REQUIREMENTS
2021/2022 academic year I. semester

Name and code of the subject: Natural Sciences I. Soil Science and Agrochemistry (MTMKG7001A)
Name and title of the person responsible for the subject: Dr Csubák Mária associate professor, Balláné Dr. Kovács Andrea, associate professor
Additional instructors involved in teaching the subject: Erdeiné Dr Kremper Rita assistant professor
Name and level of the program: Agricultural Environmental Management Engineering Msc.
Subject type: compulsory
Teaching timetable of the subject, type of examination: 2+2 P
Credit value of the subject: 4
Purpose of teaching the subject:

- The basic objective of the subject that the students know - besides soil physics and soil chemistry features - the biological processes in the soil. Physical, chemical and biological weathering processes play important role in the formation of soil. Soil biota take part in soil organic matter transformation (humus formation) and organic degradation processes (mineralization), cycle of elements and energy flow of ecosystems.
- Living organisms interact with the soil, thus affecting certain soil properties, while soil properties also affect their occurrence. The applied agrotechnical procedures can provide not only favorable conditions for the cultivated plants but also the biota living in the soil.
- Our goal is also to enable students to acquire and integrate new knowledge about the soil. During lectures we emphasize the relationship between sustainability, environmentally friendly farming and land use. The knowledge gained in the theoretical lectures is complemented by a number of practical examples, which, in turn reinforce the previous knowledge. The subject practice also contributes to a better understanding of the "soil environment".
- Additional goal is to introduce the student to the basics of sustainable nutrient management, to get to know the plant nutrients, role of nutrients in plants, the nutrient uptake and its influencing factors. They become acquainted with inorganic and organic fertilizers and their potential environmental effects.

Content of the subject (14 weeks):
Soil Science (7x2)

1. Soil as the part of the biosphere. The concept of soil, its constituents. The abiotic and biotic subsystem in the soil. The soil profile. Ecological functions of soil. The importance of minerals and rocks in soil formation. The weathering. The formation of the soils.
2. The most important physical properties of soils. Soil texture, bulk density and density, pore system and water holding capacity of pores. The soil formation, morphological and agronomic evaluation of the soil structure.
3. Water management types in soil. Moisture forms in the soil. The laws of water movement in the soil. Air and heat management in soils.
4. The most important soil chemical properties. Organic matter in the soil, the structure of the humus and their role in soil fertility. Humus quality.
5. Types of soil colloids. Processes on the surface of colloids. Effect of adsorbed cations on soil properties. The acidity and alkalinity of the soil. The pH of the soil, its buffer capacity. Soil is a redox system. .
6. Comparison of artificial and natural ecosystems. The structure and characteristics of ecosystems. Populations that build up the biocoenosis and interaction between populations.

7. The groups of living organisms. The components of the micro- and meso-, macro- and megafauna. The role of Earthworm in the soil.

Agricultural Chemistry (7x2)
8. Plant nutrients and their classification
9. Chemical composition of plants
10. The influencing factors of nutrient uptake of plants. Effects of soil parameters on plant nutrient uptake.
11. The effects of nutrient supply on the quality of the yield, Nutrient in the soil, nutrient availability, transformation processes, ionadsorption and its significance.
12. Nitrogen cycle, phophorus cycle, potassium cycle.
13. NPK chemical fertilizers, their physical, chemical properties.
14. Effects on chemical fertilizers on the environment. Organic fertilizers and their effects on the environment

Type of mid-term examination: -
Method of assessment (semester examination mark - report, practical grade, colloquium, examination): exam

Teaching aids: -

Recommended literature:

1. Brady, N. C. (1990) The Nature and Properties of Soils. Collier Macmillan Publishers (London). 10th ed.
2. Eash, N. S. – Green C. J. Razvi, A. – Bennett, W. F. (2008) Soil Science Simplified. (fifth ed.) Blackwell Publishing
3. K. Mengel and E. A. Kirkby Principles of plant nutrition (1987) ISBN:3906535037, Lang DruckAG, Liebefeld
4. J. Benton Jones, Jr. (2012) Plant Nutrition and Soil Fertility Manual, ISBN: 9781439816097, Taylor and Francis
5. J. Benton Jones Jr. (2001) Laboratory guide for Conducting soil tests and plant analysis, , ISBN: 0849302064, CRC Press LLC

REQUIREMENTS
22/2021 academic year I. semester

Name and code of the subject: Water management I. - Agrohydrology MTMKG7002A
Name and title of the person responsible for the subject: Dr. habil. Attila Nagy, associate professor
Additional instructors involved in teaching the subject:
Name and level of the program: Agricultural Engineer in Environmental Management MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 2+1 K
Credit value of the subject: 3

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

Content of the subject (14 weeks):

1. Water management of watersheds. Basics of agrohydrology, water cycle, water balance
2. Role of agrohydrology, water supply of Earth, the elements of water cycle, the element of water balance (precipitation, evapotranspiration, infiltration, runoff, water ponding. The basic relations of the elements of water cycle
3. Classification of water flow, categorization of natural water flows, Parameters of catchments, and characterization of catchment types. Characterization of cross section of river flows,
4. Pond formation and their morphology, types of ponds and reservoirs.
5. Origin, occurrence of underground water types. Classification and characterization of underground water. Anomalies in underground water. Dynamics of underground water.
6. Soil-plant water relationship
7. Crop damages caused by extreme weather - prevention
8. Measurement methods of meteorological and microclimatic factors effect on water balance
9. Measurement methods of soil water balance
10. Measurement methods of water supply
11. Define the concept of water scarcity and drought, drought types
12. Agricultural Drought Analysis Methods - traditional drought indices
13. Agricultural Drought Monitoring -Drought indices based on remote sensing data
14. The possibilities of drought damage prevention in agriculture. Options for adaptation to drought

Type of mid-term examination:

1. Active participation in the practical lessons (at least 11)
2. Completing exercises

3. Submitting report at the end of the semester

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

Teaching aids:

Recommended literature:

1. Keith Wheatley (2015): Agricultural Water Management: Insights and Challenges. Callisto Reference ISBN: 9781632391278
2. Premjit Sharma (2013): Agricultural Water Management. Genetech, 302. ISBN: 9788189729233
3. OECD (2014): Climate Change , Water and Agriculture: Towards resilient systems, OECD Studies on Water, OECD Publishing ISBN:978-92-64-20913-8
4. Wilfried Brutsaert 2005: Hydrology: An Introduction. Cambridge University Press ISBN 9781107268791
5. 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.

REQUIREMENTS
2021/22 academic year I. semester

Name and code of the subject: Environmental informatics – Environmental monitoring MTMKG7003A
Name and title of the person responsible for the subject: Dr. János Tamás, professor
Additional instructors involved in teaching the subject: Bernadett Gálya, senior lecturer
Name and level of the program: Agricultural Environmental Management MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 2+1 K
Credit value of the subject: 3

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

Content of the subject (14 weeks): theory/practice

1. Local and international environmental geospatial projects. / Surfer GUI.
2. Environment information systems on the Internet, data warehouses and metadata. / Surfer colour management.
3. The construction and operation of environmental management information systems, environmental elements and related IT tasks. / Surfer data management.
4. Characterization, collection and data structures of digital environmental management data related requirements. / Grid DEM.
5. Modelling the environment. / Data importing.
6. Modelling soil and water. / Basic Data Statistics.
7. Hydrology environmental models. / DAT data types.
8. Surface and groundwater modelling. / Griding methods.
9. Landscape protection and landscape evaluation models. / Grid report evaluation.
10. Space and time change assessment - Geostatistics basics. / Accurate interpolations.
11. Basics of Remote Sensing. / IDW, TIN.
12. Geoinformatics model of single-factor decision-making systems. / Global interpolations.
13. Applied, complex multi-factor decision-making systems. / Kriging.
14. Decision support modelling solutions. / Error propagations.

Type of mid-term examination: -

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

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

Teaching aids: Presentations of the lectures.

Recommended literature:

Janardhana Raju et al. (2015)Management of natural resources in a changing environment. Springer Publ. ISBN 9783319125589
Lichtfouse E. Goyal A. (2015) Sustainable Agriculture Reviews 16. Spriger Publ. ISBN 9783319169873
GoldenSoftware(2018) Surfer Manual https://www.goldensoftware.com/products/surfer

REQUIREMENTS
2021/2022. academic year I. semester

Name and code of the subject: Sustainable agriculture systems Crop production I, MTMKG7004A
Name and title of the person responsible for the subject: Dr. József Csajbók associate professor
Additional instructors involved in teaching the subject:
Name and level of the program: Environmental Management and Agricultural Engineering, MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 2+1 C
Credit value of the subject: 3

Purpose of teaching the subject:

Content of the subject (14 weeks):

1 General fundamentals of field crop production I
2 General fundamentals of field crop production II
3 General fundamentals of field crop production III
4 General fundamentals of field crop production IV
5 Wheat production I
6 Wheat production II
7 Wheat production III
8 Corn production I
9 Corn production II
10 Corn production III
11 Sunflower production I
12 Sunflower production II
13 Alfalfa production I
14 Alfalfa production II

Type of mid-term examination:

- Before examination students need to get signature of the course instructor.
- Special requests will be accepted in the first 2 weeks of the semester only.
- Participation is compulsory on the lectures and seminars.

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

Teaching aids: lecture material

Recommended literature:
George Acquaah (2001): Principles of Crop Production. Theory, Techniques, and Technology. Pearson Prentice Hall, Upper Saddle River, New Jersey 07458. ISBN 0-13-114556-8
John H. Martin – Richard P. Waldren – David L. Stamp (2006): Principles of Field Crop Production. Pearson Prentice Hall, Upper Saddle River, New Jersey Columbus, Ohio. ISBN 0-13-025967-5

John L. Havlin – Samuel L. Tisdale – James D. Beaton – Werner L. Nelson (2005): Soil Fertility and Fertilizers. Pearson Prentice Hall, Upper Saddle River, New Jersey. ISBN 0-13-027824-6

REQUIREMENTS
Academic year 2021/2022, semester 1

Name and code of the subject: Sectoral Public Administration and Environmental Law, MTMKG7005A
Name and title of the person responsible for the subject: Dr. Nikolett Szőllősi, assistant professor
Additional instructors involved in teaching the subject: -
Name and level of the program: Agricultural Environmental Management Engineering MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 2+1, C
Credit value of the subject: 3

Purpose of teaching the subject: Student get a knowledge about sectoral legal principles, procedures and institutions designed and used for the implementation of the principles, policies and legislation of the European Union (EU) and European Communities (EC). and on national level, in the context of public administration
Introducing the basics of environmental law regulations, a describing some special area according to environmental politics. Basically built on the Hungarian law, but also spread to the EU's legislation and requirements.

Content of the subject (14 weeks):

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

Type of mid-term examination: Completing assignments / exercises listed in Exercise book: Practical exercises for the course of Sectoral Public Administration and Environmental Law

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

Teaching aids: ppt presentations, online websites

Recommended literature:

1. Stefan Tangermann, Stephan von Cramon-Taubadel 2013. Agricultural Policy in the European Union - An Overview. Department für Agrarökonomie und Rurale Entwicklung, Universität Göttingen. ISSN 1865-2697. p. 71.
2. Elisa Morgera, Carmen Bullón Caro, Gracia Marín Durán 2012. Organic agriculture and
3. the law. Food And Agriculture Organization Of The United Nations. FAO. ISBN 978-92-5-107220-2. 302. p.
4. Andrew Farmer (Edited) 2010. Sourcebook on EU Environmental Law. Institute for European Environmental Policy. p. 388.
5. Stefan Scheuer (Edited) 2006. EU Environmental Policy Handbook. European Environmental Bureau (EEB) p. 336.

REQUIREMENTS
Academic year 2021/2022, semester 1

Name and code of the subject: Environmental Measurement Techniques MTMKG7006A
Name and title of the person responsible for the subject: Csaba Pregun (PhD)
Additional instructors involved in teaching the subject: Péter Tamás Nagy (PhD)
Name and level of the program: Agricultural Environmental Management Engineering MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination:1+3 practical grade
Credit value of the subject: 4

Purpose of teaching the subject:
It introduces students to laboratory and rapid analytical methods used in water analysis and the related water quality protection regulations and legislation. Students will be able to determine the quality of water, and thus the likely impact of water pollution and its hazardousness, and to decide on the need for intervention. They will acquire specific knowledge on the analytical background and the use of agricultural and food wastes and by-products for biogas and composting. They will gain useful knowledge on the application of ecotoxicological plant tests required prior to agricultural use.
Become familiar with the laboratory analysis of waste from agriculture and food industry and in the selection of the necessary treatment and recovery methods. Students will be able to actively participate in team work and thus be involved in research and development research and development projects.

Content of the subject (14 weeks):

1. Introduction, classical analytical methods/lab safety
2. Instrumental analytical methods/lab equipment, devices
3. Chemical calculations/making solutions, balances and volume measuring devices
4. Introduction to Titrimetry/acid-base titration
5. Titrimetry/ Determination of water hardiness by complexometric titration
6. Environmental analysis/Determination of food salt concentration (Mohr's method)
7. Test writing/soil sampling
8. Environmental analysis/Sampling methods,
9. Soil chemistry/Determination of soil density, making soil extracants
10. Determination of pH, soil carbonate, nitrate, nitrite and ammonium content
11. Determination of sulphate and phosphorus and potassium content of soil
12. Waste analysis theory I., Determination of pH, nitrate, nitrite and ammonium content of waste samples
13. Waste analysis theory II., Determination of sulphate and phosphorus and potassium content of waste samples
14. Waste analysis: Determination of different metal contents of waste samples

Type of mid-term examination:
2 mid-year exams. Attendance of the practices, keeping a practical diary. Being active in group works; Completing lab works; Taking part in field visits

Method of assessment (semester examination mark - report, practical grade, colloquium, examination): practical grade is based on oral report is taken in the examination period of the

semester focusing on the knowledge gained. Submitting reports in due time, successful mid-year exams, taking part actively in the practices and field trips and completing home work individually are compulsory.

Teaching aids: ppt presentations, online websites, Practical exercises for the course of environmental measurement techniques

Recommended literature:

Posudin Yuriy (2014): Methods of Measuring Environmental Parameters. John Wiley & Sons, Inc. Print ISBN:9781118686935 |Online ISBN:9781118914236 |DOI:10.1002/9781118914236
Practical exercises for the course of Environmental measurement techniques (elearning)
https://19january2017snapshot.epa.gov/measurements_.html
https://www.epa.gov/measurements-modeling

REQUIREMENTS
2021/2022 academic year I. semester

Name and code of the subject: Agro-environmental management I. MTMKG7007A

Name and title of the person responsible for the subject: Dr. Juhász Csaba, associate professor

Additional instructors involved in teaching the subject: Dr. Szőllősi Nikolett, assistant professor
Name and level of the program: Agricultural Environmental Management Engineering

Subject type: obligatory

Teaching timetable of the subject, type of examination: 3+2G (practice)

Credit value of the subject: 5

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

Content of the subject (14 weeks):

1. The recent social and economic processes, social structure as the original factors forming the condition of environment. Direct social factors controlling the quality of environment, emissions. Classes of environmental philosophy.
2. Sustainable development, environmental movements, environmental values, environmental awareness.
3. Examination of the social impacts of natural disasters, environmental effects of population growth and urbanization.
4. Characterization of the relationships between agriculture and environment: Environmental aspects of crop production. Evaluation and environmental aspects of nutrition management.
5. Characterization of the relationships between agriculture and environment: Environmental aspects of animal husbandry. Environmentally aspects of livestock farm establishment.
6. Natura 2000 Program. Agriculture in protected and vulnerable natural regions.
7. Renewable energy sources in the agriculture.
8. The agro-environmental aspects of climate change.
9. Proper agricultural practice.
10. Organic farming.
11. Legal and administrative regulation in connection to agro-environmental management in the EU and Hungary.
12. Agro-environmental management and rural development programs.
13. Agro-environmental management target programs.

14. Professional trip

Type of mid-term examination:
Written and/or verbal colloquium.

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. Completing exercises. Giving presentation

Teaching aids:
ppt presentations.

Recommended literature:
Birol, E. – Koundouri, P. (2008): Choice Experiments Informing Environmental Policy. Elgar, Edward Publishing, Inc. 368.p. ISBN: 978 1 84542 725 2.
Jack, B. (2009): Agriculture and EU Environmental Law. Ashgate Publication. 300.p. ISBN-13: 978-0754645405.
Juhász, Cs.-Zsembeli, J. (2014). Environment and land use. Elektronikus tananyag (tankönyv). A tananyag *„Az angol nyelvű Agrármérnöki MSc szak nemzetközi versenyképességének fejlesztése*" című, TÁMOP-4.1.2./1-11/1-2011-0009) számú projekt keretében készült. ISBN 978-963-473-654-7.
http://www.tankonyvtar.hu/hu/tartalom/tamop412A/2011_0009_Juhasz_Csaba-Environment_and_Land_Use/adatok.html
https://moodle.agr.unideb.hu/tamop/course/view.php?id=19
Merrington, G. – Winder, L. – Redman, M. (2005): Agricultural Pollution. Environmantal Problems and Practical Solutions. Spon Press. 216.p. ISBN-13: 9780419213901.
Ritter, W. F. – Shirmohammadi, A. (2001): Agricultural nonpoint source pollution. CRC Press LLC. 342.p. ISBN-13: 978-1566702225
Warren, J.-Lawson, C.-Belcher, K. (2008): The Agri-Environment. Cambridge University Press, UK, 224.p. ISBN-13 978-0-521-61488-7.

REQUIREMENTS
2021/2022 academic year I. semester

Name and code of the subject: Agro-environmental management I. MTMKG7007A

Name and title of the person responsible for the subject: Dr. Juhász Csaba, associate professor

Additional instructors involved in teaching the subject: Dr. Szőllősi Nikolett, assistant professor
Name and level of the program: Agricultural Environmental Management Engineering

Subject type: obligatory

Teaching timetable of the subject, type of examination: 3+2G (practice)

Credit value of the subject: 5

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

Content of the subject (14 weeks):

1. The recent social and economic processes, social structure as the original factors forming the condition of environment. Direct social factors controlling the quality of environment, emissions. Classes of environmental philosophy.
2. Sustainable development, environmental movements, environmental values, environmental awareness.
3. Examination of the social impacts of natural disasters, environmental effects of population growth and urbanization.
4. Characterization of the relationships between agriculture and environment: Environmental aspects of crop production. Evaluation and environmental aspects of nutrition management.
5. Characterization of the relationships between agriculture and environment: Environmental aspects of animal husbandry. Environmentally aspects of livestock farm establishment.
6. Natura 2000 Program. Agriculture in protected and vulnerable natural regions.
7. Renewable energy sources in the agriculture.
8. The agro-environmental aspects of climate change.
9. Proper agricultural practice.
10. Organic farming.
11. Legal and administrative regulation in connection to agro-environmental management in the EU and Hungary.
12. Agro-environmental management and rural development programs.
13. Agro-environmental management target programs.

14. Professional trip

Type of mid-term examination:
Written and/or verbal colloquium.

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. Completing exercises. Giving presentation

Teaching aids:
ppt presentations.

Recommended literature:
Birol, E. – Koundouri, P. (2008): Choice Experiments Informing Environmental Policy. Elgar, Edward Publishing, Inc. 368.p. ISBN: 978 1 84542 725 2.
Jack, B. (2009): Agriculture and EU Environmental Law. Ashgate Publication. 300.p. ISBN-13: 978-0754645405.
Juhász, Cs.-Zsembeli, J. (2014). Environment and land use. Elektronikus tananyag (tankönyv). A tananyag *„Az angol nyelvű Agrármérnöki MSc szak nemzetközi versenyképességének fejlesztése*" című, TÁMOP-4.1.2./1-11/1-2011-0009) számú projekt keretében készült. ISBN 978-963-473-654-7.
http://www.tankonyvtar.hu/hu/tartalom/tamop412A/2011_0009_Juhasz_Csaba-Environment_and_Land_Use/adatok.html
https://moodle.agr.unideb.hu/tamop/course/view.php?id=19
Merrington, G. – Winder, L. – Redman, M. (2005): Agricultural Pollution. Environmantal Problems and Practical Solutions. Spon Press. 216.p. ISBN-13: 9780419213901.
Ritter, W. F. – Shirmohammadi, A. (2001): Agricultural nonpoint source pollution. CRC Press LLC. 342.p. ISBN-13: 978-1566702225
Warren, J.-Lawson, C.-Belcher, K. (2008): The Agri-Environment. Cambridge University Press, UK, 224.p. ISBN-13 978-0-521-61488-7.

REQUIREMENTS
2021/22 academic year I. semester

Name and code of the subject: Agricultural engineering, precision agricultural systems and technologies MTMKG7014A
Name and title of the person responsible for the subject: Dr. János Tamás, professor
Additional instructors involved in teaching the subject: Bernadett Gálya, senior lecturer
Name and level of the program: Agricultural Environmental Management MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 1+2 G
Credit value of the subject: 3

Purpose of teaching the subject: 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.
Students use spatial data from different data acquisition devices and mapping the soil and vegetation spatial and temporal heterogeneity by GIS software and evaluate the maps. Created maps could help in decision support in precision agriculture.
An important part of the practice is that student learn the most relevant members of Hungarian precision agricultural corporations and their locations throughout the world. Student can visit the service and the precision agriculture tools of the integrators, which can be provided for farmers.

Content of the subject (14 weeks): theory/practice

1. Historical and theoretical background of precision agriculture. Parts and integration of precision agriculture into the practice. / Job computer – tractor mounted sensors – big data.
2. Reasons of spatial variability in agriculture. / Database management.
3. Global Positioning System and its complementary systems. / Spatial heterogeneity in self-created digital maps I.
4. The role of GIS in precision agriculture. / Spatial heterogeneity in self-created digital maps II.
5. Usability of remote sensing data in precision agriculture. / Spatial heterogeneity in self-created digital maps III.
6. Databases, data infrastructure and map servers. / Geo-statistically examination for more effective decision support.
7. Sensors, monitors, additional instruments. / Processing of airborne survey (LiDAR and spectral remote sensing) data for precision agriculture I.
8. Precision plant protection. / Processing of airborne survey (LiDAR and spectral remote sensing) data for precision agriculture II.
9. Precision nutrient management. / Processing of airborne survey (LiDAR and spectral remote sensing) data for precision agriculture III.
10. Precision water management. / Processing of satellite remote sensing data for precision agriculture I.
11. Precision horticultural. / Processing of satellite remote sensing data for precision agriculture II.

12. Precision animal husbandry. / Processing of satellite remote sensing data for precision agriculture III.
13. Yield monitoring, site specific information after harvest. / Field exercise/farm visit I.
14. Economical aspects of precision agriculture / Field exercise/farm visit II.

Type of mid-term examination: -

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

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

Teaching aids: Presentation of the lectures.

Recommended literature:

Brase, T. (2005): Precision agriculture. Delmar Cengage Learning. 1st edition. 288 p.
Kennedy, H. (2009) Introduction to 3D Data: Modelling with ArcGIS 3D Analyst and Google Earth. Wiley. 360 p.
Kennedy, H. (2009) Introduction to 3D Data: Modelling with ArcGIS 3D Analyst and Google Earth. Wiley. 360 p.Qin, Z. (2015): Precision Agriculture Technology for Crop Farming. Taylor & Francis. 374 p.
Srinivasan, A. (2006): Handbook of precision agriculture: Principles and applications. CRC Press. 683 p. (ISBN: 978-156-022-954-4)
Tamás, J. (2011): Precision Agriculture. University of Debrecen. Centre for Agricultural and Applied Economic Sciences. Debrecen. 126 p.
(http://www.tankonyvtar.hu/hu/tartalom/tamop425/0032_precizios_mezogazdasag/adatok.html

REQUIREMENTS
Academic year 2021/2022, semester 1

Name and code of the subject: Research methodology - scientific communication MTMKG7015A
Name and title of the person responsible for the subject: Dr. Elza Kovács, associate professor
Additional instructors involved in teaching the subject:
Name and level of the program: agricultural environmental management engineering MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 2+3 practice
Credit value of the subject: 5

Purpose of teaching the subject: Fulfilling the course, student 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 the research planning and the 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 their ability is developed via writing selected types 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, they are required to formulate potential approaches at the level R&D&I and develop scientific directions of research. To improve the communication skills on scientific work and results in written, students will write an original article, a review and a short study for the public on any agro-environmental issues. 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 understandable what added value to the actual level of scientific knowledge means and how a research plan makes research successful.

Content of the subject (14 weeks):

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

Type of mid-term examination: Completing assignments / exercises listed in Exercise book: Practical exercises for the course of Environmental statistics, research methodology - scientific communication; Being active in group works; Being active in class works.

Method of assessment (semester examination mark - report, practical grade, colloquium, examination): Essay type written exam is taken in the examination period of the semester focusing on the knowledge gained. 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.

Teaching aids: ppt presentations, online websites

Recommended literature:

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. (2015): Introduction to Educational Research. Sage Publications. ISBN-13: 9781483375489
Exercise book: Practical exercises for the course of Environmental statistics, research methodology - scientific communication

REQUIREMENTS
2021-22 academic year 1st semester

Name and code of the subject: Environmental technologies II.: Water Quality Protection, Sewage Treatment, Waste Management in Agriculture and Food Industry (MTMKG7017A)
Name and title of the person responsible for the subject: Dr Pregun, Csaba, assistant professor
Additional instructors involved in teaching the subject
Name and level of the program: Agricultural Environmental Management Engineering MSc
Subject type: A
Teaching timetable of the subject, type of examination: 2nd year, 3th semester
Credit value of the subject: 3

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

Content of the subject (14 weeks):
Curriculum (14 weeks)
1. The concept and purpose of water quality protection, the methods of water quality control and the legal background. Water quality parameters.
2. Human intervention in the river basin. Water pollution and hydromorphological regulations.
3. EU and international methods of water qualification (physical, chemical, biological & ecological water qualification)
4. Rehabilitation of surface water bodies in the river basin. Self-purification of water.
5. Pollution and protection of groundwater bodies. Water resources protection.
6. Purpose and degree of wastewater purification; the generation and characterization of wastewater. Mechanical (primary) sewage purification
7. Ecological and microbiological basics of biological wastewater purification, aerobic and anaerobic sewage purification processes; activated sludge and trickling filters, biological nitrogen and phosphorus removal; digesters.
8. Natural sewage treatment technologies. Lagoons; Natural aquatic plant systems, & Constructed Wetlands.
9. The communal waste management. The role of waste management in agriculture and the food industry; Types, grouping, quantity and agricultural utilization of communal, agricultural and food waste and by-products.
10. Composting technologies based on agricultural and food raw materials and sewage sludge.
11. Biogas production technologies based on agricultural and food raw materials and sewage sludge.
12. Hazardous waste from agriculture and food industry (pesticides, slaughterhouse waste, etc.);
13. The burning, pyrolysis of communal, agricultural, food waste, and sewage sludge.
14. Waste disposal – landfill

Type of mid-term examination:
Method of assessment (semester examination mark - report, practical grade, colloquium, examination): colloquium - written (Quizzes & Essays)

Teaching aids:
6. The curriculum (ppt or pdf format) is available to the student.

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.
- T. H. Christensen: Solid Waste Technology & Management, Volume 1 & 2. Blackwell Publishing Ltd 2011. Print ISBN: 9781405175173. Online ISBN: 9780470666883.
- M. R. Templeton, D. Butler: An Introduction to Wastewater Treatment. Ventus Publishing 2011. ISBN 978-87-7681-843-2

REQUIREMENTS
2021/2022 academic year I. semester

Name and code of the subject: **Farm Business Management and Project Management, MTMKG7018A**
Name and title of the person responsible for the subject: Dr Nikolett Szőllősi, assistant professor
Additional instructors involved in teaching the subject:
Name and level of the program: Agricultural Environmental Management Engineering MSc
Subject type: optional
Teaching timetable of the subject, type of examination: 1+2 G
Credit value of the subject: 3

Purpose of teaching the subject: Farm business management combines study in agricultural production and science with a variety of business disciplines, preparing students for entrepreneurial, management and leadership roles in the agricultural sector.
Introduction of the basic's 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.

Content of the subject (14 weeks):

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

Type of mid-term examination: Completing assignments / exercises listed in Exercise book: Practical exercises for the course of Farm Business Management and Project Management

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

Teaching aids: ppt presentations, online websites

Recommended literature:

1. 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.
2. Andrew Woodend 2010. Definitions of Terms used in Farm Business Management. Department for the Environment, Food and Rural Affairs, Crown Copyright. p. 47.
3. Gary R. Heekens, PMP: Project Management. McGraw-Hill. 0-07-137952-5. DOI: 10.1036/0071394494. p. 249.

REQUIREMENTS
22/2021 academic year I. semester

Name and code of the subject: **Remote sensing MTMKG7025A**
Name and title of the person responsible for the subject: Dr. habil. Nagy Attila, associate professor
Additional instructors involved in teaching the subject:
Name and level of the program: Agricultural Engineer in Environmental Management MSc
Subject type: optional
Teaching timetable of the subject, type of examination: 0+3 G
Credit value of the subject: 3

Purpose of teaching the subject: 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.

Content of the subject (14 weeks):

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.

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

Type of mid-term examination:

Method of assessment (semester examination mark - report, practical grade, colloquium, examination): practical course mark in written exam

Teaching aids:

Recommended literature:

4. Campbell, J. B., Wynne, R. H. (2011): Introduction to Remote Sensing. The Guilford Press. 5th Edition. 667 p. ISBN: 978-1609181765.
5. 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.
6. Weng, Q. (2009): Remote Sensing and GIS Integration: Theories, Methods, and Applications. McGraw-Hill Professional. 1st edition. 416 p. ISBN: 978-0071606530.

REQUIREMENTS
2021-22 academic year 1st semester

Name and code of the subject: Hydrobiology MTMVG7027A.
Name and title of the person responsible for the subject: Dr Pregun, Csaba egy. adj.
Additional instructors involved in teaching the subject:
Name and level of the program: Agricultural Environmental Management Engineering MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 1st year, 1st semester
Credit value of the subject: 3
Purpose of teaching the subject:
Increased knowledge, skills and competencies of students will be reflected in the following areas:
1. Mastering of the practical implementation of the qualitative and quantitative hydrobiological analysis associated with handling microscopic techniques
2. Familiarization with sampling methods of different types of waters, sediments, benthic macroinvertebrates, phytoplankton and zooplankton.
3. Understanding of ecological, bioindication indexes calculation, and its importance for the estimation of surface water quality and pollution.
Students will be able to:
1. Clearly articulate the methods and key approaches used to the assessment of the status and change in freshwater biological systems.
2. Describe the advantages, disadvantages and sources of uncertainty of these ecological and methodological approaches and methods.
3. Demonstrate well-developed conceptual knowledge in freshwater biology and ecology;
4. Collect new data and synthesis existing information to assess the status of a freshwater system.
5. Critically evaluate the strengths and weaknesses of the acquired environmental, ecological data and information;
6. Accurately communicate the findings of a freshwater biological or ecological study in a scientific report;
7. Demonstrate ability to critically assess the quality of your own work and the work of others
8. Develop a global awareness of freshwater issues and the significance of cultural diversity as it pertains to sustainability of water resources.
Content of the subject (14 weeks):
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)

Type of mid-term examination: *2 ZH*

Method of assessment (semester examination mark - report, practical grade, colloquium, examination): colloquium - written (Quizzes & Essays)

Teaching aids:

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

Recommended literature:

- Wetzel R. (2001): Limnology. Lake and River Ecosystems. 3rd Edition. Academic Press. Hardcover ISBN: 9780127447605, eBook ISBN: 9780080574394.
- 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.
- William J. Mitsch, James G. Gosselink (2015): Wetlands. John Wiley & Sons: ISBN 978-1-118-67682-0

REQUIREMENTS
21/2022 academic year I. semester

Name and code of the subject: **Drainage engineering, MTMKG7028A**
Name and title of the person responsible for the subject: Dr. habil. Zsembeli József, tudományos főmunkatárs, PhD
Additional instructors involved in teaching the subject:
Name and level of the program: Agricultural Engineer in Environmental Management MSc
Subject type: optional
Teaching timetable of the subject, type of examination: 2+1 K
Credit value of the subject: 3

Purpose of teaching the subject: The students attending the course can get acquainted with the importance, methods, tools and effects of surface- and subsurface drainage in hilly and flat areas aiming water management conditions suitable for different land use purposes. Students will practice the implementation of principles, and application of procedures as well as interpretation methods in the fields of basic hydrology, water resources, watershed management, surface and subsurface drainage, agrometeorology, lysimetry, basics of irrigation, soil-water-plant relations.

Content of the subject (14 weeks):

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

Type of mid-term examination:

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

Teaching aids:

Recommended literature:

1. Larry W. Mays (2011): Water resources engineering. ISBN-13: 978-0470460641, ISBN-10: 0470460644
2. Nakagami, Ken'ichi, Kubota, Jumpei, Setiawan, Budi Indra (Eds.) (2016): Sustainable water Management. Springer. ISBN: 9789811012044 9811012040 9811012024 9789811012020
3. Lambert K. Smedema, Willem F. Vlotman, David Rycroft (2004): Modern Land Drainage: Planning, Design and Management of Agricultural Drainage Systems. CRC Press. ISBN 9789058095541
4. Waller, Peter, Yitayew, Muluneh (2016): Irrigation and Drainage Engineering. Springer. ISBN 978-3-319-05699-9