soil moisture calculation, learn the practical application of pF curve in horticulture.

**practices:**

1. Calculation of landscape indexes.
2. Site evaluation of agroforestry area.
3. Site evaluation of constructed wetland.
4. Greenness program in practise
5. Field exercise/farm visit hillside area.
6. Field exercise/farm visit agroforestry area.
7. Field exercise/farm visit energy plantation.
8. Field exercise/farm visit constructed wetland.
9. Consultation about compulsory practical report.

**Literature, handbooks**

Bishop, D., Lange, E. (2005): Visualization in landscape and environmental planning. Taylor and Francis. 320 p. (ISBN: 978-041-530-510-5)

Magueire, D. J., Goodchild, M. F., Batty, M. (2005): GIS, Spatial Analysis and Modeling. Esri Press. 480 p. (ISBN: 975-158-948-130-5)10: 0-615-22838-0.

**Environmental technologies I. Soil remediation, soil protection, biotechnology in agriculture, MTMKG7013A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: A report, including the objective interpretation of roles, methods and the results of field scale and GIS laboratory exercises on the field of remediation and soil conservation.

- for a grade: Participation at the field trip and active participation the practical lessons (at least 8), completing exercises, submitting report at the end of the semester, written exam.

 **Summary of content – theory**

This course reviews the basic knowledge of soil pollution, characterization methods of polluted sites, regulations of remediation in Hungary, contamination transport processes in soils, and biological, chemical, physical, phytoremediation (clean-up) technologies in detail. Introduction of the reasons and consequences of the main soil degradation processes. Introduction of the technical, agronomical, soil protection, chemical, mechanical, complex amelioration and recultivation methods suitable for the moderation of the unfavourable effects.

**lectures:**

1. Definition of remediation, national and international background and main steps of remediation plans and environmental status assessment

2. Requirements of site characterization, regulation for underground water and geological medium in EU

3. Sampling methods, impoundment methods for contaminated sites

4. Pollution transport in soil and pollution distribution and transformation in soil

5. Aspects of appropriate remediation technologies

6. In-situ and ex-situ physical remediation methods

7. In-situ and ex-situ chemical remediation methods

8. In-situ and ex-situ biological remediation methods, Phytoremediation methods

9. The soil conservation, land reclamation, environmental and soil acidification, salinization, secondary salinization, soil structure degradation, soil compaction.

10. Improving acidic and saline soils.

11. Improve sandy soils, improving soil physical properties of deep ploughing.

12. Water erosion, technical and agronomic possibilities of protection against erosion.

13. Wind Erosion, protection against deflation agronomic possibilities.

14. Complex amelioration (soil improvement, drainage, surface drainage and subsurface drainage).

**Summary of content - practice**:

The aim of the practice is to provide students with the skills they need to explore and interpret at a high level, to analyze complex problems in remediation and soil protection with advanced tools. In addition, they are able to interpret legal issues and plan their management.

**practices:**

1. Field practice: Sampling of a polluted site

2-3. Laboratory and GIS practice: Defining underground contaminant transport by measuring and calculating of ground water flow speed and directions based on field survey data

 4. Laboratory practice: Analyze the basic characteristics and pollutants of soil samples (i.e. with XRF)

5. Pollution Distribution Modeling - GIS Applications

 6. Laboratory Exercise: Preparation of environmental toxicological and bioaccumulation tests

7. Measuring the environmental toxicological tests

8. Analyzing the results of environmental toxicological tests

9. Measuring the bioaccumulation test, dividing roots and shoots and drying it

10. Analyzing the results of bioaccumulation

11. Soil Loss Modeling with RUSLE

12-14 Field trip: Visiting heavy metal and organic polluted sites with ongoing remediation process

**Literature, handbooks**

Prasad, MNV. 2005. Trace Elements in the Environment: Biogeochemistry, Biotechnology, and Bioremediation CRC Press/Taylor & Francis Group Boca Raton FL 33487 USA 744 ISBN 978-1-56670-685-8

P Lens, T Grotenhuis, G Malina, H Tabak 2005. Soil and Sediment Remediation. IWA Publishing London SW1H 0QS United Kingdom 544 ISBN 9781843391005

Neilson, Alasdair H. 2007. Environmental Degradation and Transformation of Organic Chemicals. Taylor & Francis (USA) Philadelphia, PA 19106 USA ISBN 9780849372414

Mirsal I.A. 2004. Soil pollution: Origin, Monitoring and Remediation Spreinger 312. ISBN: 978-3-540-70775-5

Saligram Bhatt (2004): Environment Protection and Sustainable Development. APH Publishing. 241. p. ISBN 9788176485128

**Environmental technologies II - Water Quality Protection, Sewage Treatment, Waste Management in Agriculture and Food Industry, MTMKG7017A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Participating in the exercises, successful written examination paper , giving presentation.

- for a grade: Written (Quizzes & Essays) exam.

**Summary of content – theory**

The purpose of the course is to acquaint students with the goals, concepts and tools of water quality protection, waste water treatment and waste management. They learn about methods of water qualification and water quality control, sources and forms of water pollution, methods of water treatment, quality and quantity protection and restoration of waters & watercourses. They acquire knowledge about the management, utilization and disposal of agricultural and food waste and by-products.

**lectures:**

1. The concept and purpose of water quality protection, the methods of water quality control and the legal background. Water quality parameters.
2. Human intervention in the river basin. Water pollution and hydromorphological regulations.EU and international methods of water qualification (physical, chemical, biological & ecological water qualification)
3. Rehabilitation of surface water bodies in the river basin. Self-purification of water.
4. Pollution and protection of groundwater bodies. Water resources protection.
5. Purpose and degree of wastewater purification; the generation and characterization of waste water. Mechanical (primary) sewage purification
6. Ecological and microbiological basics of biological wastewater purification, aerobic and anaerobic sewage purification processes; activated sludge and trickling filters, biological nitrogen and phosphorus removal; digesters.
7. Natural sewage treatment technologies. Lagoon sewage purification systems; Natural aquatic plant systems, & Constructed Wetlands.
8. The communal waste management. The role of waste management in agriculture and the food industry; Types, grouping, quantity and agricultural utilization of communal, agricultural and food waste and by-products.
9. Composting technologies based on agricultural and food raw materials and sewage sludge.
10. Biogas production technologies based on agricultural and food raw materials and sewage sludge.
11. Hazardous waste from agriculture and food industry (pesticides, slaughterhouse waste, etc.);
12. The burning and pyrolysis of communal, agricultural and food waste and sewage sludge.
13. Waste disposal – landfill

**Summary of content - practice**:

The general purpose of the practice is to provide students with knowledge on the operation of water quality, wastewater treatment and waste management technologies, the safe use of equipment, instruments used in environmental ratings, accident prevention role in field, plant and practical work.

**practices:**

1. Accident prevention and work safety knowledge
2. Methods and means of field sampling 1.
3. Purchase, conservation and pre-treatment of biological and water samples, on-site measurements and tests (weather, etc.)
4. Analysis of field water samples. : Organoleptic Effects of Water Pollution
5. Biological water qualification. Classification of water pollutants
6. Basics of Hydrological and Water Quality Modelling, Hydrological, Morphological and Water Physics. River Water Quality
7. Basics of hydrological and water quality modelling biological and water chemistry. Introduction and application to the HEC-Ras model
8. The Debrecen Wastewater Treatment Plant, the Water Treatment Plant in Balmazújváros and the Eco centrum of Lake Tisza visit (8-10 hours)
9. Planning of Dorr settlers. Sewage treatment plant. Complex sewage treatment
10. Calculation of weighing scales in waste management and sewage treatment. Material flow chart.
11. Composting Quizzes
12. Analysis of the efficiency of wastewater treatment (Excel) Complex sewage treatment.
13. Examination of water quality and hydrological time series (Excel) Using regression, factor and cluster analysis through a practical example.
14. Establishment of a landfill. Isolation of a non-hazardous (municipal) landfill.

**Literature, handbooks**

The curriculum (ppt or pdf format) is available to the student.

Federal Interagency Stream Restoration Working Group (FISRWG) (10/1998). Stream Corridor Restoration: Principles, Processes, and Practices. GPO Item No. 0120-A; SuDocs No. A 57.6/2:EN3/PT.653. ISBN-0-934213-59-3.

T. H. Christensen: Solid Waste Technology & Management, Volume 1 & 2. Blackwell Publishing Ltd 2011. Print ISBN: 9781405175173. Online ISBN: 9780470666883.

M. R. Templeton, D. Butler: An Introduction to Wastewater Treatment. Ventus Publishing 2011. ISBN 978-87-7681-843-2

**Farm Business Management and Project Management, MTMKG7018A**

ECTS Credit Points: 3

14 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: colloquium

Requirements:

- for signature: Completing exercises.

- for a grade: Colloquium

**Summary of content – theory**

Farm business management combines study in agricultural production and science with a variety of business disciplines, preparing students for entrepreneurial, management and leadership roles in the agricultural sector.

Introduction of the basic methodology and most important functions of project management (project design, organization, implementation monitoring and evaluation). After mastering the subject the students will be able to prepare and undertake projects and acquire the basic skills necessary for developing projects.

**lectures:**

1. Farm management, Farm business and enterprises, income costs and profitability
2. Production economic principles and concepts, financial analyses, investment analysis and decision making
3. Marketing, value adding, Human Resource Management, Risk Management
4. The Business Plan, key economic concepts
5. Economics and the market
6. Structure and dynamics of EU farms, CAP Reform 2014-2020
7. European farmers’ intentions to invest in 2014-2020, CAP 2014-2020 Policy Instruments and Precision Agriculture
8. Project Management, Project Life Cycle, PM Principles, Project types, Project characteristics
9. Project Team, Personal Skills in Project Management
10. Project Plan, Step by Step (Scope Management, Time Management, Cost Management)
11. Dealing with Risks and Uncertainties,
12. Project Execution, communication activities, documentation
13. Project reports, conclusion, dissemination
14. Programs, call for tenders related to agricultural and environmental sector in EU

**Summary of content - practice**:

Thinking in system approach and connect different aspects

**practices:**

1. Set up a new business
2. Strategical planning
3. Risk management
4. Resource planning
5. Production structure and production technology
6. Production value (Revenue)
7. Production cost
8. Income
9. Project management goals
10. Working in group
11. Communication plan
12. Budget planning
13. Strategical analysis
14. Risk assessment

**Literature, handbooks**

S van Zyl, PG Strauss & JB Stevens 2012. Training material for extension advisors in irrigation water management Volume 2: Technical Learner Guide Part 7: Irrigation economics. Water Research Comission. ISBN 978-1-4312-0342-0. p. 155.

Andrew Woodend 2010. Definitions of Terms used in Farm Business Management. Department for the Environment, Food and Rural Affairs, Crown Copyright. p. 47.

Gary R. Heekens, PMP: Project Management. McGraw-Hill. 0-07-137952-5.
DOI: 10.1036/0071394494. p. 249.

**Food chain safety, MTMKG7010A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: c practical course mark

Requirements:

- for signature: Successful test (60%) and participation in practices

- for a grade: Completing exercises, giving presentation, successful test (60%).

**Summary of content – theory**

The main aim of the lectures is to introduce the physical, chemical and biological/microbiological hazards which have important effects on food chain safety. In this semester, students will learn the methodology of risk analysis (mainly risk assessment) and the methodology of the determination of safe human dose, tolerable intakes and other toxicological values. Students will learn the methodology of hazard analysis and the preparation of HACCP plans.

**lectures:**

1. Influencing factors of food chain safety
2. 178/2002/EC; 852/2004/EC and 853/2004/EC regulations
3. Introduction to toxicology
4. Methodology of calculation of SHD, TDI, RfD, etc.
5. Chemical hazards
6. Microbiological hazards
7. Foodborne diseases
8. Introduction to risk analysis; Preliminary risk management activities
9. Risk management and risk communication
10. Methodology of HACCP plan preparation
11. Hazard analysis of plant origin food production (bakery products)
12. Hazard analysis of plant origin food production (quick-frozen and can products)
13. Hazard analysis of animal origin food production (dairy products)
14. Hazard analysis of animal origin food production (meat products)light of food safety

**Summary of content - practice**:

The main aim of the practices is to expand the lecture’s knowledge with example tasks and case studies. Therefore the students explore case-studies and make exercises which help them to develop their abilities for the assessment of risks and hazards and for exposure assessment.

**practices:**

1. Environmental pollutants as influencing factors of food chain safety
2. RASFF system and INFOSAN
3. Bio-concentration in environmental elements
4. Environmental health chain
5. Calculation of safe human dose
6. Dose-response relationship and curve
7. Human exposure assessment (ingestion and inhalation)
8. Risk estimation
9. Risk assessment
10. Flow chart in HACCP plan
11. Hazard identification in HACCP plan
12. Determination of CPs and CCPs in HACCP plan
13. Hazard analysis in HACCP plan
14. Monitor control and corrective actions in HACCP plan

**Literature, handbooks**

IPCS (2010): WHO human health risk assessment toolkit: chemical hazards. ISBN: 978-92-4-154807-6

2016/C 278/01 EU Commission notice on the implementation of food safety management systems covering prerequisite programs (PRPs) and procedures based on the HACCP principles, including the facilitation/flexibility of the implementation in certain food businesses

Codex Alimentarius Commission: Food hygiene. Basic texts. (http://www.fao.org/docrep/012/a1552e/a1552e00.pdf)

Regulations, directives, standards

**Hydrobiology, MTMKG7027A**

ECTS Credit Points: 3

0 hour(s) lecture and 42 hour(s) seminar per semester

Type of exam: written and/or verbal exam

Requirements:

- for signature: Participation in lectures and practical exercises. Successful completion of practical tasks.

- for a grade: written and/or verbal exam

**Summary of content – theory**

Increased knowledge, skills and competencies of students will be reflected in the following areas:

1. Mastering of the practical implementation of the qualitative and quantitative hydro-biological analysis associated with handling microscopic techniques

2. Familiarization with sampling methods of different types of waters, sediments, benthic macroinvertebrates, phytoplankton and zooplankton.

3. Understanding of ecological and bio-indication indexes calculation and its importance for the estimation of surface water quality and pollution.

Students will be able to:

1. Clearly articulate the methods and key approaches used to the assessment of the status and change in freshwater biological systems.

2. Describe the advantages, disadvantages and sources of uncertainty of these ecological and methodological approaches and methods.

3. Demonstrate well-developed conceptual knowledge in freshwater biology and ecology;

4. Collect new data and synthesis existing information to assess the status of a freshwater system.

5. Critically evaluate the strengths and weaknesses of the acquired environmental, ecological data and information;

6. Accurately communicate the findings of a freshwater biological or ecological study in a scientific report;

7. Demonstrate ability to critically assess the quality of your own work and the work of others

8. Develop a global awareness of freshwater issues and the significance of cultural diversity as it pertains to sustainability of water resources.

**practices:**

1. Freshwater ecosystems. General limnology
2. Physical-Chemical characteristics of Freshwater.
3. WQ General
4. The microscope. The anatomy of the plant and animal cell
5. Phytoplankton
6. Zooplankton
7. Macroinvertebrate
8. The Functional feeding groups. Freshwater Macroinvertebrates Protocol
9. The Nekton &Fish sampling
10. Biological Water Qualification. The bio assessment protocols of the wadeable rivers
11. Determination of BISEL index
12. Water qualification according to the Hungarian method.
13. Bacterioplankton & Virioplankton
14. Eutrophication

**Literature, handbooks**

Horne, A.J. and C.R. Goldman. (1994): Limnology. 2nd edition. McGraw-Hill Co., New York, USA.

Edmondson, W. T. (1959): Freshwater Biology. John Wiley & Sons, Inc. ISBN 471 23298 X

Welch, P. S. (1952): Limnology. McGraw-Hill Book Company, Inc.

Wetzel R. (2001): Limnology. Lake and River Ecosystems. 3rd Edition. Academic Press. Hardcover ISBN: 9780127447605, eBook ISBN: 9780080574394.

**Management Systems (EMS, QMS, FSMS), MTMKG7023A**

ECTS Credit Points: 3

14 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: colloquium

Requirements:

- for signature: Completing exercises, giving presentation.

- for a grade: Colloquium.

**Summary of content – theory**

The students attending the course can get acquainted with the importance, methods, tools and effects of quality management, food safety management, health and safety management, environmental management systems and possibilities provided by integrated systems.

**lectures:**

1. Introduction to Principles of Management
2. Personality, Attitudes, and Work Behaviours, leading people and organization
3. Organization structure and changes, organization culture, managing groups and teams
4. Decision making, communication, motivation employees
5. The essential of Control, Strategic Human Resource Management
6. History of Environmental Management, standardisation, ECS 7750; EMAS; ISO 14001.
7. Implementation of Environmental Management System, documentation, operating. Continual development. Audit, audit types, audit process, documentation, integrated auditing, ISO 19011.
8. Environmental regulations, tools of environmental business management. Evaluation of environmental effects: indicators. Cleaner production. Life Cycle Analysis (LCA).
9. History of quality management, development of Quality Management Systems, Total Quality Management (TQM), Quality management systems. Requirements (ISO 9001:2000)
10. Occupational health and safety management systems. Requirements (BS OHSAS 18001),
ISO 28001.
11. History of HACCP, System of HACCP (Hazard Analysis Critical Control Points), documentation, operating. Food Safety Management System ISO 22000.
12. ISO 50 001 Energy Management Systems
13. Possibilities given by integrated systems, collective establishment.
14. Management Information Systems, ERP Systems

**practices:**

1. Planning structure of a fictive business

Implementation of Management principles

1. Market analyses
2. P-O-L-C Framework, (strategical) Planning, Organizing
3. P-O-L-C Framework; Leading, Controlling
4. Corporate Social Responsibility (CSR)
5. CSR plan, CSR profile, CSR report
6. Behaviour as an individual, Myers Briggs Personality Test based on the 16 personality types
7. Behaviours and traits of the great leader
8. Learning style, Learning Style Index (LSI)
9. SMART goals
10. Leadership skills – Charismatic leadership, Influential leadership, Authentic leadership
11. Environmental Policy, Management Policy
12. Integrated Policy
13. Presentation – Implementation of Integrated Management System (IMS)

**Literature, handbooks**

Management Principles 2012. This book is licensed under a Creative Commons by-nc-sa 3.0 (http://creativecommons.org/licenses/by-nc-sa/ 3.0/) license. p. 714 <http://2012books.lardbucket.org/pdfs/management-principles-v1.0.pdf>

Juhász, C., Szőllősi, N. 2009. Environmental management. Jegyzet. Debreceni Egyetem, Debrecen. <http://www.tankonyvtar.hu/hu/tartalom/tamop425/0032_kornyezetiranyitas_es_minosegbiztositas/adatok.html>

James Reinhard, Brad Ames, Andrew Robertson, Rita Thakkar, Ryon Pulsipher, David Bentley 2012. Integrated Auditing Practice Guide. The Institute of Internal Auditors.

United States Department of Agriculture, Food Safety and Inspection Service 1997. Guidebook For The Preparation Of HACCP Plans. p. 67.

Implementation Guidance for ISO 9001:2015. International Organization for Standardization. p. 7.

**Natural Sciences I. - Soil Science and Agrochemistry, MTMKG7001A**

ECTS Credit Points: 4

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: colloquium

Requirements:

- for signature: It is obligatory to participate in the subject practice. Active participation in the presentation. Keep a brief presentation on a special area of the subject.

- for a grade: colloquium

**Summary of content – theory**

The basic objective of the subject is that the students know - besides soil physics and soil chemistry features - the biological processes in the soil. Soil biota play an important role in the formation of soil (the first step in biological weathering), soil organic matter transformation (humus formation) and organic degradation processes (mineralization), cycle of elements and energy flow of ecosystems.

Living organisms interact with the soil, thus affecting certain soil properties, while soil properties also affect their occurrence. The applied agro-technical procedures can provide not only favorable conditions for the cultivated plants but also the biota living in the soil.

Our goal is also to enable students to acquire and integrate new knowledge about the soil. During lectures we emphasize the relationship between sustainability, environmentally friendly farming and land use. The knowledge gained in the theoretical lectures is complemented by a number of practical examples, which, in turn reinforce the previous knowledge. The subject practice also contributes to a better understanding of the "soil environment".

The acquired knowledge is related to professional subjects. Learning the curriculum allows students to supplement their knowledge and utilize it in a creative way during their later work.

 **lectures:**

1. Soil is the part of the biosphere. The concept of soil, its constituents. The abiotic and biotic subsystem in the soil. The soil profile. Ecological functions of soil. The importance of minerals and rocks in soil formation. The weathering. The formation of the soils in the Carpathian Basin.
2. The most important physical properties of soils. Soil texture, bulk density and density, pore system and water holding capacity of pores. The soil formation, morphological and agronomic evaluation of the soil structure. Water management types in soil. Moisture forms in the soil. The laws of water movement in the soil. Air and heat management in soils.
3. The most important soil chemical properties. Organic matter in the soil, the structure of the humus and their role in soil fertility. Humus quality. Types of soil colloids. Processes on the surface of colloids. Effect of adsorbed cations on soil properties. The acidity and alkalinity of the soil. The pH of the soil, its buffer capacity. Soil is a redox system.
4. The soil genetic classification in Hungary. Sceleton and rocky soils. Zonal soils: the conditions for the development of brown forest in Central and South-Eastern Europe and chernozem soil. Processes in saline soils. The main types of hydromorphic soils are: Meadow, Wetland and Floodplain forest, Bog and Casting and sloping sediments soils.
5. Biosphere, biome, ecosystem, population. Comparison of artificial and natural ecosystems based on elements cycle and energy flow. The structure and characteristics of ecosystems. Populations that build up the bio-coenosis and interaction between populations.
6. The groups of living organisms. The edafon. Life phenomena. Prokaryotes. Bacteria. The place of microscopic and macroscopic fungi among the living organisms. Mycorrhiza. The Algae. The components of the micro- and meso-, macro- and megafauna. The role of Earthworm in the soil.
7. Elements cycle and energy flow in ecosystems. Elements cycles: carbon, nitrogen, phosphorus and potassium in the soil-plant system.

**Agricultural Chemistry (7+2)**

1. Plant nutrients and their classification
2. Chemical composition of plants
3. The influencing factors of nutrient uptake by roots
4. The influencing factors of nutrient uptake by leaves, water uptake by plants and influencing factors
5. The effects of nutrient supply on the quality and quantity of yield
6. Nitrogen in soil, nitrogen uptake by plants, the role of nitrogen in plants, Phosphorus in soil, P uptake by plants, the role of P in plants, Potassium in soil, K uptake by plants, the role of K in plants, S, Ca, Mg in soil, in plant.
7. Chemical fertilizers, physical, chemical properties, fertilization methods, basic fertilization, foliar fertilization, making fertilizer solution. Effects on chemical fertilizers on the environment.

**practices:**

**Soil Science (7x2)**

1. Soil profile, soil sampling
2. Soil texture. Clay and silt content, Plasticity according to Arany
3. Bulk density and soil density, porosity
4. Water management, soil structure
5. pH, acidity, sodium- and calcium carbonate
6. To start the incubation experiment for measuring of net nitrification and carbon-dioxide emission
7. Evaluation of incubation experiment

**Agricultural Chemistry (7+2)**

1. Calculation of concentrations of solutions, making standard solutions
2. Water hardness I. Temporary hardness
3. Water hardness 2. Total water hardness Water softening
4. Soil fertility 1. Determination of plant available phosphorus
5. Soil fertility 1. Determination of plant available potassium
6. Plant tissue test
7. Investigation of physical and chemical properties of chemical fertilizers

**Literature:**

Brady, N. C. (1990) The Nature and Properties of Soils. Collier Macmillan Publishers (London). 10th ed.

Eash, N. S. – Green C. J. Razvi, A. – Bennett, W. F. (2008) Soil Science Simplified. (fifth ed.) Blackwell Publishing

K. Mengel and E. A. Kirkby Principles of plant nutrition (1987) ISBN:3906535037, Lang DruckAG, Liebefeld

J. Benton Jones, Jr. (2012) Plant Nutrition and Soil Fertility Manual, ISBN: 9781439816097, Taylor and Francis

J. Benton Jones Jr. (2001) Laboratory guide for Conducting soil tests and plant analysis, , ISBN: 0849302064, CRC Press LLC

**Natural sciences II: Nature conservation ecology, MTMKG7008A**

ECTS Credit Points: 4

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: Colloquium

Requirements:

- for signature: Regular visits to lectures, successful completion of the lectures, the practical examinations and the fulfilment of individual tasks.

- for a grade: Colloquium in the Examination Period: Anyone who has obtained the examination privilege may take an oral or written examination under the specified conditions during the examination period, the result of which is not influenced by the grade obtained in practice. A total of 3 examinations per semester, of which a possible third (“C”) exam will only be conducted orally before the Examination Board.

**Summary of content – theory**

In this subject, there is a special focus on the development of students' general awareness and correct ecological approach. The ecological concept of the biotic environment and the levels of ecological organization are also part of the curriculum. In addition to the above, they are familiarised with the national system of nature conservation and its most important values.

**lectures:**

1 The system of biotic environmental factors. Population Ecology. The structure of populations, factors that regulate the population.

2. Regulatory mechanism of population numbers, r and K-type selection. Graduation.

3. Intra- and interspecific interactions.

4. Community Ecology. Structure and change of communities.

5. Food chains, food networks. Material and energy flow in bio-cenosis.

6. The habitat of living beings. Basics of biogeography. The Pannon biogeographical region.

7. Biodiversity. Types, measurement, protection of biodiversity. Concept of ecological footprint.

8. Concept, purpose, principles and system of symbols of nature protection. Green Days.

9. International regulation of nature conservation.

10. Nature conservation value groups. Geological, aquatic values ​​and protection

11. Protection of their wild plant and animal associations.

12. Area-protected natural values

13. International Conservation Conventions

 14. Nature Conservation Regulation in the European Union

**Summary of content - practice**:

During the practice students will learn and will be able to apply in practice the specific system of ecological organizational levels and the ecological relationships of living communities. The introduction of anthropogenic impacts on living communities based on the principle of "think globally, act locally" is particularly important. In addition to ecological approach, they gain insight into certain elements of domestic and international nature conservation practices.

**practices:**

1. Evaluation of biotic factors- general field methods
2. Examples for actual projects of nature conservation management in Hungary
3. Migration types, the protection of migratory species
4. The elements and endangering factors of water circle
5. Impact studies about global warming and climate change
6. Taxonomy and protection of geological values
7. Taxonomy and protection of hydrological values
8. Taxonomy and protection of botanical values
9. Taxonomy and protection of zoological values
10. Area-protected natural values in Hungary
11. Area-protected natural values internationally
12. Endemic and relic species in the Pannon biogeographic region
13. Nature Conservation Regulation in the EU: the Natura 2000 system
14. Ex-situ Nature Conservation- a Field trip in the Zoo of Debrecen

**Literature, handbooks**

Begon M. , Harper J.L., Townsend C.R. (1996): Ecology- Individuals, Populations and communities, Blackwell Science, ISBN: 0-632-03801-2

Otero C., Bailey C. (2003): Europe’s Natural and Cultural Heritage, Friends of the countryside, ISBN: 84-607-9790-2

Voloscuk I. (ed). (1999): The National Parks and Biosphere Reserves in Carpathians-The last nature paradise, ACANAP, Tatranská Lominca, Slovak Republic, ISBN: 80-88680-31-X

**Professional Language Skills, MTMK7NY2A**

ECTS Credit Points: 3

28 hour(s) lecture and 0 hour(s) seminar per semester

Type of exam: exam mark

Requirements:

- for signature: Absence as regards class attendance (3 allowed absences per semester)

- for a grade: Completing assignments / exercises. Continuous tests orally and written. A term mark to be given at the end of the semester

**Summary of content - theory**:

The main goal of the classes is to acquire the essence of oral communication, its general connection system, as well as the components of communication, and to get introduced to the professional and human communication. Students will get acquainted with the rhetorical and the negotiation technique methods, and based on these, with practice through profession related situations.

 **lectures:**

|  |
| --- |
| 1. Presentation techniques I (definitions, layers, types)
 |
| 1. Presentation techniques II (professional presentation methods)
 |
| 1. The logical construction of presentation, the effective approach of a target group
 |
| 1. The SPAM method, 1st Student Presentation practice
 |
| 1. Workshop-training
 |
| 1. Practice for professional writing
 |
| 1. Midterm exam
 |
| 1. Strategies for reading profession related texts
 |
| 1. The use of the logical matrix and the SWAT analysis in the presentation technique
 |
| 1. Exercises to improve debate skills
 |
| 1. Profession related listening exercises
 |
| 1. Profession related listening exercises
 |
| 1. Sources and possibilities of independent study
 |
| 1. End term, Evaluation
 |

**practices:**

|  |
| --- |
| 1. Profession-related writing, speaking, reading comprehension and listening comprehension
 |
| 1. Profession-related vocabulary building, writing, speaking listening and reading comprehension
 |
| 1. Presentation skills, reading comprehension and listening comprehension, profession-related writing
 |
| 1. Developing profession-related literacy, speaking, reading and listening comprehension,
 |
| 1. Speaking and presenting,, reading comprehension and listening comprehension tasks, and profession-related writing.
 |
| 1. The situational dialogues, reading comprehension and listening comprehension tasks, and writing formal letters on a given topic
 |
| 1. A survey of the skills and knowledge acquired thus far
 |
| 1. Presentation, reading comprehension and listening comprehension tasks, and profession-related writing.
 |
| 1. Profession-related conversation, reading comprehension and listening comprehension tasks, and profession-related writing
 |
| 1. Profession-related conversation, critical thinking, reading comprehension and listening comprehension tasks, and writing essays.
 |
| 1. Presentation, reading comprehension and listening comprehension tasks, and profession-related conversation writing
 |
| 1. Speaking and presentation, reading comprehension and listening comprehension tasks, and profession-related conversation writing
 |
| 1. Essay writing, speaking, reading comprehension and listening comprehension
 |
| 1. A survey of the skills and knowledge acquired throughout the semester
 |

**Literature:**

ANDREWS, P. H. & BAIRD, J. E. (2000): Communication for Business and the Professions 8th Edition. Waveland Press, Long Grove, IL. ISBN-13: 978-1577663799, 720 old.

COOPMANN, S. J. & LULL, J. (2015): Public Speaking: The Evolving Art, 3rd Edition. Boston, MA. ISBN-10: 1285432827, 416 old.

HOSTETLER, M. & KAHL, M. (2012): Advanced Public Speaking: A Leader's Guide. Routledge: N.Y. ISBN-10: 0205740014, 240 old.

WIWCZAROSKI, T.B. (2007): Writing and Professional Communication. Debrecen, 97 old.

ZAREFSKY, D. (2011). Public speaking: strategies for success. Boston, Allyn & Bacon. ISBN-13: 978-0205857265, 528 old.

**Remote sensing, MTMKG7025A**

ECTS Credit Points: 3

1. hour(s) lecture and 42 hour(s) seminar per semester

Type of exam: practical course mark

Requirements:

- for signature: A report, including the objective interpretation of the roles, methods and the results of field scale and GIS laboratory exercises. Active participation in the lessons (at least 11), completing exercises, submitting report at the end of the semester.

- for a grade: Practical course mark in written exam.

**Summary of content – theory**

Though there are no theory lectures, the aim of the course is to present the basics and practical application of remote sensing. Throughout the course, students will learn about the physical background of remote sensing, the tools of remote sensing and methods of data processing and their practical applications. The course practice is orientated to the aspects of remote sensing with agricultural, environmental management applications. The subject covers the topics of multispectral, hyperspectral remote sensing, thermography and laser scanning.

**Summary of content - practice**:

During the exercises, the students will be able to process the data from the remote sensations using GIS software. The students learn several RS based land-use change and monitoring, vegetation analysis, abiotic stress effects on orchards, arable crops, drought management, forestry applications, drainage conditions, ground conditions and inland water risk analysis. The analytical methods are acquired through sample tasks in a GIS software environment.

**practices:**

1. Physical basics of remote sensing. Interpretation of the physical characteristics of the electromagnetic wave through the measurement and analysis of the reflection properties of soil and vegetation.
2. Grouping remote sensing devices and data. Description of more commonly used satellites, evaluation of aerial remote sensing methods for analyzing multispectral and hyperspectral remote sensing methods
3. Georeferencing remote sensing data
4. Analysis of relevant vegetation indices. Quantitative evaluation methods
5. Interpretation and Application of supervised and unsupervised classifications, Post Processing, Error Matrix, and Kappa Index Calculation Methods.
6. Assessing effects of abiotic stress, regional drought and biomass monitoring based on multispectral data
7. Project task: Multispectral and airborne hyperspectral data analysis of agricultural land, by supervised classification, post-processing
8. Project task: Hyperspectral examination of spatial distribution of vegetation by supervised class classification, post-processing
9. Run-off modeling based on radar and laser scanning data
10. Forest monitoring and species variety composition analysis based on hyperspectral data
11. Spectral assessment of the physical density and moisture of the soils
12. Spectral evaluation of canopy water supply
13. Thermography in the assessment of water supply in agriculture
14. Analysing on orchards by non-destructive instruments

**Research methodology - scientific communication, MTMKG7015A**

ECTS Credit Points: 5

28 hour(s) lecture and 42 hour(s) seminar per semester

Type of exam: exam

Requirements:

- for signature: Submitting reports in due time, taking part actively in the practices and completing home work individually are compulsory. Student may skip class maximum 3 times during the semester.

- for a grade: Essay type written exam is taken in the examination period of the semester focusing on the knowledge gained. List of the subjects is provided below.

**Summary of content – theory**

Fulfilling the course, students will be able to formulate problems at the level of R+D, will be capable of determining potential scientific alternatives for their solutions and working out proper research plans. The students will know and will be able to plan the proper conditions required for efficient research. As part of the course, statistical data analyses as methods will be learned and applied in specific case studies. Environmental statistics is incorporated into research planning and input and output data assessment. In addition, students will be familiar with the written communication forms of new scientific results and conclusions to different target groups, and they will be able to develop this skill via selected types of writings of scientific articles under guidance and continuous share of opinions and scientific argument. Practical tasks serve to apply the theoretical knowledge on research methodology, ideally, based on the subject of the BSc thesis, which are required to formulate potential approaches at the level R&D&I and develop scientific directions of research. To improve the written communication skills on scientific work and results, students will write an original article, a review and a short study for the public on any agro-environmental issues.

**lectures:**

1. Evolution of science, science classification
2. Types and characteristics of scientific research (basic, applied; qualitative, quantitative; descriptive, analytical)
3. Research methodologies (empirical, theoretical; logical, comparative)
4. Process and steps of scientific research, terms of efficient, high-quality research
5. Data and information sources, literature review techniques
6. Problem formulation, hypothesis, objectives, evaluation methods
7. Mathematical methods, research designing
8. Modelling, scientific model types and applications
9. Sampling strategies, statistical bases of environmental sampling
10. Cumulative and probability distribution functions, one sample and two sample t-tests, paired difference test, variance analysis, nonparametric tests
11. Relationships in the environment: correlation, regression
12. Data and information visualization techniques
13. Communication tools for scientific results and conclusions, structures of scientific articles (original article, review, short study for the public)
14. Measures of scientific performance, ethical issues in science

**Summary of content - practice**:

Students will practice the implementation of principles, and application of procedures as well as interpretation methods adapted to a selected case study, individually, understanding the approach of agriculture related environmental issues at scientific level, following the instructions of the lecturer. Students will work on either improving their BSc theses or planning their MSc research projects and write reports and articles for different target groups about the same scientific issue. The overall aim is to make it understandable what added value to the actual level of scientific knowledge means and how a research plan makes research successful.

**practices:**

1. Making difference between research and engineering; discovering rules in science; finding patents and understanding the link between science and business sector.
2. Formulating a scientific problem that has not been solved, yet, based on the articles available via the Science Direct data base, based on the student’s interest.
3. Formulating a hypothesis to justify a theory, and a relevant objective; justifying the approach.
4. Literature review and writing an Introduction chapter for an original research paper manuscript; creating the structure of a review.
5. Developing a research proposal with consideration of all necessary resources; clarifying expectations based on the actual level of scientific knowledge, creating conceptual model.
6. Describing and assessing a case study, working with data, transforming data into information, modelling and model validation.
7. Identifying relevant indicators of a phenomenon, relationships; formulating experimental designs; data collection, sampling from existing databases, measurements in the field and in the laboratory with environmental samples.
8. Finding and discussing changes, trends; applying relevant statistical methods; understanding correlation and regression.
9. Answering the scientific question, solving the problem, arriving at a conclusion that is an added value to the actual level of knowledge.
10. Analysing the structure of an abstract and writing one.
11. Finalizing the research paper manuscript.
12. Writing short article for the public based on the original research paper.
13. Preparing a 10 minutes long presentation for scientists.
14. Analysing reviewers’ assessment and opinions for given manuscripts submitted to a journal.

**Literature, handbooks**

Macrina, F. L. (2000): Scientific Integrity: An Introductory Text with Cases, 2nd ed. ASM Press, Washington, DC.ISBN-13: 9781555811525

Montgomery, S. L. (2003): The Chicago Guide to Communicating Science. University of Chicago Press, Chicago. ISBN-13: 978-0226534855

J. L. Lebrun (2008): Scientific writing. A readers and writer’s guide. Word Scientific Publishing. Singapore. 223.p. ISBN-13: 978-9814350600

M.J. Katz (2009): From research to Manuscript. A guide to scientific writing. Spinger Publ. 204. p.  ISBN-13: 978-1402094668

[Mertler, Craig A.](http://www.prospero.hu/katalogus/kereso/?form_submit=1&szerzo=Mertler+Craig) (2015): Introduction to Educational Research. Sage Publications. ISBN-13: 9781483375489

Exercise book: Practical exercises for the course of Environmental statistics, research methodology - scientific communication

**Sectoral Public Administration and Environmental Law, MTMKG7005A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: Colloquium

Requirements:

- for signature: Completing exercises, giving presentation

- for a grade: Colloquium

**Summary of content – theory:**

Students gain knowledge about sectoral legal principles, procedures and institutions designed and used for the implementation of the principles, policies and legislation of the European Union (EU) and European Communities (EC) and on national level, in the context of public administration.

The basics of environmental law regulations are introduced, describing some special areas related to environmental politics. The course is basically built on the legislation of the EU but global aspects are also covered.

**lectures:**

1. Agriculture and Rural Development in EU
2. Food and Agriculture Policy for the European Union
3. Direct payments, Cross-compliance, Green payments
4. Organic Farming, organic production in EU
5. Agro-Environmental Schemes and measurements, indicators
6. The Process of Formulating Agricultural Policy in the EU
7. Sectoral legislation – Nature,
8. Sectoral legislation – Water
9. Sectoral legislation – Soil
10. Sectoral legislation – Air 1.
11. Sectoral legislation – Air 2
12. Sectoral legislation – Waste
13. Horizontal legislation – Public involvement, Environmental Measures on Production, Planning and Management
14. Horizontal legislation – Product Policy, EU environmental legislative structure, Implementation and Enforcement

**practices:**

1. Sectoral public administration
2. Sectoral public administration
3. Sectoral public administration
4. Food safety
5. Organic Agriculture
6. Organic Agriculture
7. Greening
8. Agri-Environmental measures, indicators
9. Nature conservation
10. Water protection
11. Water protection
12. Soil protection
13. Air protection

**Literature, handbooks**

Stefan Tangermann, Stephan von Cramon-Taubadel 2013. Agricultural Policy in the European Union - An Overview. Department für Agrarökonomie und Rurale Entwicklung, Universität Göttingen. ISSN 1865-2697. p. 71.

Elisa Morgera, Carmen Bullón Caro, Gracia Marín Durán 2012. Organic agriculture and

the law. Food And Agriculture Organization Of The United Nations. FAO. ISBN 978-92-5-107220-2. 302. p.

Andrew Farmer (Edited) 2010. Sourcebook on EU Environmental Law. Institute for European Environmental Policy. p. 388.

Stefan Scheuer (Edited) 2006. EU Environmental Policy Handbook. European Environmental Bureau (EEB) p. 336.x

**Sustainable agricultural systems and technologies I.–crop production MTMKG7004A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: oral exam

Requirements:

- for signature: Aattendance and active work in the practices, giving a short presentation.

- for a grade: oral exam

**Summary of content - theory**:

During the course, students learn the basics of the contact system between plant production and interactive environment. Our goal is to present biological, agro-ecological production and technological factors as a complex system, the system description prevailing energy and material processes. The concept, elements, types of alternative cropping systems. Conventional, sustainable, organic and other cropping systems. Sustainable crop production technology models of grain and forage crops.

 **lectures:**

1. Definition of sustainable crop production, the change of world’s population.
2. Global land use data, proportion of cultivated land, challenge of the agriculture in the future.
3. The agricultural production and area of the main crops in the world.
4. Definition, significance and the aims of organic farming. What is the transition period in organic farming?
5. Nutrient supply possibilities in organic farming. Plant protection possibilities in organic farming.
6. Global water use, the main and special aims of irrigation.
7. Short evaluation of the irrigation methods.
8. Precision farming technologies and the benefits of precision farming.
9. What are the transgenic crops, the generations of GM crops?
10. The global GM crops’ area, the aims of creating GM plants, the main GM crops in the world.
11. Definition and benefits of agroforestry systems. Agroforestry practices.
12. Sustainable maize production technology.
13. Sustainable winter wheat production technology.
14. Sustainable alfalfa production technology.

**practices:**

1. Definition of sustainable crop production, the change of world’s population.
2. Global land use data, proportion of cultivated land, challenge of the agriculture in the future.
3. The agricultural production and area of the main crops in the world.
4. Definition, significance and the aims of organic farming. What is the transition period in organic farming?
5. Nutrient supply possibilities in organic farming. Plant protection possibilities in organic farming.
6. Global water use, the main and special aims of irrigation.
7. Short evaluation of the irrigation methods.
8. Precision farming technologies and the benefits of precision farming
9. What are the transgenic crops, the generations of GM crops?
10. The global GM crops’ area, the aims of creating GM plants, the main GM crops in the world.
11. Definition and benefits of agroforestry systems. Agroforestry practices.
12. Sustainable maize production technology
13. Sustainable winter wheat production technology
14. Sustainable alfalfa production technology

**Literature, handbooks in English**

Alabaster Jenkins (2016): Agronomy and crop production. ISBN 978-1682860373

Corey Aiken (2015): Crop Production: Technology and Methodology ISBN 978-1632391346

Nand Kumar Fageria (2014): Nitrogen Management in Crop Production ISBN 978-1482222838

Muhammad Ashraf (2012): Crop Production for Agricultural Improvement ISBN 9789400741157

**Sustainable agricultural systems and technologies II – Animal breeding, MTMKG7012A**

ECTS Credit Points: 3

14 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Attendance at lectures is recommended, but not compulsory.

Participation at practice is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader.

- for a grade: written exam

**Summary of content – theory**

The general aim of the subject is to inform students about the modern animal housing systems and the extensive animal production as well. During the lectures student will study the requirements of sustainable animal production, the effect on environment and the possibilities to alter the effect of animal production on grassland, environment and climate change.

**lectures:**

1. Aim of animal production and animal products and performance
2. Production traits, requirements to environment
3. Housing and feeding of livestock species: cattle
4. Housing and feeding of livestock species: sheep
5. Housing and feeding of livestock species: swine
6. Housing and feeding of livestock species: poultry
7. Animal nutrition, genetics, selection for breeding can contribute to a sustainable animal production
8. The role of gene reserve stocks on sustainable animal production, environmental protection, and ecological production
9. Environmental issues of animal nutrition. Possibilities to decrease environmental load of nitrogen, phosphorous, potassium, methane.
10. The effect of domestic animals on environment. Technologies to decrease ecological footprint.
11. Feed processing, compound feed production and environment.
12. Animal grazing
13. Animal grazing technologies. Grazing on vulnerable land.
14. Ecological animal production with different livestock and poultry species

**Summary of content - practice**:

Students will have knowledge and experience on mitigation strategies and can evaluate the significance of environmental effect of livestock.

**practices:**

1. Sustainable animal production in related to methane emission
2. Animal performance and environmental consequences
3. Cattle contributes to climate change – different viewpoints
4. Possibilities and tools to decrease nitrogen output from livestock farms
5. Possibilities and tools to decrease nitrogen output from livestock farms
6. Possibilities and tools to decrease phosphorous output from livestock farms
7. Possibilities and tools to decrease phosphorous output from livestock farms
8. Enzymes in feed
9. How can precision livestock farming decrease the environmental impact of animal production?
10. How can precision livestock farming decrease the environmental impact of animal production?
11. Effect of livestock on biodiversity
12. Effect of livestock grazing on biodiversity
13. Effect of livestock grazing on vegetation of grassland
14. Effect of livestock grazing on soil properties of grassland

**Literature, handbooks**

Henning Steinfeld, Pierre Gerber, Tom Wassenaar, Vincent Castel, Mauricio Rosales, Cees de Haan (2006): Livestock's Long Shadow: Environmental Issues and Options. Food and Agriculture Organization of the United Nations. 1-390.

Henning Steinfeld et al., eds. (2010): Livestock in a changing landscape. Volume 1. Island Press. 1-396.

Pierre Gerber et al., eds. (2010): Livestock in a changing landscape. Volume 2. Island Press. 1-189.

**Water management II – excess water management, irrigation techniques, MTMKG 7011A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: oral exam

Requirements:

- for signature: Completing the exercises in due time, taking part actively in the practices and field trips and completing home work individually are compulsory. Student may skip class maximum 3 times during the semester.

- for a grade: Oral exam

**Summary of content – theory**

The students attending the course can get acquainted with the importance, methods, tools and effects of excess water management and irrigation.

**lectures:**

1. Causes and conditions of forming of excess water.
2. Excess water systems and water shed areas in plain lands.
3. Controlled outlet of excess waters taking the changeable hydrological conditions for a longer term into consideration.
4. Tools of implementation, technical, agro-technical and agronomical measures aiming excess water management.
5. Designing and setting of outlet systems. Setting and maintaining excess water outlet canals.
6. Objects of excess water outlet canals, objects serving outlet water control.
7. Preparation of watershed management plans.
8. Reutilization of waters, the quality of retained, stored water.
9. Management focusing on retaining excess waters in order to mitigate the harmful effects of climate change and droughts.
10. Review of technological practices, activities of irrigation management concerning agriculture and environmental management.
11. Review of theoretical knowledge of irrigation and exercises in practice.
12. Basic knowledge of irrigation techniques, process of setting of an irrigation system, general information on automatic irrigation systems, main elements of irrigation systems.
13. Features and application of surface, sprinkle and micro irrigation.
14. Theory of designing, theory of setting and installation, handing over of irrigation systems.

**Summary of content - practice**:

Students will practice the implementation of principles, and application of procedures as well as interpretation methods in the fields of basic hydrology and agro-meteorology, lysimetry, irrigation management and operation, water resources, watershed management, surface and subsurface drainage, soil-water-plant relations.

**practices:**

1. Basic definitions of excess water management.
2. Causes and conditions of forming of excess water.
3. Technical, agro-technical and agronomical measures of excess water management.
4. Setting, maintaining and objects of excess water outlet canals.
5. Preparation of water shed management plans.
6. Utilization of excess waters for the decrease of water demand of irrigation.
7. Fundamentals and basic definitions of irrigation technology.
8. Elements and techniques of surface irrigation.
9. Elements and techniques of sprinkler irrigation.
10. Elements and techniques of micro-irrigation.
11. Pumps applied in irrigation.
12. Theory and practice of irrigation design.
13. Irrigation systems in the XXI century

**Literature, handbooks**

Larry W. Mays (2011): Water resources engineering. ISBN-13: 978-0470460641, ISBN-10: 0470460644

Nakagami, Ken’ichi, Kubota, Jumpei, Setiawan, Budi Indra (Eds.) (2016): Sustainable water Management. Springer. ISBN: 9789811012044 9811012040 9811012024 9789811012020

[Larry Keesen; Cindy Code](http://www.amazon.com/s/ref%3Dntt_athr_dp_sr_1?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Larry%20Keesen%3B%20Cindy%20Code) (1995): The Complete Irrigation Workbook: Design, Installation, Maintenance & Water Management. GIE Media, Inc., Richfield OH.

[Stephen W. Smith](http://www.amazon.com/s/ref%3Dntt_athr_dp_sr_1?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Stephen%20W.%20Smith) (1997): Landscape Irrigation: Design and Management. John Wiley & Sons, Inc., Hoboken, New Jersey.

**Water management I. - Agrohydrology MTMKG7002A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: A report, including the objective interpretation of roles, methods and the results of field scale and GIS laboratory exercises on the field of agro-hydrology.

- for a grade: Active participation in the practical lessons (at least 11), completing exercises, submitting report at the end of the semester. Written exam.

**Summary of content – theory**

Students acquire knowledge on hydrological cycle, watercourses, rules of water cycle. Accomplishing the course, students will be able to evaluate the soil-plant water relationship and assess the hydrological processes and water balance of cropping sites. The goal of the course is to make students understand and use the practical application of drought management, including the following: forms, rise, quantitative characteristics, measurement, spatial and periodical dispersions, and density- and dispersion functions of drought. Applying the mechanisms, forms, measurement and calculation of the evapotranspiration.

 **lectures:**

1. Water management of watersheds. Basics of agro-hydrology, water cycle, water balance

2. Role of agro-hydrology, water supply of Earth, the elements of water cycle, the element of water balance (precipitation, evapotranspiration, infiltration, runoff, water ponding. The basic relations of the elements of water cycle

3. Classification of water flow, categorization of natural water flows, Parameters of catchments, and characterization of catchment types. Characterization of ross section of river flows,

4. Pond formation and their morphology, types of ponds and reservoirs.

5. Origin, occurrence of underground water types. Classification and characterization of underground water. Anomalies in underground water. Dynamics of underground water.

6. Soil-plant water relationship

7. Crop damages caused by extreme weather - prevention

8. Measurement methods of meteorological and microclimatic factors effect on water balance

9. Measurement methods of soil water balance

10. Measurement methods of water supply

11. Define the concept of water scarcity and drought, drought types

12. Agricultural Drought Analysis Methods - traditional drought indices

13. Agricultural Drought Monitoring -Drought indices based on remote sensing data

 14. The possibilities of drought damage prevention in agriculture. Options for adaptation to drought

**Summary of content - practice**:

The overall objective of the exercise is to provide practical knowledge of the terrain modeling required for river basin planning. In addition, during the semester students get acquainted with the practical application of applied drought indices and water supply measurement methodology. In addition, IT technology is also used to describe the use of river basin modeling for drainage and aggregation.

**practices:**

1-2. Basic land measurements, area survey in rectangular and polar coordinate systems. - demonstration field practice

3-4. Cross section and micro relief leveling. - demonstration field practice

5-6. Modeling of runoff, drainage and basin conditions based on data of practice 3-4 - GIS applications

7-8. Calculation and evaluation of traditional drought indices - calculation tasks

9-10. Measuring meteorological and microclimate factors affecting water resources - demonstration field practice

11-12. Measuring soil water resources - demonstration field practice

13-14. Measuring Abiotic Stress Effects on Foliage (Spectral, Thermography) - Demonstration Field Practice

**Literature:**

Keith Wheatley (2015): Agricultural Water Management: Insights and Challenges. Callisto Reference ISBN: 9781632391278

Premjit Sharma (2013): Agricultural Water Management. Genetech, 302. ISBN: 9788189729233

OECD (2014): Climate Change , Water and Agriculture: Towards resilient systems, OECD Studies on Water, OECD Publishing ISBN:978-92-64-20913-8

Wilfried Brutsaert 2005: Hydrology: An Introduction. Cambridge University Press ISBN 9781107268791

World Meteorological Organization (WMO) and Global Water Partnership (GWP), 2016: Handbook of Drought Indicators and Indices (M. Svoboda and B.A. Fuchs). Integrated Drought Management Programme (IDMP), Integrated Drought Management Tools and Guidelines Series 2. Geneva.

# **Internship**

Students have to carry out a 4-week internship involved in the model curriculum. The internship course must be signed up for previously via the NEPTUN study registration system in the fall semester (3rd semester). Its execution is the criteria requirement of getting the pre-degree certificate (absolutorium).

# **Work and Fire Safety Course**

According to the Rules and Regulations of University of Debrecen a student has to complete the online course for work and fire safety. Registration for the course and completion are necessary for graduation. For MSc students the course is only necessary only if BSc diploma has been awarded outside of the University of Debrecen.

Registration in the Neptun system by the subject: MUNKAVEDELEM

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

# **Physical Education**

According to the Rules and Regulations of University of Debrecen a student has to complete Physical Education courses at least in two semesters during the Bachelor training and one semester during the Master training. Our University offers a wide range of facilities to complete them. Further information is available from the Sport Centre of the University, its website: [http://sportsci.unideb.hu.](http://sportsci.unideb.hu/)

# **Thesis**

A Thesis is the creative elaboration of a professional task in written form. By solving the task, the student relies on his/her studies using national and international literature under the guidance of an internal and external supervisor (referee). By solving the task, the agricultural environmental management engineering student certifies that he/she is capable to apply the acquired knowledge in practice and to summarize the completed work and its results in a professional way, to solve the tasks related to his/her topic creatively and to complete individual professional work. By preparing and defending thesis students who complete the Agricultural Environmental Management Engineering graduate program prove that they are capable of the practical applications of the acquired skills, summarizing the work done and its results in a professional way, creatively solving the tasks related to the topic and doing individual professional work. The faculty academic calendar sets the thesis submission deadline.

A student in master program has to prepare a thesis as a prerequisite of the final exam. The requirements of the thesis content, the general aspects of evaluation and the number of credits assigned to the thesis are determined by the requirements of the program. In agricultural environmental management engineering program the credits assigned to the thesis is 30.

The latest that thesis topics are announced by the departments for the students is the end of Week 4 of the study period of the last semester. A thesis topic can be suggested by the student as well and the head of department assigned shall decides on its acceptance.

Thesis is evaluated by the referee, and it is evaluated and qualified individually by the department. The Head of the Department makes suggestion on its qualification to the Final Exam Board.

If thesis is evaluated with a fail mark by the referee, and the student is not allowed to take the final exam and is supposed to prepare a new or modified thesis. The student has to be informed about it. Conditions on resubmitting the thesis are defined by the program coordinator.

# **Final examination (Final Exam)**

Students having obtained the pre-degree certificate will finish their studies by taking the final exam. Final exam can be taken in active student status in the forthcoming exam period after gaining the pre-degree certificate then after termination of student status in any exam period within two years according to the valid education requirements. After the fifth year of the termination of student status the candidate is not allowed to take the final exam. Only students who do not have outstanding charges are allowed to take the final exam. (E.g.: Students who obtained a pre-degree certificate until 1 September 2020 can take the final exam until 1 September 2022.)

A student having obtained the pre-degree certificate (absolutorium) will finish his/her studies training by taking the final exam. A final exam is the evaluation and control of the knowledge and skills acquired in tertiary education during which the candidate has to certify that he/she is able to apply the obtained knowledge in practice.

A final exam can be taken in the forthcoming exam period after obtaining the pre-degree certificate. The Department announces two final exam dates in a year, one at the beginning of January and one at the end of June. A final exam has to be taken in front of the Committee on the fixed date. If a candidate does not pass his/her final exam by the termination of his/her student status, he/she can take his/her final exam after the termination of the student status on any of the final exam days of the relevant academic year according to existing requirements on the rules of the final exam.

The Final exam consists of two parts according to the curriculum.

1. Written and oral exam on the given topics.
2. Thesis Defence (a presentation of the thesis, answering questions, comments then answering questions based on the knowledge related to the thesis topic)

A final exam can be started if the candidate can be submitted to the final exam on the basis of definite opinion of the referees. The two parts must be held on the same day.

The parts of the final exam are evaluated on a five-point scale by members with voting rights in the Final Exam Board. The final grade for the final exam will be decided on by voting in a closed sitting after the final exam, then. In case of equal votes, the committee chair will make the decision. Final exam results will be announced by the committee chair. Results of the final exam and thesis defence will be announced at the end of the given exam day (when all candidates finished final exam and thesis defence on the given day). A note of the final exam will be taken.

*Improving failed final exam*

If a thesis is evaluated with a fail mark by the Final Exam Board a final exam has to be retaken with a new or modified thesis.

If any of part if the final exam is a fail it must be retaken according to the existing rules of the university. Final exam can be retaken twice. The ensuing final exam period is the soonest that the re-sit is allowed.

*Final exam board*

Committee chair and members of the committee are called upon and mandated by the dean with the consent of the Faculty Council. They are selected from the acknowledged internal and external experts of the professional field. Traditionally, it is the chair and in case of his/her absence or indisposition the vice-chair who will be called upon, as well. The committee consists of – besides the chair – at least one member (a professor, an associate professor or college professor) and at least two questioners (instructors) and the examiner. In controversial cases the chair makes the decision. The mandate of a Final Examination Board lasts for three years. The division of the candidates to the mandatory final exam board is announced by the Registry Office.

# **DIPLOMA**

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

The diploma is an official document decorated with the coat of arms of Hungary which verifies the successful completion of studies in Agricultural Environmental Management Engineering graduate program. The diploma contains the following data: name of HEI (higher education institution); institutional identification number; serial number of diploma; name of diploma holder; date and place of his/her birth; level of qualification; training program; specialization; mode of attendance; place, day, month and year issued. Furthermore, it has to contain the dean’s (or vice-dean’s) original signature and the seal of HEI. It has to contain the dean’s (in case of being prevented from attending the vice- dean for educational affairs) original signature and the imprint of the official stamp of the tertiary institute.

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

Calculation of a diploma grade according to this formula:

The qualification of the diploma is the simple arithmetic average results of the weighted academic average of all semesters of the given training, the result of the oral complex final exam, and the thesis.

Grade=(A+B+C)/3, where
A: Weighted academic average of all semesters of the given training

B: Grade of the oral complex final exam
C: Grade awarded for defending the thesis

On the basis of the calculated average grade the classification of the award: Outstanding 4,81 – 5,00

Excellent 4,51 – 4,80

Good 3,51 – 4,50

Satisfactory 2,51 – 3,50

Pass 2,00 – 2,50

Award with Honour

An award with Honour is permitted where a student obtained grade 5 in all subjects of the final exam. The average of thesis grade, his/her exam grades and mid-semester grades during his/her studies is at least 4.00. Moreover, he/she is not permitted to have a grade worse than grade 3 during his/her studies.

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| --- | --- |
|  | *Coordinator: Dr. Péter Tamás Nagy, associate professor* |
|  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | **21. 03. 2022.** |  |
| **Code** | **Subject name** | **semester I** | **semester II** | **semester II** | **semester IV** | Lecturer |   |
| 14 | 14 | 14 | 10 |   |
| lec | prac | type | credit | lec | prac | type | credit | lec | prac | type | credit | lec | prac | type | credit |   |
|   | *Compulsory subjects* |   |   |   |   |   |   |
| MTMKG8001A | Environmental chemistry | 2 | 2 | K | 4 |   |  |  |   |   |  |  |   |   |  |  |  | Dr. Nagy Péter Tamás |   |
| MTMKG8002A | Soil physics and geohydrology | 2 | 2 | G | 4 |   |  |  |   |   |  |  |   |   |  |  |  | Dr. Magyar Tamás |   |
| MTMKG8003A | Environmental informatics – Environmental monitoring | 2 | 2 | K | 4 |   |  |  |   |   |  |  |   |   |  |  |  | Dr. Tamás János |   |
| MTMKG8004A | Applied hydrology, hidraulics | 3 | 3 | K | 6 |  |  |  |  |   |  |  |   |   |  |  |   | Dr. Pregun Csaba |   |
| MTMKG8005A | Circular Economy in Agriculture | 2 | 1 | G | 3 |   |  |  |   |  |  |  |   |  |  |  |   | Dr. Szőllősi Nikolett |   |
| MTMKG8006A | Physical and chemical methods of environmental technology | 3 | 2 | G | 5 |   |  |  |   |   |  |  |   |   |  |  |  | Dr. Magyar Tamás |   |
|   | *Total number of hours:* | 14 | 12 |   | 26 |   |   |   |   |   |   |   |   |   |   |   |
| MTMKG8007A | Nature conservation, ecology |   |  |  |   | 2 | 2 | G | 4 |   |  |  |   |   |  |  |   | Dr. Juhász Lajos |   |
| MTMKG8008A | Environmental impact assessment and environmental modeling |   |  |  |   | 2 | 2 | K | 4 |   |  |  |   |   |  |  |   | Dr. Tamás János |   |
| MTMKG8009A | Wastewater and slurry management |   |  |  |   | 2 | 1 | G | 3 |   |  |  |   |   |  |  |   | Dr. Boczonádi Imre |   |
| MTMKG8010A | Precision agriculture |   |  |  |   | 1 | 2 | G | 3 |   |  |  |   |   |  |  |   | Farkasné Dr. Gálya Bernadett |   |
| MTMKG8011A | Environmental technologies I. – Soil remediations |   |  |  |   | 2 | 1 | K | 3 |  |  |  |  |   |  |  |   | Dr. Nagy Attila |   |
| MTMKG8012A | Environmental Measurement Techniques |   |  |  |   | 2 | 2 | G | 5 |  |  |  |  |   |  |  |  | Dr. Nagy Péter Tamás |   |
| MTMKG8013A | Environmental Technologies II: Aerobic and anaerobic technological systems |   |  |  |   | 2 | 1 | K | 3 |   |  |  |   |   |  |  |   | Dr. Magyar Tamás |   |
|   | *Total number of hours:* |   |   |   | 13 | 11 |   | 25 |   |   |   |   |   |   |   |   |
| MTMKG8014A | Drought and excess water management, melioration |   |  |  |   |   |  |  |   | 3 | 2 | K | 3 |   |  |  |   | Dr. Nagy Attila |   |
| MTMKG8015A | Agricultural forestry and biomass production |   |  |  |   |   |  |  |   | 2 | 1 | K | 3 |   |  |  |   | Dr. Rédei Károly |   |
| MTMKG8016A | Water certification, Water quality protection |   |  |  |   |   |  |  |   | 2 | 1 | K | 3 |   |  |  |   | Dr. Pregun Csaba |   |
| MTMKG8017A | Waste management in agriculture and food industry |   |  |  |   |   |  |  |   | 2 | 1 | G | 3 |   |  |  |  | Dr. Magyar Tamás |   |
| MTMKG8018A | Environmental planning, land consolidation, landscape conservation |   |  |  |   |   |  |  |   | 2 | 1 | K | 3 |  |  |  |  | Dr. Fehér Zsolt |   |
| MTMKG8019A | Farm Business Management and Project Management |   |   |   |   |   |  |  |   | 1 | 2 | G | 3 |   |   |   |   | Dr. Szőllősi Nikolett |   |
|   | *Total number of hours:* |   |   |   |   |   |   | 12 | 8 |   | 18 |   |   |   |   |   |
| MTMKG8020A | Agro-environmental management: Ecotoxicology, environmental risk assessment |   |  |  |   |   |  |  |   |   |  |  |   | 2 | 2 | G | 4 | Dr. Nagy Péter Tamás |   |
| MTMKG8021A | Environmental Policy, Law and Sectoral administration |   |  |  |   |   |  |  |   |   |  |  |   | 2 | 1 | K | 3 | Dr. Szőllősi Nikolett |   |
| MTMKG8022A | Agricultural biotechnology |   |   |   |   |   |   |   |   |  |  |  |   | 2 | 1 | G | 3 | Dr. Boczonádi Imre |   |
|   | *Total number of hours:* |   |   |   |   |   |   |   |   |   | 6 | 4 |   | 10 |   |   |
|   | *Optional subjects* |   |   |   |   |   |   |
| MTMKG8023A | Remote sensing |  |  |  |  |   |  |  |   | 0 | 3 | G | 3 |  |  |  |   | Dr. Nagy Attila |   |
| MTMKG8024A | Research methodology, scientific communication |  |  |  |  |   |  |  |   | 0 | 3 | G | 3 |  |  |  |   | Dr. Nagy Péter Tamás |   |
| MTMKG8025A | Air quality protection | 0 | 3 | G | 3 |   |  |  |   |   |  |  |   |  |  |  |  | Dr. Magyar Tamás |   |
| MTMKG8026A | Noise and vibration protection |  |  |  |  |   |  |  |   | 0 | 3 | G | 3 |   |  |  |  | Dr. Magyar Tamás |   |
| MTM7NY1A | Academic language skills | 0 | 2 | G | 3 |   |  |  |   |  |  |  |   |  |  |  |   | Dr. Czellér Mária |   |
| MTM7NY2A | Professional language skills |   |   |   |  |   |  |  |   | 0 | 2 | G | 3 |  |  |  |   | Dr. Czellér Mária |   |
| MTMKG7GYA | *Internship (4 weeks)* |   |   |   |   | 0 | 160 | G | 5 |   |   |   |   |   |   |   |   | Dr. Nagy Péter Tamás |   |
| MTMKG8D1A | *Thesis preparation I* |  |  |  |   |   |   |   |   | 0 | 3 | G | 10 |   |  |  |  | Dr. Tamás János |   |
| MTMKG8D2A | *Thesis preparation II* |   |   |   |   |   |   |   |   |   |   |   |   | 0 | 3 | G | 20 | Dr. Nagy Péter Tamás |   |
| SI-001 | *Physical excercise* | 0 | 2 | A | 0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|   | *Total number of credits for compulsory subjects* | 26 | 25 | 18 | 10 | **79** |   |
|   | *Total number of credits for subjects of free choise* | 3 |   | 3 |   | **6** |   |
|   | *Professional practice (4 weeks)* |   | 5 |   |   | **5** |   |
|   | *Thesis* |   |   | 10 | 20 | **30** |   |
|   | Total credit: | 26/29 | 30 | 28/31 | 30 | **120** |   |
|   | Total number of hours alltogether (hour/week): | 14 | 12/17 | 26/31 | 13 | 11 | 26 | 12 | 8/17 | 20/29 | 6 | 4/7 | 10/13 |   |   |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Topics of final exam: |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Environmental management |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Environmental protection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sustainable agricultural systems |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Environmental Technology |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**MODEL CURRICULUM OF AGRICULTURAL ENVIRONMENTAL MANAGEMENT ENGINEERING MSC**

**The curriculum of the program is available in excel format on the webpage of the Faculty of Agricultural and Food Sciences and Environmental Management:**

**(https://mek.unideb.hu/en/agricultural-environmental-management-engineering).**