REQUIREMENTS
20/2019 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 Water 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: 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 Magagement. McGraw-Hill. 0-07-137952-5. DOI: 10.1036/0071394494. p. 249.

REQUIREMENTS
20/2019 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 Water Management Engineering 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
20/2019 academic year I. semester

Name and code of the subject: **Drought management, MTMKG7026A**
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 Water Management Engineering MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 2+2 G
Credit value of the subject: 4

Purpose of teaching the subject: 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.

Content of the subject (14 weeks):

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.

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 analysing 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. Quality criteria and quality improvement of surface water and groundwater resources used for irrigation.

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:

1. Paul A. DeBarry (2004): Watersheds: Processes, Assessment and Management. John Wiley & Sons, Inc., Hoboken, New Jersey. ISBN-13: 978-0471264231
2. Isobel W. Heathcote (2009): Integrated Watershed Management: Principles and Practice. John Wiley & Sons, Inc., Hoboken, New Jersey. ISBN-13: 978-0470376256
3. 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.
4. 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.
5. 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

REQUIREMENTS
Academic year 2019/2020, semester 1

Name and code of the subject: Water chemistry MTMVG7004A
Name and title of the person responsible for the subject: Dr. Elza Kovács, associate professor
Additional instructors involved in teaching the subject: Dr. Péter Tamás Nagy, associate professor
Name and level of the program: Agricultural water management engineering MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 2+1, C
Credit value of the subject: 4

Purpose of teaching the subject: Completing the subject, students will know the chemical parameters of water, and the (bio)chemical reactions potentially taking place under environmental circumstances. They will understand the effect of the changing physical and/or chemical and/or biological environment on the overall water quality, and the cross-relations of the reactions leading to new equilibria. As part of the practice, their skills on sampling, sample preparation, use of quick tests and some analytical equipment, as well as documentation and evaluation of the results will be improved.

Content of the subject (14 weeks):

1. Introduction, water consuming/lab safety
2. Water usage/lab equipment, devices
3. Chemical calculations/making solutions,
4. Chemical calculations/balances and volume measuring devices
5. Water structure/measuring possibilities of main properties of water
6. Main physical and chemical parameters of water/ main measuring methods and parameters
7. General introduction to Water analysis/ Determination of TSS and TDS
8. Water reactions I./ Determination of water hardness
9. Water reactions II./ Determination of water EC
10. Water pollutions/Water sampling and pretreatment
11. Principle of titrimetry/Determination chloride in water samples
12. Water analysis/determination of pH, N forms (nitrate, nitrite, ammonium)
13. Water analysis/determination of P, K and sulphate
14. Water analysis/determination of different metals (Cu, Zn, Mn, Fe)

Type of mid-term examination: Completing assignments / exercises listed in Exercise book: Practical exercises for the course of Water chemistry; Being active in group works; Completing lab works; Taking part in field visits

Method of assessment (semester examination mark - report, practical grade, colloquium, examination): Oral exam about a choosen topic 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 field trips and completing home work individually are compulsory.

Teaching aids: ppt presentations, online websites

Recommended literature:
Benjamin, Mark M. (2014): Water Chemistry, Second Edition 2nd Edition, Waveland Press. Inc.,907p ISBN: 978-1478623083
Hauser, Barbara (2002): Drinking Water Chemistry. A Laboratory Manual. Lewis Puslishers, 2014p. ISBN 9781566704861

Exercise book: Waterchemistry
https://www.britannica.com/science/anomalous-water
https://cdn.ymaws.com/www.mainerwa.org/resource/resmgr/2019_conference/2019ppts/basic_water_chemisty_allabs_.pdf

REQUIREMENTS
20/2019 academic year I. semester

Name and code of the subject: Soil Physics, MTMVG7005A
Name and title of the person responsible for the subject: Lajos Blaskó prof. emeritus
Additional instructors involved in teaching the subject:
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

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):

15. Soil, as natural resource, functions and composition the soils. Soil forming factors and processes
16. Particle sizes. Physical and physico-chemical properties of particles with different sizes
17. Soil texture. Textural classes of soil particles
18. Soil properties related to soil texture
19. The structure of solid phase in soils. Genesis of soil structure (physical, chemical processes), characterization of soil structure (soil physical and morphological techniques),
20. Total and differential porosity of soils. Functions of pores with different sizes.
21. Soil water principles: Water forms in the soils. Energy concept of soil water (soil water potential, components of water potential).
22. Water movement in soil, saturated flow
23. Transport of soil water under unsaturated conditions
24. Practical aspects of water retention and movement in soils. Soil water management categories.
25. Soil Aeration. Mechanism of soil gas exchange. Air movement in the soils.
26. Pedotransfer rules and functions for estimation of soil properties difficult to measure.
27. Soil compaction and soil structure deterioration
28. 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:

7. 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
8. Manoj K. Shukla (2013) Soil Physics: An Introduction. CRC Press. ISBN 9781439888421
   Recommended textbooks:
9. 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

REQUIREMENTS
2019/20 academic year 1 semester

Name and code of the subject: Pond culture and fisheries management MTMVG7007A
Name and title of the person responsible for the subject: Laszlo Stündl PhD
Additional instructors involved in teaching the subject:
Name and level of the program: Agricultural water 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: Course objective : to provide information on the theory of fish genetics and breeding including the broodstock management, induced and natural reproduction, fry and larvae management. The knowledge acquired will enable to participate / cooperate in practical breeding programmes.

Content of the subject (14 weeks):

29. Current status and tendencies in pond fish culture
30. Pond construction, engineering and water management
31. Applied hydrobiology – plankton management
32. Fish biology propagation and larvae management
33. Feeding and nutrition
34. Pond management and harvesting
35. Multifunctional and integrated aquaculture
36. Aquatic and fisheries resources
37. Key fish species
38. Fish biology: growth, recruitment and management
39. Fish population ecology and dynamics
40. Stock assessment and management
41. Inland fishing methods and equipment
42. Inland fisheries engineering and construction

Type of mid-term examination: Taking part on the 70% of the practices are compulsory.

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

Teaching aids: Lecture slides & handouts (texts)

Recommended literature:

10. FAO (2016): The State of World Fisheries and Aquaculture 2016. Contributing to food security and nutrition for all. Rome. 200 pp.
11. 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]
12. 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

13. 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

REQUIREMENTS
2019/2020. academic year I. semester

Name and code of the subject: Irrigated crop production, MTMVG7008A
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: Agricultural Water 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:
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.

Content of the subject (14 weeks):
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. Production requirements of irrigation. Aims of irrigated crop production.
7. Necessary 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.
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)

Type of mid-term examination:
- Before examination students need to get signature of the course instructor.
- Special requests will be accepet in the first 2 weeks of the semester only.

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

Teaching aids: lecture material

Recommended literature:
Burton, M. (2010): Irrigation Management: Principles and Practices, CAB Intl. ISBN: 9781845935160
Brebbia, C.A, Marinova, M, Bjornlund, H (2010) : Sustainable Irrigation Management, Technologies and Policies III, Wit Pr/Computational Mechanics, Billerica, USA, ISBN: 9781845644468

REQUIREMENTS
20/2019 academic year I. semester

Name and code of the subject: Remote sensing and GIS in hydrology, MTMVG7014A
Name and title of the person responsible for the subject: János Tamás professor
Additional instructors involved in teaching the subject: Dr. Attila Nagy
Name and level of the program: Agricultural Water Management Engineering MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 2+2 G
Credit value of the subject: 4

Purpose of teaching the subject: The goal of this subject is to make it possibile 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.

Content of the subject (14 weeks):

43. Spatial objects
44. GIS models
45. GNSS methods
46. Input data collection methods
47. Structure of geo-database for surface waters
48. Structure of geo-database for groundwater
49. Spatial decision support in water management
50. Spatial uncertainty and risk analysis in water management
51. Physically background of remote sensing
52. Space borne and airborne remote sensing
53. Image analysis and land use
54. Image analysis and water quality management
55. Hydrological modelling
56. Hungarian and international hydrology databases and data mining

Skills to be learnt:

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

Type of mid-term examination:

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

Teaching aids:

Recommended literature:

1. Li, Z., Zhu, Q., Gold, C. (2005): Digital terrain modeling: Principles and Methodology. CRC Press. 318 p. (ISBN: 0-415-32462-9)
2. 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)
3. Maquire, D. J. (2005): GIS, Spatial Analysis and Modeling. ESRI Press. 479 p. (ISBN: 978-158-948-130-5)

REQUIREMENTS
20/2019 academic year II. semester

Name and code of the subject: **Environmental technologies I - Soil remediation, soil protection, biotechnology in agriculture, MTMKG7013A**
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 Water Management Engineering 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: 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.

Content of the subject (14 weeks):

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).

Type of mid-term examination:

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

Teaching aids:

Recommended literature:

1. 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
2. P Lens, T Grotenhuis, G Malina, H Tabak 2005. Soil and Sediment Remediation. IWA Publishing London SW1H 0QS United Kingdom 544 ISBN 9781843391005
3. Neilson, Alasdair H. 2007. Environmental Degradation and Transformation of Organic Chemicals. Taylor & Francis (USA) Philadelphia, PA 19106 USA ISBN 9780849372414
4. Mirsal I.A. 2004. Soil pollution: Origin, Monitoring and Remediation Spreinger 312. ISBN: 978-3-540-70775-5
5. Saligram Bhatt (2004): Environment Protection and Sustainable Development. APH Publishing. 241. p. ISBN 9788176485128

REQUIREMENTS
20/2019 academic year II. semester

Name and code of the subject: Hydrobiology MTMVG7003A
Name and title of the person responsible for the subject: Dr Csaba Pregun, assistant professor
Additional instructors involved in teaching the subject:
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

Purpose of teaching the subject: 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.).

Content of the subject (14 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. Physical, chemical and biological qualification of surface water bodies, self-purification of waters and eutrophication.
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:

Method of assessment (semester examination mark - report, practical grade, colloquium, examination): Written and/or verbal exam

Teaching aids:

Recommended literature:

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.

REQUIREMENTS
20/2019 academic year II. semester

Name and code of the subject: Floodplain management, MTMVG7009A
Name and title of the person responsible for the subject: Dr Csaba Pregun, assistant professor
Additional instructors involved in teaching the subject:
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

Purpose of teaching the subject: The purpose of the course is to provide the student with an understanding of the principles and current practices for managing floodplains, and other flood hazard areas, to bring about flood-loss reduction and natural resource protection, emphasizing multidisciplinary approaches to management. Students will learn the relationship between the hydrology, hydraulics, ecology, river morphology. Students gain knowledge about the impacts of human activities on floodplains and the basic possibilities of river corridor restoration. Within integrated river basin management, river valley is presented as an ecological entity along with its flood and inland water protection, water resource management and environmental and nature conservation aspects. The latter are concerned with the role of floodplain and backwaters in landscape protection, in the ecological corridor network, in recreation, in aquatic and ecotourism. The possibilities for river and wetlands restoration are also reviewed.

Content of the subject (14 weeks):

57. The concept of floodplain. History of flood management. Floodplain management as part of water resources management. Integrated river basin management and water resource management in the river valley.
58. The hydraulics of the streams.
59. The fluvial geomorphology of the streams and river corridors.
60. Geomorphological and ecohydrological properties of the rivers and river valley.
61. River ecology. The river as a living ecosystem (River continuum and Flood Pulse Concept)
62. The types of floods and floodplains;
63. The river and floodplain classification. The Rosgen classification.
64. The hydrologic computational techniques. Risk assessment. Rehabilitation of wetlands.
65. Flood hazard studies; discussion of floodplain management plan.
66. Flood damage reduction strategies and tools.
67. Natural functions and resources of floodplains and their value.
68. Strategies and tools to preserve and/or restore natural and beneficial floodplain resources.
69. Floodplain Management and Protection of Wetlands.
70. River corridor and watershed management

The general purpose of the exercises is to give students a realistic picture of the situation and opportunities of flood management, the relationship between the agricultural and water management, flood management, environmental and nature protection activities on the floodplains.

15. Assessment of the general characteristics of watercourses
16. Geomorphology of streams
17. Stream hydrology and hydraulics
18. Ecohydrology of streams
19. Stream & floodplain ecology I
20. Stream & Floodplain Ecology – Water Quality and Health II
21. Arrangement of rivers and river valleys (Rosgen)
22. The pattern of streamflows
23. Floodplain formation
24. Modelling of aquatic structures
25. Watershed and river basin
26. Water flow in the floodplain
27. Summary and control questions

Type of mid-term examination:

Method of assessment (semester examination mark - report, practical grade, colloquium, examination): Written and/or verbal exam
Teaching aids:

Recommended literature:

14. The theoretical and practical material of the course is available in pdf and ppt format.

15. 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.x

REQUIREMENTS
20/2019 academic year II. semester

Name and code of the subject: Irrigation for horticulture production, MTMVG 7010A
Name and title of the person responsible for the subject: Dr Péter Riczu, assistant professor
Additional instructors involved in teaching the subject:
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

Purpose of teaching the subject: 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.

Content of the subject (14 weeks):

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 for special purposes (pre-sowing, pre-plant, frost protection, fruit coloration, fertigation).
7. Hydroponic and aeroponic farming systems.
8. Irrigation of parks and sports courts.
9. Irrigation technologies in greenhouses.
10. Irrigation methods and purposes in vegetable production.
11. Irrigation methods and purposes in fruit production.
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.

Type of mid-term examination:

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

Teaching aids:

Recommended literature:

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)

REQUIREMENTS
20/2019 academic year II. semester

Name and code of the subject: **Wastewater and slurry management, MTMVG7011A**
Name and title of the person responsible for the subject: Dr. János Tamás professor
Additional instructors involved in teaching the subject: Péter Tamás Nagy (PhD)
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

Purpose of teaching the subject: 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.

Content of the subject (14 weeks):

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

Type of mid-term examination:

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

Teaching aids:

Recommended literature:

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

REQUIREMENTS
academic year 2019/2020, semester 2

Name and code of the subject: Water resource protection and water damage prevention MTMVGH7013A
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 water management engineering MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 2+2 practice
Credit value of the subject: 4

Purpose of teaching the subject: Completing the subject, students will understand the actual challenges of water resource protection and water-related environmental damage prevention, the European legislation of qualitative and quantitative water resource protection, and its implementation. They will know the environmental risk assessment methods in relation to the water resource protection, including the modeling tools, too. As part of the subject, the water resource management, flood and drought management, and handling water contamination in practice will be introduced as well. Practice will include the improvement of skills such as water resourcee and water balance calculations, modeling hidrogeological processes, and applying different risk assessment tools. They work on individual projects and use relevant software.

Content of the subject (14 weeks):

1. Vulnerability of water resources
2. Global and regioinal water resources and their utilization, water balances
3. Actual and potential drinking water resources, and their protection
4. Water policy and implementation in the European Union
5. Qualitative and quantitative monitoring and protection tools for surface water resources
6. Qualitative and quantitative monitoring and protection tools for groundwater resources
7. Environmental risk assessment methodology
8. Legislation of environmental risk assessment and management
9. Tools of environmental risk assessment
10. Hidrogeological processes and their modeling
11. Flood control
12. Drought control
13. Regional water resource management
14. Management of surface water and groundwater contamination

Type of mid-term examination: Completing assignments / exercises adapted from the Exercise book: Practical exercises for the course of Agro-environmental management II - ecotoxicology, environmental management; Being active in group works; Completing lab works; Taking part in field visits

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 field trips 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:

Journal of Water Resource Protection https://www.scirp.org/Journal/jwarp/
Hadrian F. Cook: The protection and conservation of water resources. 2nd Ed. Wiley Online Library, ISBN:9781119334316, DOI:10.1002/9781119334316
Áine Gormley, Simon Pollard, Sophie Rocks: Guidelines for Environmental Risk Assessment and Management. Cranfield University, 2011:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69450/pb13670-green-leaves-iii-1111071.pdf
Best available techniques – guidelines: http://eippcb.jrc.ec.europa.eu/reference/
http://eippcb.jrc.ec.europa.eu/reference/BREF/IRPP_Final_Draft_082015_bw.pdf
Exercise book: Practical exercises for the course of agro-environmental management II - ecotoxicology, environmental management

REQUIREMENTS
academic year 2019/2020, semester 2

Name and code of the subject: Water resource protection and water damage prevention MTMVGH7013A
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 water management engineering MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 2+2 practice
Credit value of the subject: 4

Purpose of teaching the subject: Completing the subject, students will understand the actual challenges of water resource protection and water-related environmental damage prevention, the European legislation of qualitative and quantitative water resource protection, and its implementation. They will know the environmental risk assessment methods in relation to the water resource protection, including the modeling tools, too. As part of the subject, the water resource management, flood and drought management, and handling water contamination in practice will be introduced as well. Practice will include the improvement of skills such as water resourcee and water balance calculations, modeling hidrogeological processes, and applying different risk assessment tools. They work on individual projects and use relevant software.

Content of the subject (14 weeks):

1. Vulnerability of water resources
2. Global and regioinal water resources and their utilization, water balances
3. Actual and potential drinking water resources, and their protection
4. Water policy and implementation in the European Union
5. Qualitative and quantitative monitoring and protection tools for surface water resources
6. Qualitative and quantitative monitoring and protection tools for groundwater resources
7. Environmental risk assessment methodology
8. Legislation of environmental risk assessment and management
9. Tools of environmental risk assessment
10. Hidrogeological processes and their modeling
11. Flood control
12. Drought control
13. Regional water resource management
14. Management of surface water and groundwater contamination

Type of mid-term examination: Completing assignments / exercises adapted from the Exercise book: Practical exercises for the course of Agro-environmental management II - ecotoxicology, environmental management; Being active in group works; Completing lab works; Taking part in field visits

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 field trips 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:

Journal of Water Resource Protection https://www.scirp.org/Journal/jwarp/
Hadrian F. Cook: The protection and conservation of water resources. 2nd Ed. Wiley Online Library, ISBN:9781119334316, DOI:10.1002/9781119334316
Áine Gormley, Simon Pollard, Sophie Rocks: Guidelines for Environmental Risk Assessment and Management. Cranfield University, 2011:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69450/pb13670-green-leaves-iii-1111071.pdf
Best available techniques – guidelines: http://eippcb.jrc.ec.europa.eu/reference/
http://eippcb.jrc.ec.europa.eu/reference/BREF/IRPP_Final_Draft_082015_bw.pdf
Exercise book: Practical exercises for the course of agro-environmental management II - ecotoxicology, environmental management

REQUIREMENTS
2019/2020 academic year II. semester

Name and code of the subject: Farm machines of the irrigation-irrigation technology MTMVG7015A
Name and title of the person responsible for the subject: Dr. Zoltan Hagymassy associate professor
Additional instructors involved in teaching the subject:
Name and level of the program: Agricultural Water Management Engineering MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 1+2 Practical grade
Credit value of the subject: 3

Purpose of teaching the subject:
Students learn about the irrigation systems equipment, the machines structural elements, and the settings of the equipment. Students able to managing the operation of the machines. Based on the studies Students necessary to plan the workflow of the irrigation system.

Content of the subject (14 weeks):

1. Mechanics of Fluids I.
2. Mechanics of Fluids II.
3. Water Pump Features
4. Type of pumps
5. Operation of Water Pump
6. Pipes and pipelines
7. Couplings, pipe fittings
8. Pipe Shut-off devices.
9. Water supply systems in agriculture
10. Drainage equipment
11. Irrigation equipment I.
12. Irrigation equipment II.
13. Irrigation equipment III.
14. Water Power Machines

Type of mid-term examination:
Participation in practical classes is a condition for obtaining a signature. Absences are no more than 30**%.** Completing exercises.

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

Teaching aids: Power point slides of university lectures issued to students

Recommended literature:
Glenn J. Hoffman, Robert G. Evans, Marvin Eli Jensen, Derrel L. Martin, Ronald L. Elliott: Design And Operation Of Farm Irrigation Systems ISBN-13: 978-1892769640, ISBN-10: 1892769646
Brian Bell: Farm Machinery ISBN 1903366682
John Carrol: Tractors and Farm Machinery ISBN-13: 978-0754826583

REQUIREMENTS
20/2019 academic year II. semester

Name and code of the subject: Integrated water management and monitoring, MTMVG7018A
Name and title of the person responsible for the subject: Dr. János Tamás professor
Additional instructors involved in teaching the subject:
Name and level of the program: Agricultural Water Management Engineering MSc
Subject type: compulsory
Teaching timetable of the subject, type of examination: 3+2 K
Credit value of the subject: 5

Purpose of teaching the subject: 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 emphasing the cases of the Hungarian catchment areas. By 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.

Content of the subject (14 weeks):

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. SWAT
14. DHI

Type of mid-term examination:

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

Teaching aids:

Recommended literature:

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)

REQUIREMENTS
20/2019 academic year II. semester

Name and code of the subject: **Urban Hydrology , MTMVG7024A**
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 Water 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: 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.

Content of the subject (14 weeks):

71. Introduction - concept, urbanization - megacities
72. Definition, climate change
73. Urban microclimate
74. Urban water balance
75. Precipitation – Runoff, Infiltration
76. Grey water – water harvesting (non - structural management)
77. Evapotranspiration – Green surface, urban landscape
78. Flood management
79. Sewer network
80. Wastewater treatment
81. Biological wastewater treatment and sewage sludge management
82. Bioenergy, alternative water resources
83. Urban hydrology monitoring, smart cities
84. Decision support modeling in IUWM

Type of mid-term examination:

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

Teaching aids:

Recommended literature:

4. Musco, F. Counteracting urban heat island effects in a global climate change scenario
5. Urban Hydrology for small watershed TR55 USDA
6. New Urban Agenda ENSZ, Quito 2016.
7. SWIFT – IURWM decision package