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

Agricultural Water Management Engineering MSc Program

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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.

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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)

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# **INSTITUTE OF HORTICULTURE**

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# [**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**

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**INSTITUTE OF NUTRITION**

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# **INSTITUTE OF PLANT PROTECTION**

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

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**AGRICULTURAL LABORATORY CENTRE**

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**INSTITUTE OF WATER AND ENVIRONMENTAL MANAGEMENT**

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**ACADEMIC CALENDAR**

# General structure of the academic year:

|  |  |  |  |
| --- | --- | --- | --- |
| Fall semester | 1st – 2nd week | Registration\* | 2 weeks |
| 1st – 14th week | Study Period  for non-graduating students | 14 weeks |
| 1st – 9th week | Study Period  for 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 Period  for non-graduating students | 14 weeks |
| 1st – 10th week | Study Period  for 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**

# <https://edu.unideb.hu/p/university-calendars>

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

INTRODUCTION OF THE PROGRAM

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

 The aim of the training is to train agricultural water management engineers who are able to use creative engineering in the field of sustainable integrated water management within the field of agricultural water management with the knowledge gained in master's degree. With their qualifications they are able to cooperate at a high level in solving domestic and international problems related to their field of expertise. They are suitable for the design and development of engineering, research and leadership positions. They are ready to continue their studies in doctoral training.

Agricultural water management engineers will have the knowledge of

* high level scientific, technical and relevant knowledge required for the agricultural water management.
* the applicability of the latest agricultural water management technologies and procedures and their legal regulations.
* the specificities of agricultural water management and processes, recognition the existing relationships between them.
* the latest IT solutions for agricultural water management and sustainable water resources management.
* international relations, the design, implementation, implementation methods, rules and related features of agricultural water management.
* the specialties of team and project work, with leadership knowledge.
* the different levels of leadership functions, the methods of evaluation, and conflict management techniques.
* modern management theory and applied psychology that can be applied in the field and applicable to the whole agricultural sector.
* the relationship between the economy, the society and the agricultural sector.
* the strategic role of R & D & I in the agrarian economy.
* the specific methods of research, abstraction techniques, and the ways of developing the practical aspects of theoretical questions.
* the professional and effective oral, written and network communication methods and tools.
* the special vocabulary of the field of expertise in English.

 Agricultural water management engineers will have competences on

* developing and implementing climate adaptation solutions.
* using and further developing the latest agricultural water management technologies and processes.
* coordinating the professional task of agricultural water management.
* orientating and providing a professionally based opinion on domestic and international economic policy and social events related to the agricultural economy.
* independently interpreting and applying legislation related to its professional activity.
* defining, planning and organizing the activity of the field of expertise.
* forming its own position and defending it in a debate about general social, agricultural economics, and special issues related to the field.
* following a thorough, analytical approach to the relevant international literature of its field of expertise.
* providing the necessary conditions for the implementation of the specified activities, to continuously manage and control the implementation, and to organize it.
* practicing the various functions of leadership activities, motivating them, evaluating their performance, and legitimate and effective handling of conflicts.
* developing a project team, actively participating in research and development projects.
* analysing the different areas of the ideas that form the knowledge system of the given field of expertise, and of exploring the complex and specific contexts.
* identifying the professional problems, their versatile, interdisciplinary approach, and the detailed, conceptual and practical background needed to solve it.
* agrarian analyses, which can be transposed across sectors, contexts, complex formulas and evaluations.
* applying state-of-the-art IT tools, professional and effective oral and written communication.
* engineering and environmental friendly solutions that support individuals and the health of society.

Main subjects typically include (this list is indicative and subject to change): Applied Hydrology and Hydraulics, Climatology, Hydrogeograpy, Hidrobiology, Water Chemistry, Soil Physics, Melioration and Land Consolidation, Pond Culture and Fisheries Management, Irrigated Crop Production, Floodplain Management, Irrigation for Horticultural Production, Wastewater and Slurry Management, Management and Utilization of Aquatic Habitats, Water Resource Protection – Environmental Damage Prevention, Remote Sensing and GIS in Hydrology, Farm Irrigation Machines , Irrigation Technology , Precision Agriculture, Drought Management, Integrated Water Management and Monitoring, Water Economics, Excess Water Management, Agricultural Water Supply Systems, Agricultural Water Management Planning and Implementation, Water Policy, Water Law and Sectoral Public Administration, Thesis.

Internship, practice: Students should complete a 4-week summer field practice. 65

Career prospects: Postgraduates are qualified for the design and development of engineering, research and leadership positions. They may continue their studies in doctoral training.

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

|  |  |
| --- | --- |
|  | **SEMESTER 1.** |
| MTMKG8004A | Applied hydrology and hydraulics |
| MTMVG8001A | Climatology |
| MTMVG8002A | Water chemistry |
| MTMKG8002A | Soil physics and geohydrology |
| MTMKG8018A | Land-consolidation and landscape conservation |
| MTMVG8003A | Remote sensing and GIS in hydrology |
|  |  |
|  | **SEMESTER 2.** |
| MTMVG8004A | Wetland and floodplain management, flood protection |
| MTMVG8005A | Hydrobiology |
| MTMVG8006A | Irrigated crop and horticultural production |
| MTMVG8007A | Integrated water management - water information systems |
| MTMKG8009A | Wastewater and slurry management |
| MTMVG8008A | Farm machines of the irrigation, irrigation technology |
|  |  |
|  | **SEMESTER 3.** |
| MTMKG8010A | Precision agriculture |
| MTMVG8009A | Agricultural water supply systems, hydrogeography |
| MTMKG8014A | Drought and excess water management, melioration |
| MTMVG8010A | Water economics |
|  |  |
|  | **SEMESTER 4.** |
| MTMVG8011A | Pond culture and fisheries management |
| MTMVG8012A | Agricultural water management planning and implementation |
| MTMVG8013A | Waterpolicy, water law and sectoral public administration |
|  |  |
|  | ***Optional subjects*** |
| MTMKG8024A | Research methodology, scientific communication |
| MTMKG8016A | Water quality management |
| MTMKG8019A | Farm Business Management and Project Management |
| MTMKG8023A | Remote sensing |
| MTMVG8014A | Urban hydrology |
| MTMVG8015A | Soil remediaition and prevention |
| MTM7NY1A | Academic language skills (scientific language) |
| MTM7NY2A | Professional language skills (business language) |

**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:**

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

**practices:**

|  |
| --- |
| Academic writing, speaking, reading comprehension and listening comprehension |
| Academic vocabulary building, writing, speaking listening and reading comprehension |
| Presentation skills, reading comprehension and listening comprehension, academic writing |
| Developing academic literacy, speaking, reading and listening comprehension, |
| Speaking and presenting,, reading comprehension and listening comprehension tasks, and academic writing. |
| The situational dialogues, reading comprehension and listening comprehension tasks, and writing a formal letter regarding a given topic |
| A survey of the skills and knowledge acquired thus far |
| Poster and presentation, reading comprehension and listening comprehension tasks, and academic writing. |
| Effective presentation, reading comprehension and listening comprehension tasks, and academic writing |
| Time management, critical thinking, reading comprehension and listening comprehension tasks, and writing essays. |
| Presentation, reading comprehension and listening comprehension tasks, and academic writing |
| Speaking and presentation, reading comprehension and listening comprehension tasks, and academic writing |
| Essay writing, speaking, reading comprehension and listening comprehension |
| 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 water management planning and implementation, MTMVG8012A**

ECTS Credit Points: 3

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

Type of exam: colloquium

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 agricultural water management planning.

- for a grade: written exam

**Summary of content – theory**

In order to get acquainted with agricultural production security and with the adaption to climate change students will study water retention, sustainable management of water resources, water saving irrigation technology planning, design, production methods adapted to climate change and sustainable land use planning processes. Students will acquire the appropriate methods, tools and effects of irrigation technology for the creation of a sustainable irrigated crop management conditions.

Students will be able to evaluate the water capacity of soils at agricultural sites, analyzing the water balance of agricultural sites, identification of sites with erosion risk, assessment and application of agronomic, technical and forestry practices of hilly drainage, lowland drainage, analyzing and planning amelioration. Identification of sites with excess water, creating irrigation fertigation scheduling, and irrigation planning.

**lectures:**

1. Water drainage on hilly regions.

2. Delineation of areas at risk of erosion, evaluation and applicability of agronomic, technical and forestry practices of hilly drainage

3. Plains water management, excess water drainage.

4. Channeling, channel planning

5. Methods of soil pipe drainage network planning and design. Soil and groundwater investigations methods in correspondence with soil piping, the soil pipe network construction, operation and maintenance.

6. Structure and planning of Micro Irrigation Systems

7. Structure and planning of Sprinkler Systems

8. Structure and planning of Surface Design of irrigation systems

9. Irrigation and fertigation planning.

**Summary of content - practice**:

The purpose of the practice is to enable students to understand the water balance of arable land and orchards. In addition, Student will be able to delineate erosion risk areas, landscaping on hilly sites by agro technical, technical and forestry methods, melioration options and design. In addition, vulnerable areas can be delineated for the preparation of irrigation plans and planning of irrigation turns for nutrient solution.

**practices:**

1. Geospatial delimitation of excess water effected areas, drainage collection calculation modeling

2. Channel measurement

3. Methods of designing the piping networks. Soil and groundwater studies related to soil piping.

4. Designing, operating and maintaining pipeline networks.

5. Design of surface irrigation systems

6. Preparation of irrigation and nutrient plan for sprinkling irrigation systems

7. Assessment of irrigation and nutrient management plan for sprinkling irrigation systems

8. Preparation of irrigation and nutrient plan for sprinkling micro-sprinkling systems

9. Assessment of irrigation and nutrient management plan for sprinkling micro-sprinkling systems

**Literature, handbooks**

Uhlig, U. (2011): Current Issues of Water Management. InTech Published. 340 p. ISBN: 978-9533074139.

Kumar, M. D., Sivamohan, M. V. K., Bassi, N. (2012): Water Management, Food Security and Sustainable Agriculture in Developing Economies (Earthscan Studies in Water Resource Management). Routledge. 256 p. ISBN: 978-0415624077.

Tanji, K. K., Kielen, N. C. (2006): Agricultural Drainage Water Management in Arid and Semi-arid Areas. FAO. ISBN: 978-8172334567.

H. Bjornlund, C. A. Brebbia, S. Wheeler: Sustainable Irrigation and Drainage IV: Management, Technologies and Policies. WIT Press / Computational Mechanics. 2012. ISBN-13: 978-1845646486

Chaudhry, M. H. (2007): Open-Channel Flow. Springer. 2nd edition. 540 p. ISBN: 978-0387301747.

Majumdar, D. K. (2012): Irrigation Water Management: Principles and Practice. PHI Learning Private Limited. 570 p. ISBN: 978-8120317297.

**Agricultural water supply systems, MTMVG8009A**

**Name and title of the person responsible for the subject:** Dr. Pregun Csaba senior lecturer

**Additional instructors involved in teaching the subject:**

**Name and level of the program:** Agricultural Water Management Engineering 2nd year MSc

**Subject type:** lecture, practice

**Teaching timetable of the subject, type of examination:**

**Credit value of the subject:** 2+1

**Purpose of teaching the subject:**

The aim of the subject:

Hydrogeography. Introduction to the landforms and distribution of natural and artificial water bodies, and the geographic relationships between them.

Agricultural water supply systems. To study the management of water supply systems, their hydro-ecological and technical functions, and the related theoretical and practical knowledge.

**Content of the subject (13 weeks):**

Hydrogeography

1. Hydrogeography and its subdivisions. The hydrosphere. River basins and their boundaries. The concept of watercourses and their formations. Energy, sediment transport and channel formation of rivers. Floods. Discharge curves, flood hydraulics. Characteristics of river basins. Water level, discharge of rivers
2. Groundwaters and its classification. Groundwater table, effluent and influent rivers. Role of human activity in groundwater quality and quantity problems. Aquifer protection. Karst waters.
3. Lakes. The concept of a lake. The degradation and ageing of lakes. Water quality problems. The EU Water Framework Directive (2000/60/EC). The world sea: oceans and seas. The chemical composition of seawater. Characterisation of waves. Sea and ocean currents.
4. Basics and objectives of agricultural water management planning.
5. Components and characteristics of water supply for agricultural purposes.
6. Water storage for irrigation, industrial and human consumption.
7. Water management, hydrological and ecological aspects of reservoirs.
8. Streams, canals, water management, hydrological and ecological aspects.
9. Water supply to irrigation farms and fish ponds.
10. Water management, hydrological and ecological aspects of dams and hydroelectric power plants.
11. Protection of river basins and shorelines. Maintenance of flood protection levees.
12. General water treatment technologies.
13. Development of the agricultural water management sector.

**Type of mid-term examination:**

Participation in the exercises is compulsory. In case of absence, the student is required to submit a theoretical and practical report on the missed practical training or to participate in the departmental research. Participation in the practicals is a prerequisite for obtaining a signature.

**Method of assessment (semester examination mark - report, practical grade, colloquium, examination):**

Participation in the exercises is compulsory.

In case of absence, the student must submit a report of the missed practical within two weeks.

Attendance at the exercises is a condition of signature.

**Teaching aids:**

Lecture slides and supplementary material are available in ppt and pdf format (E-learning).

**Recommended literature:**

Alan Strahler (2011): Introducing Physical Geography. Boston University. John Wiley & Sons, Inc. ISBN 13 978-0470-41811-6

F. Lempérière (2012): Design and Construction of Dams, Reservoirs, and Balancing Lakes. Corpus ID: 16417966

**Applied hydrology and hydraulics MTMKG8004A**

**Name and title of the person responsible for the subject:**

**Additional instructors involved in teaching the subject:** Dr. Pregun Csaba, assistant professor, Dr. Kiss Nikolett Éva teaching assistant

**Name and level of the program:** Agricultural Water Management Engineering MSc

**Subject type:** obligatory

**Teaching timetable of the subject, type of examination:** 2+2K

**Credit value of the subject:** 4

**Purpose of teaching the subject:** Students learn about the basics of hydrology, water cycle, precipitation and run-off patterns, soil moisture, groundwater and the analysis process, subsurface water sources. Aquifers, flow, analysis and quality are covered. Pollution, and problems are also discussed. In graduate programs, theories are studied, included distribution, testing, movement and contaminants. Contaminants in different water sources is the focus of this course. Students learn about different contaminants in ground water, streams and precipitation. Protection, removal and treatment methods are covered. Students learn about creating models, interpreting models and using models in problem-solving. Different types of models are covered. Students may develop their own models in these courses. Students learn about the storage of water and movement within watersheds. This course may cover watershed modelling and introduce students to watershed manipulation techniques. Introduces the physical statics and dynamics and properties of incompressible fluids and the practical application of fluid power principles involving agricultural and environmental engineering worksites.

**Content of the subject (14 weeks):**

1. The subject of hydrology, the water supply of the Earth, the circulation of water, the elements of the cycle. The hydrological cycle and its sub-processes.
2. Knowledge, measurement and description of primary elements of water balance (precipitation, evaporation, infiltration, run-off, ponding). Basic relationships of hydrological elements.
3. Hydraulic Basics I. (physical properties of liquids and hydrostatics)
4. Hydraulic Basics II. (flow laws, pressure flow, gravity flow, pump operation and regulation)
5. Basics of hydrodynamics 1. (closed pipeline water movements and groundwater movement)
6. Basics of hydrodynamics (knowledge of open surface water movements and groundwater movements)
7. Classification of watercourses. Types of river valley, type of stage, estuary types.
8. The formation and morphology of the lakes. Types of lakes.
9. Geometric parameters of the catchment areas, characterization of the catchment areas.
10. Cross section of watercourses, site analysis, types of sections.
11. The groundwater. Forms, characterization and classification of stratified waters.
12. Types and characterization of groundwater.
13. Groundwater contamination and treatment.
14. Characterization and classification of karstic waters. Types of springs.

**Summary of content – practice (14 weeks):**

1. The hydrological cycle
2. Water balances
3. Hydrostatics
4. Hydrodynamics
5. Conveyance of channels
6. Estimating the energy of watercourses.
7. Sizing of channels
8. River modelling (HEC-RAS) I.
9. River modelling (HEC-RAS) II.
10. Culverts and Bridges
11. River classification methods
12. Storm water collection systems
13. Precipitation, infiltration measurement
14. Groundwater measurement

**Type of mid-term examination:**

Written and/or verbal

**Method of assessment (semester examination mark - report, practical grade, colloquium, examination):**

The implementation of the practices. Missing the practice in accordance with the University of Debrecen Study and Exam Regulations. Active participation in exercises. Calculation exam task.

**Teaching aids:**

ppt presentations.

**Recommended literature:**

Han D. (2008) Concise Hydraulics. Ventus Publishing ApS. Bookboon.com. ISBN 978-87-7681-396-3

Han D. (2010) Concise Hydrology. Ventus Publishing ApS. Bookboon.com. ISBN 978-87-7681-536-3

**Climatology, MTMVG8001A**

ECTS Credit Points: 3

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

Type of exam: Oral exam

Requirements:

- for signature: Completing assignments / exercises (60%), submitting essay or giving presentation (00%).

- for a grade: Oral exam

**Summary of content – theory**

The aim of the course is to provide knowledge on the terminology of climatology; to understand the basics of the functioning of the climate system, to understand the interactions between climate forming factors and their impacts; to gain a picture on the temporal and spatial patterns of climate elements and on the anomalies in the climate system of the Earth.

**lectures:**

1. Definitions of meteorology, processes of the atmosphere
2. Structure and component of the atmosphere. Changes of components of the atmosphere. Solid and liquid components of the atmosphere
3. Dry and wet air. Measures of the humidity
4. Universal gas equation for wet air. Adiabatic processes of wet air. Barometric formula and its practical applications
5. Precipitation forming, types. Acidic rain
6. Weather fronts
7. Atmospheric forces and balance. Condensation. Cloud types
8. Subsurface waters
9. Morphometric background of watersheds. Classification of rivers, headwaters and valley networks
10. River drainage networks, classification of river channel types. The flow regime. Processes of erosion, transportation and accumulation. Sediment transport of fluvial systems
11. Floods and flash floods. Overview of the Danube watershed and the main rivers of Hungary. Problems of Inland excess water
12. Managing river channels
13. The application of Remote Sensing and Geographic Information Systems in hydrogeography

**practices:**

1. Devices of the meteorological measurements. The weather station
2. Ombrometer, ombrograph and the modern alternatives
3. Measuring temperature and the requirements
4. Measuring humidity
5. Potential and real evapotranspiration
6. Possibilities of the prediction and measurements
7. Measuring practice
8. Visiting an active meteorological station
9. Flume experiments: basic concepts, development of different channel types
10. Flume experiments: formation of alluvial fans and delta estuaries.
11. Flume experiments: concepts of surface development in lowland areas.
12. Remote sensing of fluvial environments – delineation of water-related areas by spectral indices.
13. GIS-based methods for determining flow patterns
14. GIS-based methods for determining flow patterns, scenario analyses

**Literature:**

Charlton, R. (2008). Fundamentals of Fluvial Geomorphology. Routledge, New York.

Brierley, G.J., Fryirs, K.A. (2005). Geomorphology and River Management: Applications of the River Styles Framework. Wiley-Blackwell Publishing.

John E. Oliver (ed) (2005): Encyclopedia of wolrd climatology. Springer

C Donald Ahrens: Metorology today. An introduction to weather, climate, and the environment.

**Drought and excess water management, MTMKG8014A**

ECTS Credit Points: 4

28 hour(s) lecture and 28 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. Active participation the lessons (at least 11), completing exercises.

- for a grade: practical course mark in written exam

**Summary of content – theory**

The aim of the course is to make students understand and apply the practical application of drought management, including the following: the 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 plant water supply for irrigation systems. As a result of completing 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 are to get the agricultural environmental management engineering MSc students acquainted with mainly drought management plans, drought stress monitoring and a method for measurement and calculation of the evapotranspiration. The exercises provide advanced knowledge on drought monitoring techniques, plant water supply for irrigation systems. As a result of completing 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 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

**Farm Business Management and Project Management , MTMKG8019A**

ECTS Credit Points: 3

0 hour(s) lecture and 1 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 basics 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

**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.

**Hydrobiology MTMVG8005A**

ECTS Credit: 3

Type of the subject: compulsory

Ratio of theory and practice: (credit%) 70/30

Type and number of classes per semester: 28 hour(s) lecture and 14 hour(s) practice per semester

Number of classes per week: 2+1

Type of exam: exam

Subject in the curriculum: semester 1

Preliminary requirements: -

Summary of content - theory:

Course objectives: Students will acquire knowledge of the hydrobiological aspects of the agriculture, water management, environmental protection and nature conservation. Students learn about the relationship among the environment and aquatic ecosystems. Students will acquire the water biological and ecological knowledge that are necessary for agricultural water management practice (water qualifications, abstraction and distribution, design, construction and maintenance of water treatment and wastewater treatment, management of natural and artificial waterbodies and wetlands, aquaculture & irrigation systems etc.).

Weeks:

1. The concept of Hydrobiology. The main forms of surface water and groundwater bodies.

2. The biologically relevant physical and chemical properties of inland waters. The material and energy cycles of waters.

3. General Limnology. The aquatic habitats and biomes.

4. Aquatic communities. General. The concept of plankton

Aquatic communities. The phytoplankton

5. Aquatic communities. The zooplankton

6. Aquatic communities. Macroinvertebrates

7. Aquatic communities. Macroinvertebrates & FFG,

8. Aquatic communities. Macrophytes.

9. Aquatic communities. The animals of nekton. Physiology & ecology of fishes.

10. The ecological relationships of aquatic life communities (C-N-P cycles).

11. The biological (ecological) water qualification.

12. The methods of biological indications. The role of the macroscopic aquatic invertebrate in the field of the ecological water qualification.

13. Water pollution and eutrophication. Protection of natural and artificial water bodies (ponds) against eutrophication.

14. The biological aspects of waste water purification (Constructed Wetlands)

Summary of content - practice:

1. Freshwater ecosystems

2. Physical-Chemical characteristics of Freshwater

3. Phytoplankton 1

4. Phytoplankton 2

5. Zooplankton

6. Bacterioplankton 1

7. Bacterioplankton 2

8. Eutrophication

9. Macroinvertebrate

10. Fishes

11. Virioplankton

12. WQ General

13. General limnology

14. Freshwater Macroinvertebrates Protocol

Literature, handbooks in English

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

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

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

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

5. FISRWG (10/1998).Stream Corridor Restoration: Principles, Processes, and Practices. By the Federal Interagency Stream Restoration Working Group (FISRWG) (15 Federal agencies of the US gov't). GPO Item No. 0120-A; SuDocs No. A 57.6/2:EN3/PT.653. ISBN-0-934213-59-3.

Competencies gained (acc. to the Regulation on training and outcome requirements)

a) Knowledge:

 The student has the high level of hydrobiological and hydroecological knowledge needed to cultivate the agricultural water management field.

 The student is familiar with hydrobiological and engineering applications related to environmental technology, biotechnology and water management.

 The student is familiar with the latest ecological and biological water qualification procedures

 The student is familiar with the technologies and procedures for the management, design and operation of natural and artificial wetlands.

b) Skills:

 The student is able to manage and protect the communities of irrigation systems and wetlands

 The student is able to effectively apply and further develop environmental and engineering techniques in the field of water quality and water treatment.

 The student is able to independently interpret and apply standards and legislation related to water management and environmental activities.

c) Attitude:

 The student takes into account the principles of environmental sustainability and economic efficiency

 The student is committed to environmental protection and sustainable agriculture.

 Make the student's opinion on a professional basis, consistently represent them.

 The student cooperates with experts from other disciplines, accepts different opinions if they are appropriately supported by the professional.

 Lifelong learning

d) Autonomy and responsibility:

 With his practical experience, the student decides independently on the way in which biological water treatment, wetland management, water supply, engineering and environmental technology work processes are implemented.

 The student makes decisions with professional responsibility, takes the consequences.

 The student represents, adheres to and complies with the environmental and engineering ethics rules of his / her field

Responsible lecturer: Dr Pregun, Csaba

Terms of course completion:

1. Completing assignments / exercises

Form of examination:

written and/or verbal

Requirement(s) to get signature:

Participation in lectures and practical exercises. Successful completion of practical tasks.

Exam questions:

1. Describe the subject of hydrobiology and its relationship with the sciences.

2. Describe the main physical characteristics of water!

3. Describe the main chemical characteristics of water!

4. Describe the biological significance of density, buoyancy, concentration and solubility.

5. An overview of standing water habitats.

6. Characterization of pleuston and nekton.

7. Zoning and characteristic vegetation of the coastal region.

8. Stream water habitats and associations

9. Describe the River Continuum Concept!

10. Describe the Flood Pulse Concept!

11. Vertical layering of lakes (by light and temperature)

12. The light conditions of the waters

13. The sediment materials according to their origin.

14. Types of biological sediments.

15. General characterization of plankton.

16. Characterization and significance of bacterioplankton.

17. The importance and ecological role of phytoplankton (algae).

18. The plankton paradox.

19. A summary of blue algae (Cyanobacteria) and whipped-algae (Euglenophyta).

20. Summary of Diatoms and Dinophyta.

21. A summary of the green algae.

22. A summary of brown algae (Phaeophyta) and red algae (Rhodophyta).

23. Description of macrophytes.

24. Macrophytes adapt to the aquatic lifestyle.

25. Characterization of animal monocytes (zooplankton I)

26. Characterization and reproduction of Rotatoria (zooplankton II)

27. Characterization of Cladocera and Copepods (Zooplankton III)

28. The general characterization of aquatic invertebrates

29. Characterization of aquatic invertebrates (mayflies).

30. Characterization of aquatic invertebrates (dragonflies).

31. Characterization of aquatic invertebrates (stoneflies)

32. The Functional Feeding Groups.

33. General characterization of the body structure of fish.

Fish lifestyle and ecology.

34. The lifestyle and theology of frogs.

35. Water rating methods.

36. Eutrophication

37. Constructed wetlands

**Integrated water management and monitoring , MTMVG7018A**

ECTS Credit: 5

Type of the subject: compulsory

Ratio of theory and practice: (credit%) 50/50

Type and number of classes per semester: 42 hour(s) lecture and 28 hour(s) practice per semester

Number of classes per week: 3+2

Type of exam: exam

Subject in the curriculum: semester 3

Preliminary requirements: -

Summary of content - theory:

Course objectives:

Within this subject the students get acquainted with the Hungarian and international management systems of water catchment areas and the evaluation methods of these systems as well. They learn the planning specifications of water catchment areas of the Carpathian basin and other international catchment areas. With this subject the students will be able to solve water management tasks alone, and they will be able to coordinate the planning and implementation phases of minor catchment areas.

1. Definition and development of integrated watershed management

2. International management systems of catchment areas, Catchment areas of the Carpathian basin

3. Elaboration of monitoring systems, data collection and data analysis

4. Specifications of catchment area management of Tisza

5. Danube - Drava river basin management

6. Watershed management of the Lake Balaton and its area

7. Industrial water use – Alternative water resources

8. Urban water management

9. Waterways regulation

10. Drainage and reserving of water

11. Irrigation – drought management

12. HEC-RAS

13. SWAT14. DHI

Summary of content - practice:

Skills to be learnt:

1. DanubeGIS concept

2. DanubeGIS structure

3. DanubeGIS metadata

4. Inspire directive and hydrology

5. Data management of DanubeGIS

6. SQL and WMS of DanubeGIS

7. Tisza water quality

8. Tisza water quantity

9. Tisza water monitoring

10. Hungarian Drought Monitoring

11. Use Global Precipitation Measurement (GPM) system

12. Earth Observation System

13. IMERG - STRORM system

14. MODIS -Evapotranspiration

Literature, handbooks in English

Chow, V. T., Maidment, D. R., Mays, L. W. (1988) Applied Hydrology. McGraw-Hill Book Company. 558 p. (ISBN: 978-007-010-810-3)

ICPDR (2015): The Danube River Basin District Management Plan. International Comission for the Protection of the Danube River – ICPDR. https://www.icpdr.org/

Lawson, J. (2005): River Basin Management. CRC Press. 369 p. (ISBN: 0415392004)

Competencies gained (acc. to the Regulation on training and outcome requirements)

a) Knowledge:

- Has a high level of natural sciences and technical knowledge necessary for the operation of agricultural water management.

- Know the applicability and the legal regulation of the latest agricultural water management technologies and procedures.

- Acknowledges in detail the characteristics of agricultural water management and processes, recognizes the existing relationships among them.

b) Skills:

- They are able to apply and further develop the latest agricultural water management technologies and processes

- They are able to independently interpret and apply legislation related to its professional activity.

- Capacity to analyse and evaluate agri-business and related sectors

- Have the knowledge in written and oral communication in Hungarian and foreign languages.

c) Attitude:

- They are committed to environmental protection and a sustainable agricultural economy.

- Recognize professional values, responsive to the application of effective methods and tools

- Open and responsive to the knowledge and practical application of modern and innovative processes

d) Autonomy and responsibility:

- Equal partner in professional and specialist co-operation.

- Represent special science and engaged to keep the ethical rules of engineering and environment of its field.

Responsible lecturer: Prof. János Tamás

Other lecturer(s): Dr. Tamás Magyar

Terms of course completion:

1. Completing assignments / exercises

2. Submitting essay

3. Giving presentation

Form of examination:

written exam

Requirement(s) to get signature:

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

Exam questions:

1. Definition and development of integrated watershed management

2. Water Framework Directive goals, and history

3. Catchment areas of the Carpathian basin

4. Elaboration of monitoring systems, data collection and data analysis

5. Specifications of catchment area management of Tisza

6. Danube - Drava river basin management

7. Watershed management of the Lake Balaton and its area

8. Industrial water use – Alternative water resources

9. Urban water management

10. Drainage and reserving of water

11. Irrigation – drought management

12. Groundwater monitoring

13. Integrated Urban water management

14. Industrial water use – Alternative water resources

15. Green and Blue engineering

16. Agricultural water use and watershed management

17. Waste water reutilization

18. Water policy, water price , DSS

19. International Drought Management

20. HEC-RAS

21. SWAT DHI

22. DanubeGIS

23. Scientific background of remote sensing

24. Earth Observation Monitoring portal and hydrology

25. Satellite based hydrological information (MODIS, Sentinel)

**Irrigated crop and horticultural production, MTMVG8006A**

ECTS Credit Points: 3

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

Type of exam: Written exam

Requirements:

- for signature: Attendance and active work on the practices, giving a short presentation - for a grade: Written exam

**Summary of content – theory**

The main goals are to give effective academic and practical knowledge connected to irrigated crop production: Interaction between water management and crop production in agriculture. Knowledge about water balance and water requirement of plants. Learning about the significance of environment friendly and economic irrigation. Effects of the irrigation on soil and plant and environment. Principles of irrigation, main functions of irrigation and crop production. Irrigation regime of main crops.

**lectures:**

1. Interaction between water management and crop production in agriculture.
2. Water balance of plants, water demand of plants.
3. Bases of water regulation in crop production.
4. Learning of significance of environment friendly and economic irrigation.
5. Effect of irrigation on soil and plants.
6. Aims of irrigated crop production.
7. Necessity of irrigation, efficiency of water use.
8. Principles of fertilization in irrigated fields.
9. Evaluation of irrigation patterns.
10. Main functions of irrigation and crop production.
11. Correlations between irrigation and yield stability, yield quality.
12. Irrigation regime of main crops I (green peas, alfalfa, red clover).
13. Irrigation regime of main crops II (corn, sweet corn, corn seed).
14. Irrigation regime of main crops III (rice, potato, sugar beet).

**Summary of content - practice**:

The main goals are to give effective practical knowledge connecting to the irrigated crop production.

**practices:**

1. Interaction between water management and crop production in agriculture.
2. Water balance of plants, water demand of plants.
3. Bases of water regulation in crop production.
4. Learning of significance of environment friendly and economic irrigation.
5. Effect of irrigation on soil and plants.
6. Aims of irrigated crop production.
7. Necessity of irrigation, efficiency of water use.
8. Principles of fertilization in irrigated fields.
9. Evaluation of irrigation patterns from the point of view of crop production.
10. Main functions of irrigation and crop production.
11. Correlations between irrigation and yield stability.
12. Practical knowledge on irrigation regime of main crops I (green peas, alfalfa, red clover)
13. Practical knowledge on irrigation regime of main crops II (corn, sweet corn, corn seed)
14. Practical knowledge on irrigation regime of main crops III (rice, potato, sugar beet)

**Literature, handbooks**

Burton, M. (2010): Irrigation Management: Principles and Practices, CAB Intl. ISBN: 9781845935160

Lee, T. S. (2012): Irrigation Systems and Practices in Challenging Environments, Intech, Rijeka, Croatia ISBN 978-953-51-0420-9

Esteve, Y.V, Brebbia, C.A. Rico, D.P. (2008): Sustainable Irrigation Management, Technologies and Policies II WIT Press, Southampton, UK ISBN: 978-1-84564-116-0

Brebbia, C.A, Marinova, M, Bjornlund, H (2010): Sustainable Irrigation Management, Technologies and Policies III, Wit Press/Computational Mechanics, Billerica, USA, ISBN: 9781845644468

M. H. Ali (2010)-Fundamentals of Irrigation and On-farm Water Management-Springer-Verlag New York ISBN 978-1-4419-6334-5

**Summary of content – theory**

Production of appropriate quality and quantity horticultural products is provided by excellent irrigation technological practices. The main purpose is the irrigation for the water demand of cultivated plants. The aim of the subject is to introduce the students to the basics of vegetable and fruit irrigation, to recognize the most effective irrigation methods in horticultural crop production, to recognize the irrigation water requirement of horticultural plants and the opportunities of irrigation modelling in horticulture.

**lectures:**

1. The role of water management. The historical overview of irrigation. Situation of irrigation in the world.

2. Basic irrigation concepts and principles of irrigation planning. Recognition of water forms in soil.

3. Measuring of water resources in soil and water status in plants.

4. Technical basics of irrigation (water acquisition, pumps, pipe networks).

5. Technical basics of irrigation (fertigation, fertilizer delivering and dosing).

6. Irrigation methods and purposes in vegetable production.

7. Irrigation methods and purposes in fruit production.

8. Irrigation opportunities in field vegetable production.

9. Irrigation opportunities in greenhouse vegetable production.

10. Irrigation properties of certain fruit species.

11. Irrigation properties of vineyards.

12. Relationship between irrigation and plant protection in vegetable and fruit production.

13. The role of irrigation quality.

14. Remote sensing and GIS in precision irrigation techniques.

**Summary of content - practice**:

The general aim of the practice is that students learn modern irrigation systems in vegetable and fruit plantation and such greenhouse systems, where effective growing is provided by developed irrigation control and fertigation system.

Students adopt irrigation scheduling, quantity, quality and temporal issues of irrigation practices. In order to determine irrigation water requirement, the moisture content of soil, practical calculations are learnt. Students learn the applicability of the most modern irrigation simulation programs in horticulture.

**practices:**

1. Soil moisture calculation, practical application of pF curve in horticulture.
2. Calculation of irrigation requirement of horticultural plants.
3. Water abstraction planning.
4. The role of FAO Cropwat 8.0 and AquaCrop 6.0 software in irrigation modelling.
5. Applicability of FAO Cropwat 8.0 irrigation modelling software in horticulture I.
6. Applicability of FAO Cropwat 8.0 irrigation modelling software in horticulture II.
7. Applicability of FAO Cropwat 8.0 irrigation modelling software in horticulture III.
8. Field exercise/farm visit I.
9. Field exercise/farm visit II.
10. Field exercise/farm visit III.
11. Field exercise/farm visit IV.
12. Field exercise/farm visit V.
13. Field exercise/farm visit VI.
14. Consultation about compulsory practical report.

**Literature, handbooks**

Allen, R. G., Pereira, L. S., Raes D., Smith M. (1998): Crop evapotranspiration: guidelines for computing crop water requirements. Irrigation and Drainage Paper no. 56. FAO. Rome, Olaszország, 300 p.

Christen, E., Ayars, J., Hornbuckle, J., Hickey, M. (2006): Technology and practice for irrigation in vegetables. NSW Department of Primary Industries. State of New South Wales. 59 p.

Stetson, L. E. (2011): Irrigation. 6th edition. Irrigation Research Institute. 1089 p.

Wickson, E. J. (2015): Irrigation in Fruit Growing. Scholar's Choice, 166 p. (ISBN: 978-129-809-435-3)

**Land consolidation, landscape conservation, MTMKG8018A**

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.

**Wetland and floodplain management, flood protection MTMVG8004A**

ECTS Credit Points: 3

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

Type of exam: exam and personal presentation

Requirements:

- for signature: Participation at the study trips, give a presentation of a case study. Being active during the classes & group works.

- for a grade: Essay type written exam.

**Summary of content – theory**

The general aim of the course is to transfer the basic knowledge necessary for the management of wetlands directly or indirectly affected by the water management practice of agriculture, which helps the agricultural water management engineer’s work in accordance with the regulation of the nature conservation authority and the conservation biological principles.

**lectures:**

1. The basics of the conservation biology.
2. Natural conservation assessment, treatment.
3. The status and situation of wetlands in Hungarian and in international approaches.
4. The Hungarian and international law background of conservation of wetlands.
5. The conceptual bases of habitat management, its legal and economic background.
6. The types of river controls, their history and consequences of the interventions.
7. Revitalization of streaming waters.
8. Types of still waters, their protection and management.
9. Conservation and management of fountains, moorlands, marshes and small astatic and eustatic waters.
10. Conservation and management of reeds.
11. Conservational approaches of fish management in wild waters and fishponds.
12. Situation, conservation and management of soda pans.
13. Hunting and other recreational management of wetlands.
14. Sample projects on wetland management.

**practices:**

1. Field practice.
2. Field practice.
3. Field practice.
4. Field practice.
5. Field practice.
6. Field practice.
7. Field practice.
8. Field practice.
9. Field practice.
10. Field practice.
11. Student presentation.
12. Student presentation.
13. Student presentation.
14. Student presentation.

**Literature, handbooks**

Ian F. Spellerberg (1996): Conservation Biology. Longman. ISBN 0-582-22865-4

C. M. Finlayson et al. (edit) (2018): The Wetland Book, Springer, ISBN 978-90-481-3493-9.

Paul Keddy (2000): Wetland Ecology: Principles and Conservation ISBN 978-0521739672

Lauchlan H. Fraser &Paul Keddy (2005): The World’s Largest Wetlands: Ecology and Conservation.

Boros, Z. Ecsedi and J. Oláh (2013): Ecology and management of soda pans in the Carpathian Basin. Kiadó HTE, Balmazújváros. ISBN 978-963-08-9471-5

**Pond culture and fisheries management, MTMVG8011A**

ECTS Credit Points: 4

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

Type of exam: Oral or written exam

Requirements:

- for signature: Completion of the assignments / exercises and submission of essays on practical topics.

- for a grade: Oral or written exam

**Summary of content – theory**

To provide theoretic information on pond fish culture and fisheries management including key species, fish propagation, extensive and intensive technologies, including feeding as well as the significance of stock assessment and the factors influencing fish production in inland fisheries management.

**lectures:**

1. Current status and tendencies in pond fish culture
2. Pond construction, engineering and water management
3. Applied hydrobiology – plankton management
4. Fish biology propagation and larvae management
5. Feeding and nutrition
6. Pond management and harvesting
7. Multifunctional and integrated aquaculture
8. Aquatic and fisheries resources
9. Key fish species
10. Fish biology: growth, recruitment and management
11. Fish population ecology and dynamics
12. Stock assessment and management
13. Inland fishing methods and equipment
14. Inland fisheries engineering and construction

**Summary of content - practice**:

Information will be provided for the practical application of theoretic skills. The essays, calculations, plans to be submitted are closely related to the topics below:

**practices:**

1. Basics of construction design and calculations for a pond farm
2. Plankton sampling, evaluation and calculations of plankton yield
3. Propagation and larvae rearing of selected freshwater fish species
4. Feed design and formulation
5. Management plan of a pond farm
6. Management plan of an intensive aquaculture system
7. Business plan of a conventional aquaculture enterprise (pond farm or intensive system)
8. Business plan of a multifunctional or integrated aquaculture enterprise
9. Stock assessment calculations for freshwater
10. Population dynamics estimation – yield & recruitment prediction
11. Technical details of inland fisheries structures (dam, waste dam, fish passage, etc.)
12. Financial sources and funding opportunities for fisheries and aquaculture investment and operation

**Literature, handbooks**

FAO (2016): The State of World Fisheries and Aquaculture 2016. Contributing to food security and nutrition for all. Rome. 200 pp.

Boyd, C.E., Lim, C., Queiroz, J., Salie, K., de Wet L., McNevin, A. (2012): Best Management Practices for Responsible Aquaculture. Aquaculture Collaborative Research Support Program [ACRSP]

Burke, D., Goetze, B., Clair D., Egna H. (1996): Pond Dynamics/Aquaculture. Collaborative Research Support Program. Office of International Research and Development Oregon State University, USA

Allan, G., Heasman H., Ferrar P. (2006): Aquaculture Nutrition: Report on the Aquaculture Nutrition Master Class held at Asian Institute of Technology, Bangkok Thailand 7-19 August 2006 ISBN 0 7347 1771 7

**Precision agriculture, MTMVG8010A**

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, and a successful fulfilment of the tasks defined by the lecturer.

- for a grade: 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 map spatial and temporal heterogeneity of the soil and vegetation by GIS software and evaluate the maps. Created maps can provide help in decision support in precision agriculture. An important part of the practice is that students become familiar with the most relevant members of Hungarian precision agricultural corporations and their locations throughout the world. Students can visit the service and the precision agriculture tools, which can be provided for the 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.

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>

**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:**

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

**practices:**

|  |
| --- |
| Profession-related writing, speaking, reading comprehension and listening comprehension |
| Profession-related vocabulary building, writing, speaking listening and reading comprehension |
| Presentation skills, reading comprehension and listening comprehension, profession-related writing |
| Developing profession-related literacy, speaking, reading and listening comprehension, |
| Speaking and presenting,, reading comprehension and listening comprehension tasks, and profession-related writing. |
| The situational dialogues, reading comprehension and listening comprehension tasks, and writing formal letters on a given topic |
| A survey of the skills and knowledge acquired thus far |
| Presentation, reading comprehension and listening comprehension tasks, and profession-related writing. |
| Profession-related conversation, reading comprehension and listening comprehension tasks, and profession-related writing |
| Profession-related conversation, critical thinking, reading comprehension and listening comprehension tasks, and writing essays. |
| Presentation, reading comprehension and listening comprehension tasks, and profession-related conversation writing |
| Speaking and presentation, reading comprehension and listening comprehension tasks, and profession-related conversation writing |
| Essay writing, speaking, reading comprehension and listening comprehension |
| 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 MTMKG8023A**

ECTS Credit Points: 3

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

Type of exam: oral 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 in the lessons (at least 11). Completing exercises.

- 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 of 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

**Literature, handbooks**

Campbell, J. B., Wynne, R. H. (2011): Introduction to Remote Sensing. The Guilford Press. 5th Edition. 667 p. ISBN: 978-1609181765.

Jones, H. G., Vaughan, R. A. (2010): Remote Sensing of Vegetation: Principles, Techniques, and Applications. Oxford University Press. 1st edition. 400 p. ISBN: 978-0199207794.

Weng, Q. (2009): Remote Sensing and GIS Integration: Theories, Methods, and Applications. McGraw-Hill Professional. 1st edition. 416 p. ISBN: 978-0071606530

**Remote sensing and GIS in hydrology, MTMVG8003A**

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, plus a successful fulfilment of the tasks defined by the lecturer.

- for a grade: written exam.

**Summary of content – theory**

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

**lectures:**

1. Spatial objects
2. GIS models
3. GNSS methods
4. Input data collection methods
5. Structure of geo-database for surface waters
6. Structure of geo-database for groundwater
7. Spatial decision support in water management
8. Spatial uncertainty and risk analysis in water management
9. Physically background of remote sensing
10. Space borne and airborne remote sensing
11. Image analysis and land use
12. Image analysis and water quality management
13. Hydrological modelling
14. Hungarian and international hydrology databases and data mining

**practices:**

1. Sample collection and preparation
2. EM spectra VI
3. EM spectra NIR
4. Avantes spectrometer
5. Alta spectrometer
6. Uncalibrated measuring
7. Calibration measuring
8. Spectral curves
9. Soil spectrum
10. Vegetation spectrum
11. Satellite spectrum
12. Unsupervised classification
13. Supervised classification
14. Technical reporting and presentation

**Literature, handbooks**

Li, Z., Zhu, Q., Gold, C. (2005): Digital terrain modelling: Principles and Methodology. CRC Press. 318 p. (ISBN: 0-415-32462-9)

Khorram, S., van der Wiele, C. F., Koch, F. H., Nelson, S. A. C., Potts, M. D. (2016): Principles of Applied Remote Sensing. Springer. 307 p. (ISBN: 978-331-922-593)

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

**Research methodology - scientific communication, MTMKG8024A**

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

**Soil physics and geohydrology, MTMKG8002A**

**Name and title of the person responsible for the subject:** Dr. Tamás Magyar, senior lecturer

**Additional instructors involved in teaching the subject:** Guizani Douraied, PhD student

**Name and level of the program:** Agricultural Water Management Engineering MSc

**Subject type:** compulsory

**Teaching timetable of the subject, type of examination:** 2+2 K

**Credit value of the subject:** 3

**Purpose of teaching the subject:** The aim of the lectures is to provide students with a basic understanding of theoretical and applied soil physics. In the frame of the course, students are given an overall and up-to-date knowledge on soil physics involved in water management, soil cultivation and amelioration. Cognition of the most important physical processes in the soil- water- air system and learning the mitigation options of the adverse effects on the soil water regime according to the following themes:

**Content of the subject (14 weeks):**

1. Soil, as natural resource, functions and composition the soils. Soil forming factors and processes
2. Particle sizes. Physical and physico-chemical properties of particles with different sizes
3. Soil texture. Textural classes of soil particles
4. Soil properties related to soil texture
5. The structure of solid phase in soils. Genesis of soil structure (physical, chemical processes), characterization of soil structure (soil physical and morphological techniques),
6. Total and differential porosity of soils. Functions of pores with different sizes.
7. Soil water principles: Water forms in the soils. Energy concept of soil water (soil water potential, components of water potential).
8. Water movement in soil, saturated flow
9. Transport of soil water under unsaturated conditions
10. Practical aspects of water retention and movement in soils. Soil water management categories.
11. Soil Aeration. Mechanism of soil gas exchange. Air movement in the soils.
12. Soil compaction and soil structure deterioration
13. Soil physical aspects of amelioration, cultivation and irrigation.

**Type of mid-term examination:** -

**Method of assessment (semester examination mark - report, practical grade, colloquium, examination):** Colloquium

**Teaching aids:** Presentation materials.

**Recommended literature:**

Várallyay Gy. (2013): Soil Scientific Basis of Agricultural Water Management. <http://www.tankonyvtar.hu/hu/tartalom/tamop412A/2011_0009_Varallyay_Gyorgy-Soil_Scientific_Basis_of_Agricultural_Water_Management/ch16.html>

Manoj K. Shukla (2013) Soil Physics: An Introduction. CRC Press. ISBN 9781439888421

Glinski, J., Horabik, J. Lipiec, J. (Eds.) (2011): Encyclopedia of Agrophysics. Springer. ISBN 978-90-481-3585-1 Hillel, D. (1980) Fundamentals of Soil Physics, ACADEMIC PRESS, INC. Elsevier Inc ISBN: 978-0-08-091870-9

**Soil remediation and prevention MTMVG8015A**

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: 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 details. 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. Laboratory and GIS practice: Defining underground contaminant transport by measuring and calculating of ground water flow speed and directions based on field survey data
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. Analysing 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. Field trip: Visiting heavy metal and organic polluted sites with ongoing remediation process
13. Field trip: Visiting heavy metal and organic polluted sites with ongoing remediation process
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

**Urban Hydrology , MTMVG8014A**

ECTS Credit Points: 3

14hour(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: written exam

**Summary of content – theory**

Students are acquainted with urban environment, hydrological loop and hydrological cycle. The design and management of the urban water system based on an analysis of the entire system will lead to more sustainable solutions than separate design and management of the elements of the system. A crucial aspect of integrated urban water management (IUWM) is the early and effective involvement of stakeholders based on explored critical decision factors of local urban watershed. This course presents an overview of IUWM and the phases necessary for developing a strategic plan to move towards it. It provides assistance for shifting from a conventional approach in urban water management towards an approach based on integration that is more suitable to meet current requirements and cope with future developments more sustainably.

**lectures:**

1. Introduction - concept, urbanization - megacities
2. Definition, climate change
3. Urban microclimate
4. Urban water balance
5. Precipitation – Runoff, Infiltration
6. Grey water – water harvesting (non - structural management)
7. Evapotranspiration – Green surface, urban landscape
8. Flood management
9. Sewer network
10. Wastewater treatment
11. Biological wastewater treatment and sewage sludge management
12. Bioenergy, alternative water resources
13. Urban hydrology monitoring, smart cities
14. Decision support modeling in IUWM

**practices:**

1. Team work – focus area
2. Team work –focus area
3. Team work – stakeholders
4. Remote sensing – Urban hydrology
5. Team work – Precipitation, runoff
6. Team work – Flood management
7. Case study - drinking water
8. Case study- sewer network
9. Case study- WWTP
10. Data acquisition – Land use, urban mapping
11. UH indexing
12. 3D urban environment models
13. UH landscape models
14. Reporting

**Literature:**

Musco, F. Counteracting urban heat island effects in a global climate change scenario

Urban Hydrology for small watershed TR55 USDA

New Urban Agenda ENSZ, Quito 2016.

SWIFT – IURWM decision package

**Wastewater and slurry management, MTMVG8009A**

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 fulfilment of the tasks defined by the lecturer.

- for a grade: written exam

**Summary of content – theory**

The wastewater and slurry management course introduces students to modern wastewater treatment objectives, concepts and its importance. Furthermore, water pollution forms caused due to human action and the methods of water purification and treatments are also introduced. Students learn the objectives and procedures of modern slurry treatments and recovery. It promotes the formation of new agro-environmental approach. Students will be able to determine the likely impact of water pollution, and its degree and danger, they can make a decision about the need for intervention. Important information will be scored in the topic of sewage, sludge, sewage sludge compost and manure storage and agricultural utilization, and their legal background. The students become proficient for the selection of the necessary wastewater cleaning, treatment and particularly the utilization technology based on the relevant legal requirements. The students will have theoretical and practical background knowledge about the necessary wastewater qualification methods.

**lectures:**

1. The objectives of wastewater treatment technology. The production and characterisation of wastewater; General wastewater quality requirements.
2. The degree of wastewater treatment (mechanical, physical-chemical, biological wastewater treatment operations). Theoretical basis, their conditions and implementation;
3. Chemical treatment degree of wastewater treatment. Theoretical basis, their conditions and implementation
4. The conditions and microbiological background of aerobic wastewater treatment processes, and their practical implementation; Trickling water treatment, biological nitrogen and phosphorus removal;
5. The conditions and microbiological background of anaerobic wastewater treatment processes, and their practical implementation; Digesters;
6. Natural Technologies of Wastewater Treatment; Aquatic plants systems and Bioeliminators.
7. Visiting of Wastewater Treatment Plant of Debrecen, Hungary
8. Calculations and sizing of the wastewater treatment technologies; Examination of models of activated sludge and fixed film systems. Options of intensification for sludge anaerobic digestion.
9. Presentation of specific wastewater treatment processes used in industrial plants: Ion exchange, reverse osmosis, membrane filtration.
10. Presentation and comparing methods of sewage sludge treatment and recovery processes (agricultural utilization, composting, biogas production, incineration); Sludge dewatering and sizing of its equipment.
11. International and national position, proportions and practical implementation of sewage sludge utilization; Legal background and framework of sludge storage, utilization and transport;
12. Concept of slurry, conditions of slurry production, the quality and composition of slurry. Presentation and comparing of the slurry-treatment processes;
13. Slurry-utilization methods (agricultural utilization, biogas production, etc.). Legal background of slurry storage and utilization; Presentation of Nitrate Directive rules.
14. Visiting of Regional Biogas Plant of Nyíbátor, and Cattle Farm of Bátortrade Ltd., Hungary

**Literature, handbooks**

Crites, R. W., Middlebrooks, J. Reed, S. R. (2006): Natural Wastewater Treatment Systems. CRC Press. 549 p. (ISBN: 978-146-658-326-9)ű

Gerardi, M. H. (2006): Wastewater bacteria. John Wiley & Sons, Inc., Hoboken, New Jersey. 272 p. (ISBN: 978-047-197-991-3)

Hettiarachchi, H., Ardakanian, R. (2016): Safe Use of Wastewater in Agriculture: Good Practice Examples. UNU-Flores. United National University. Institute for Intergrated Management of Material Fluxes and of Resources. (ISBN: 978-394-486-330-6).

Sastry, C. A., Hashim, M. A., Agamuthu, P. (1995): Waste Treatment Plants 1st Edition. Wiley. 435 p. (ISBN: 978-047-114-301-7)

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>

**Water chemistry, MTMVG8002A**

ECTS Credit Points: 4

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

Type of exam: oral exam

Requirements:

- for signature: Completing assignments / exercises, giving presentation.

- for a grade: oral exam

**Summary of content - theory**:

In the framework of the practice students become familiar with the applied classic and modern laboratory measuring techniques. Lab rules will be discussed. Basic devices will be presented. Weight and volume measuring techniques use in lab are discussed, furthermore, basic chemical calculations will be made. They will be able to use mobile, rapid water analytical methods and the related water quality protection regulations and legal background. Students will be able to determine water quality and thus the likely impact and danger of pollutions and can make a decision needed for intervention. Students acquire specialized knowledge in the measurement of drinking, municipal, agricultural and industrial water samples and their analytical background. They receive useful knowledge about sampling methods (water) and sample pre-treatment.

**Summary of content - practice**:

Wworking individually and in team; basic knowledge of classic and modern analytical measurements.

**practices:**

Exercise 1: Lab safety, basic lab equipment

Exercise 2: Chemical calculations

Exercise 3: Water sampling and analysis steps

Exercise 4: Determination of total dissolved and suspended solids in water samples

Exercise 5: Determination of the pH of different water samples

Exercise 6: Determination of the conductivity of different water samples

Exercise 7: Determination of the acidity of different water samples

Exercise 8: Determination of the chloride concentration of different water samples

Exercise 9: Determination of the hardness of different water samples

Exercise 10: Determination of the dissolved oxygen concentration of different water samples

Exercise 11: Determination of turbidity of different water samples

Exercise 12: Determination of nitrate, nitrite and ammonium content of different water samples

Exercise 13: Determination of sulphate ion concentration in different water samples

Exercise 14. Determination of phosphorus and potassium content of water samples

**Literature, handbooks in English**

Patrick Brezonik, William Arnold (2011): Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems Oxford University Press, 2011. pp. 808. ISBN 019981354X, 9780199813544; FC On line: GB855 .B744 2011eb

Frank R. Spellman (2017): The Drinking Water Handbook. 3rd Edition, CRC Press pp. 356. ISBN 9781138066472 - CAT# K33428

Barbara Hauser (2001): Drinking Water Chemistry: A Laboratory Manual. 1st Edition, CRC Press pp. 214. ISBN 9781566704861 - CAT# LA4129

**Water economics, MTMVG8010A**

ECTS Credit Points: 3

14 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 get a knowledge about irrigation from a micro and macro-economic point of view. Water supply directly increase yield, in addition, it also has indirect effect on profitability, which provides additional economic benefits - students are introduced to this and other aspects, as well.

**lectures:**

1. Farm management, Farm businesses 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
5. The multiple dimensions of water management (Micro-level, Regional, Interregional)
6. Handling drought and inland waters
7. The benefits and costs of irrigation
8. The theory of the production function (Physical production functions, Spil’man function, Marginal rate of substitution, Profit maximization) water-plant relationships
9. Irrigation systems and characteristics, costs
10. Decision support system
11. Irrigation economics
12. Protecting orchard from frost and freeze, hail protection net system in orchard, (investment costs, annual costs)
13. Economic and environmental characteristics of bottled water production
14. Agricultural Water Management for Sustainable Rural Development

**Summary of content - practice**:

Thinking in system approach and connect different aspects

**practices:**

1. Importance of water in agriculture, hydrological cycle
2. Importance of irrigation
3. Agri-Environmental indicators and irrigation in EU
4. European Irrigation Association
5. Water and energy advanced management for irrigation
6. Irrigation systems
7. Micro irrigation systems
8. Economics of irrigation systems
9. Frost and freeze protection in orchard
10. Ice storm challenges in orchard
11. Precision irrigation
12. Irrigation solutions in practice (irrigation in cropland)
13. Irrigation solutions in practice (precision irrigation)
14. Presentation

**Literature, handbooks**

Viktor Szabó 2016. Economics of hail protection net installation in super intensive apple orchards. Agrártudományi Közlemények, vol. 68. p. 27-35.

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.

International Commission on Irrigation and Drainage (ICID) 2016. Agricultural Water Management for Sustainable Rural Development. p. 84.

Karina Schoengold and David Zilberman 2007. The economics of water, irrigation, and development. (In: Handbook of Agricultural Economics, Volume 3 Edited by Robert Evenson and Prabhu Pingali) DOI: 10.1016/S1574-0072(06)03058-1. p. 2939-2984.

Alan Pilling Kleinman 1969. The production function and the imputation of the economic value of irrigation water. Retrospective Theses and Dissertations. Paper 4122. Digital Repository @ Iowa State University. p. 133.

**Water policy, water law and sectoral public administration, MTMVG8013A**

ECTS Credit Points: 3

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

Type of exam: written exam

Requirements:

- for signature: Completing exercises, giving presentation.

- for a grade: Colloquium

**Summary of content - theory**:

In the frame of global environmental problems, students get detailed information about water related environmental issues. Students gain knowledge about the legal background of water as natural resource. In addition strategic planning and implementation in EU.

**lectures:**

1. Water related environmental problems and achievements, Global Water Framework for Action
2. Water and sustainable development, World Water Development Report
3. Availability and sustainable management of water, Action Plan by High Level Panel On Water
4. Ecosystem based management approaches for water related infrastructure solutions
5. Environment Policy in EU, Climate change and the environment, Water protection and management
6. Status of EU waters (policy context, Land use and the ecological status of EU waters, pollution and targets, EU water efficiency, vulnerability of EU waters) and related regulations
7. European Water Charter, Water Framework Directive, Flood Risk Management Guidelines for Planning Authorities, Nitrates Directive, water in law, water management
8. Quality of water intended for human consumption, requirements for the protection of the health of the general public, irrigation
9. The 2030 Agenda for Sustainable Development, 7th EAP General Union Environment Action Programme to 2020

**Summary of content - practice**:

Thinking in system approach and connect different aspects.

**practices:**

1. Importance of water, water and environmental problems
2. Global Organisations
3. Global Organisations
4. Global Organisations
5. EU, Water Framework Directive, River Basin Plans
6. Ground water protection, Nitrate Directive
7. Sectoral administration – Nature conservation, Natura 2000
8. Sectoral administration – Soil protection
9. Sectoral administration – Air protection

**Literature, handbooks**

Groundwater Governance 2016. Global Framework for Action to achieve the vision on Groundwater Governance, p. 115.

UNESCO 2016. The United Nations World Water Development Report 2016. ISBN 978-92-3-100146-8, ePub ISBN 978-92-3-100155-0, p. 148.

United Nations Environment Programme 2014. Green Infrastructure Guide for Water Management: Ecosystem-based management approaches for water-related infrastructure projects. ISBN: 978-92-807-3404-1 p. 75.

HIGH LEVEL PANEL ON WATER 2016. Action Plan. p. 23.

European Commission 2014. General Union Environment Action Programme to 2020 Living well, within the limits of our planet. European Union. ISBN 978-92-79-34724-5 doi:10.2779/66315 p. 87.

**Water quality management MTMKG8016A**

**Name and title of the person responsible for the subject:** Dr Csaba Pregun, assistant professor

**Additional instructors involved in teaching the subject: Dr. Nikolett Kiss**

**Name and level of the program:** Agricultural Water Management Engineering MSc

**Subject type:** compulsory

**Teaching timetable of the subject, type of examination:** 2+1 K

**Credit value of the subject: 3**6

**Purpose of teaching the subject:**

To learn about the characteristics that determine water quality, water pollutants, pollution processes and the mechanisms of self-purification. To learn water qualification and water quality protection techniques and practices. Learning about water pollutants, their effects, water protection management and technologies.

**Content of the subject (13 weeks):**

1. Water management - water resources management. Water balances, water resources, water uses in Hungary.
2. Hydrological basics. Types of surface water and groundwater.
3. Physical, organoleptic, chemical, biological, bacteriological characterisation of water. Principles of surface water classification, water quality classes.
4. Water quality assessment methods used in Hungary and in the EU.
5. Ecological water quality assessment
6. Water pollution, pollutants, their classification. Human activities causing water pollution.
7. Oil pollution and its effects.
8. Effect of pollutants on aquatic ecosystem species, flora, fauna.
9. Effects of pollutants on drinking water. Process of pollution of watercourses, spread of pollutants, self-purification of watercourses.
10. Pollution of stagnant waters, eutrophication, input, output methods to control eutrophication.
11. Groundwater pollution, sources, spread of pollution. Groundwater protection.
12. Mechanical and biological wastewater treatment. Domestic water quality management and protection.
13. Legal, economic, technical methods of water quality protection

**Type of mid-term examination:** Participation in the exercises is compulsory. In case of absence, the student is required to submit a theoretical and practical report on the missed practical training or to participate in the departmental research. Participation in the practicals is a prerequisite for obtaining a signature.

**Method of assessment (**semester examination mark - report, practical grade, **colloquium**, examination):colloquium

**Teaching aids:** Lecture slides and supplementary material are available in ppt and pdf format (E-learning).

**Recommended literature:**

* J. Jeffrey Peirce, P. Aarne Vesilind, Ruth F. Weiner (1997): Environmental Pollution and Control, 4th. Elsevier Science & Technology Books. ISBN: 0750698993
* Mackenzie L. Davis (2010): Water and Wastewater Engineering. Design Principles and Practice. McGraw-Hill. ISBN: 978-0-07-171385-6
* 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.
* M. R. Templeton, D. Butler: An Introduction to Wastewater Treatment. Ventus Publishing 2011. ISBN 978-87-7681-843-2

**Internship requirements**

Water Management Engineering MSc Students have to carry out a 4-week internship involved in the model curriculum. The internship course must be signed up in the NEPTUN study registration system in the autumn semester (3th semester) and should be undertaken in summer after 2nd semester. Its execution is the criteria requirement of getting the pre-degree certificate (absolutorium).

**The objective of the internship, competences**

Students get acquainted with professional work in conformity with their degree program at the company or institution and join the daily work process. They have to resolve tasks individually assigned by their supervisor and gain experiences which may be utilized later in the labour market.

During the internship general and specific competences may be acquired. General competences: precisely work to schedule either individually or in team, applying correct technical terms. Specific competences: practical application of the professional skills acquired during the studies and acquiring new knowledge.

**Places suitable for internship**

All the organizations, institutions and companies which provide students with the opportunity to acquire proficiency in accordance with their specialization in the field of precision agriculture, agricultural water management, irrigation technologies, irrigated crop production or horticulture, river basin management, water engineering may be a suitable place.

Initiating internship at the company and providing for the documents from the company is the student’s duty. If the student does not specify the receiving company or does not provide the documents on time, the responsible person for internship will refuse the internship papers.

In case of any questions arising from internship, please kindly turn to Budayné Bódi Erika (e-mail: bodi.erika@agr.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. By solving the task, the Water Management Engineering MSc 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 Water Management Engineering MSc 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 Water Management Engineering MSc program the credits assigned to the thesis is 30.

 Thesis topics are announced by the departments for the students in each semester. A thesis topic can be suggested by the student as well and the head of department shall decide 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 the 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 the 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. Attila Nagy, associate professor* | | | | | | | | | | | | | | | | | | | |
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| lec | prac | type | credit | lec | prac | type | credit | lec | prac | type | credit | lec | prac | type | credit |
|  | *Compulsory subjects* |  | | | |  | | | | #ÉRTÉK! | | | |  | | | |  | | |
| MTMKG8004A | Applied hydrology and hydraulics | 3 | 3 | K | 6 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Pregun Csaba | | |
| MTMVG8001A | Climatology | 2 | 1 | K | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Fehér Zsolt | | |
| MTMVG8002A | Water chemistry | 2 | 2 | K | 4 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Nagy Péter Tamás | | |
| MTMKG8002A | Soil physics and geohydrology | 2 | 2 | K | 4 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Magyar Tamás | | |
| MTMKG8018A | Land-consolidation and landscape conservation | 2 | 1 | K | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Fehér Zsolt | | |
| MTMVG8003A | Remote sensing and GIS in hydrology | 2 | 2 | G | 4 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Tamás János | | |
|  | *Total number of hours:* | 13 | 11 | 24 | |  |  |  | |  |  |  | |  |  |  | |  | | |
| MTMVG8004A | Wetland and floodplain management, flood protection |  |  |  |  | 2 | 2 | K | 6 |  |  |  |  |  |  |  |  | Dr. Pregun Csaba | | |
| MTMVG8005A | Hydrobiology |  |  |  |  | 2 | 1 | K | 3 |  |  |  |  |  |  |  |  | Dr. Pregun Csaba | | |
| MTMVG8006A | Irrigated crop and horticultural production |  |  |  |  | 2 | 2 | G | 5 |  |  |  |  |  |  |  |  | Dr. Csajbók József, Dr. Hájos Mária | | |
| MTMVG8007A | Integrated water management - water information systems |  |  |  |  | 2 | 2 | K | 5 |  |  |  |  |  |  |  |  | Dr. Tamás János | | |
| MTMKG8009A | Wastewater and slurry management |  |  |  |  | 2 | 1 | K | 3 |  |  |  |  |  |  |  |  | Dr. Boczonádi Imre | | |
| MTMVG8008A | Farm machines of the irrigation, irrigation technology |  |  |  |  | 1 | 2 | G | 3 |  |  |  |  |  |  |  |  | Dr. Hagymássy Zoltán | | |
|  | *Total number of hours:* |  |  |  | | 11 | 10 | 25 | |  |  |  | |  |  |  | |  | | |
| MTMKG8010A | Precision agriculture |  |  |  |  |  |  |  |  | 1 | 2 | G | 3 |  |  |  |  | Farkasné Dr. Gálya Bernadett | | |
| MTMVG8009A | Agricultural water supply systems, hydrogeography |  |  |  |  |  |  |  |  | 2 | 2 | K | 5 |  |  |  |  | Dr. Pregun Csaba | | |
| MTMKG8014A | Drought and excess water management, melioration |  |  |  |  |  |  |  |  | 3 | 3 | G | 9 |  |  |  |  | Dr. Nagy Attila | | |
| MTMVG8010A | Water economics |  |  |  |  |  |  |  |  | 2 | 1 | K | 3 |  |  |  |  | Dr. Szőllősi Nikolett | | |
|  | *Total number of hours:* |  |  |  | |  |  |  | | 8 | 8 | 20 | |  |  |  | |  | | |
| MTMVG8011A | Pond culture and fisheries management |  |  |  |  |  |  |  |  |  |  |  |  | 2 | 2 | G | 4 | Dr. Fehér Milán | | |
| MTMVG8012A | Agricultural water management planning and implementation |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 2 | G | 3 | Dr. Nagy Attila | | |
| MTMVG8013A | Waterpolicy, water law and sectoral public administration |  |  |  |  |  |  |  |  |  |  |  |  | 2 | 1 | K | 3 | Dr. Szőllősi Nikolett | | |
|  | *Total number of hours:* |  |  |  | |  |  |  | |  |  |  | | 5 | 5 | 10 | |  | | |
|  | *Optional subjects* |  | | | |  | | | |  | | | |  | | | |  | | |
| MTMKG8024A | Research methodology, scientific communication | 0 | 3 | G | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Nagy Attila | | |
| MTMKG8016A | Water quality protection, status assessment of water bodies | 2 | 1 | K | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Pregun Csaba | | |
| MTMKG8019A | Farm Business Management and Project Management |  |  |  |  |  |  |  |  | 1 | 2 | G | 3 |  |  |  |  | Dr. Szőllősi Nikolett | | |
| MTMKG8023A | Remote sensing |  |  |  |  |  |  |  |  | 0 | 3 | G | 3 |  |  |  |  | Dr. Nagy Attila | | |
| MTMVG8014A | Urban hydrology |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 2 | G | 3 | Dr. Fehér Zsolt | | |
| MTMVG8015A | Soil remediaition and prevention |  |  |  |  |  |  |  |  |  |  |  |  | 2 | 1 | K | 3 | Dr. Nagy Attila | | |
| MTM7NY1A | Academic language skills (scientific language) | 0 | 2 | G | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Czellér Mária | | |
| MTM7NY2A | Professional language skills (business language) |  |  |  |  | 0 | 2 | G | 3 |  |  |  |  |  |  |  |  | Dr. Czellér Mária | | |
|  | *Internship (4 weeks)* |  |  |  |  | 0 | 160 | G | 5 |  |  |  |  |  |  |  |  | Dr. Nagy Attila | | |
| MTMVG8D1A | *Thesis preparation I* |  |  |  |  |  |  |  |  | 0 | 3 | G | 10 |  |  |  |  | Dr. Tamás János | | |
| MTMVG8D1A | *Thesis preparation II* |  |  |  |  |  |  |  |  |  |  |  |  | 0 | 3 | G | 20 | Dr. Nagy Attila | | |
|  | *Physical excercise* | 0 | 2 | A | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | *Total number of credits for compulsory subjects* | 24 | | | | 25 | | | | 20 | | | | 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: | 27 | | | | 30 | | | | 30 | | | | 33 | | | | 120 | | |
|  | Total number of hours alltogether (hour/week): | 13 | 11/14 | 24/27 | | 11 | 10 | 30 | | 8 | 10 | 30 | | 5/6 | 8/10 | 30/33 | |  | | |

**MODEL CURRICULUM OF AGRICULTURAL WATER 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-water-management-engineering).