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

Precision Agricultural Engineering

BSc Program

2023

**COURSE DESCRIPTIONS FOR PRECISION AGRICULTURAL ENGINEERING BSC**

**Knowledge topic: Basic engineering knowledge**

**Credit range (15-20 cr.): 15 cr.**

**Courses: 1) Mathematics, 2) Informatics, 3) Mechanical knowledge, 4) Statistics, 5) Hydraulics, pneumatics**

**Mathematics**

ECTS Credit Points: 3

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

Type of exam: oral exam

Requirements:

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

- for a grade: written exam

**Summary of content**

Math is an integral part of our daily life and has a great practical value. This subject attempts to illustrate this viewpoint with an applied approach. The main objective is to motivate students using their knowledge in their everyday life. Problem solving approach is emphasized throughout the whole course. In order to reach that goal, every new concept and definition will be illustrated by numerous real-life examples and concrete appropriate applications. The other goal of the subject is to introduce the students to the basic methods and terminology or definitions in mathematics, which can be used in economics. The differential calculus of one and two-variable functions and their practical application is in the focus of interest, as well as the extreme value and elasticity calculation of one and two-variable functions.

**lectures and seminars:**

1. Algebric preliminaries: Real number line, operations, rules for exponents and radicals, operations with algebraic expressions, factoring, Cartesian coordinate systems, straight lines, distance in the plane
2. Graph and algebra of functions, application is business economics, break-even analysis, supply-demand, market equlibrium, Exponential, logarithmic and logistic curves and its applications
3. Financial Mathemtics: present and future value, compound interest, mathematical models, Present and future Value of annuities, annuities due, loans and amortization of debts, bond pricing
4. limits and continuity and derivatives
5. Differential Calculus I: rules, higher order derivatives, marginal functions in economics
6. Differential Calculus II: first and second, curve sketching
7. Differential Calculus III: optimization, elasticity and other applications in business economics
8. Matrix operations and its practical applications
9. Gauss-Jordan elimination for solving systems of linear equations and its applications
10. Partial derivatives, maximum and minimum of multivariable functions
11. Cobb-douglas function, Lagrange multiplier method
12. Combinatorics, Permutation and combinations, probability, estimated probability, odds, odds ratio
13. Application of the classic and geometric definition to real-life problems, sampling
14. Application of conditional probability to real-life problems, Probability trees and Bayes rule

**Literature, handbooks:**

Required reading:

E. Haeussler – R. Paul – P. Wood (2014): Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, 13th edition, Pearson, UK, ISBN: 978-1-29202-114-0

Recommended reading:

R.J. Harschbarger – J.J. Reynolds (2015): Mathematical application for Management, Life and Social Sciences, Brooks/Cole, USA, Belmont, CA, ISBN: 978-1305108042

S.T. Tan (2016): Applied Mathematics for Managerial, Life and Social Sciences, Cengage Learning, USA, Stamford, ISBN: 978-1-285-46464-0

K. Sydaster – P. Hammond (2016): Essential Mathematics for Economics Analysis, Pearson Education, UK, ISBN: 978-1-292-07465-8

M. Spiegel – J. Schiller – A. Srinivasan (2001): Probability and Statistics, McGraw Hill, USA, ISBN: 0-07-139838-4 159 pages

S. Warner – S. R. Costenoble (2007): Finite Mathematics and applied calculus, Thomson Higher Education, USA, Belmont, CA, ISBN: 0-495-01631-4 1252 pages

**Informatics**

ECTS Credit Points: 3

42 hour(s) seminar per semester

Type of exam: practical grade

Requirements:

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

- for a grade: written exam

**Summary of content**

The aim of the course is to provide students, regardless of their educational background, with the IT and digital skills they need to continue their studies and to acquire the practical skills required by a graduate professional. They should be able to gather knowledge from the Internet and use it and the Office suite to solve complex tasks. The training is essentially application-oriented, with a wide range of practical exercises. A further aim is to provide students with practical knowledge and skills in the use and management of office software recommended for SMEs. During the exercises, the students will learn solutions that support and can be used in a sample of agribusiness processes.

Competences to be acquired: The course will provide the student with the methods for identifying agricultural problems, relevant information gathering, analysis and problem solving methods and processes. The student should be able to use written and oral communication tools effectively, to recognise the advantages and disadvantages of using IT and, where necessary, to use them in a conscious and professional manner.

**Lectures:**

1. Elements of spreadsheet systems
2. Functions
3. Diagrams
4. Excel list management (sorts)
5. Excel list management (filters)
6. Excel list management (pivots)
7. First report
8. Elements of database management systems
9. Databases, tables
10. Queries
11. Forms
12. Creating and managing reports.
13. Analysis of the structure and database of a selected agricultural enterprise
14. Second report

**Literature, handbooks:**

Required reading:

Excel Functions, <http://www.excelfunctions.net>

MS Excel Topics, Tech ont he Net, <http://www.techonthenet.com/excel/index.php>

Summarize Spreadsheet Data, With Excel's Array Formulas, <http://www.exceluser.com/explore/arrays1.htm>

Access 2013 tutorials; <http://www.gcflearnfree.org/access2013>

Recommended reading:

R. Elmasri: Fundamentals of Database Systems, Pearson, 2016, ISBN: 9781292097619, pp. 1272

Ullman, J.D., Widom J.: Adatbázisrendszerek, Alapvetés, Panem Kft., 2009, 9789635454815, pp. 600

Date, J. C.: An Introduction to Database Systems, Pearson, 2003, ISBN13 (EAN): 9780321197849, pp. 1024.

**Mechanical knowledge**

ECTS Credit Points: 3

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

Type of exam: oral exam

Requirements:

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

- for a grade: written exam

**Summary of content**

The aim of the subject education is to summarize the basic technical knowledge and basic concepts that the student will encounter in their future working environment. Therefore, it gives the student a comprehensive picture, so that, knowing the technical environmental foundations, they can recognize the structure and the possible defects of the applied equipment. The students get their own structure of mechanical equipment, the material properties of parts, and features of the machineries. During the course, students will gain the knowledge of the principles and structure of the working and power machines and other mechanical structures used. After this course, the graduated students will be able to uncover and identify mechanical issues, and then they will be able to solve these issues, as well.

**Lectures:**

1. Historical overview
2. Material knowledge
3. Material testing methods
4. Properties of metallic materials
5. Properties of polymer materials
6. Material processing
7. Soluble bonds
8. Insoluble bonds
9. Tools and procedures of bindings
10. Axles, bearings
11. Clutches
12. Mechanical drives
13. Electronic drives
14. Practical uses

**Literature, handbooks:**

Required reading:

- Attila Vas: Internal combustion engines in car and tractor technology ISBN 9633562120

- Péter Szendrő: Agricultural Engineering ISBN 9639121177

- Péter Szendrő: Examples of AGRICULTURAL ENGINEERING in ISBN 9633562066

- János Ducsai: Cutting procedures 9789632750828 ISBN

Recommended reading:

- Henry T. Brown: 507 Mechanical Movements ISBN 9781614275183

**Statistics**

ECTS Credit Points: 3

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

Type of exam: **colloquium**

Requirements:

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

- for a grade: written exam

**Summary of content**

The course introduces the basic statistical concepts and covers the procedures most frequently used in the descriptive analysis of precision agriculture. The focus will be mainly put on the computation and interpretation of the most widely used statistical measures and some basic methodological indicators that have importance in the precison agriculture.

They are able to collect, analyze and synthesize data using special software, and are able to support management decisions and formulate recommendations with knowledge of the application and operation of special precision agricultural equipment and infocommunication tools. The knowledge gained here forms the basis for participation in the master's program.

**lectures:**

1. Introduction to statistics, basic concepts
2. Sampling
3. Databases
4. Levels of measurement data
5. Central tendency
6. Central tendency
7. Measuring spread
8. Notable distributions
9. Confidence intervals
10. Measurement accuracy, ways to give accuracy
11. Hypothesis theories
12. Two-sample parametric tests
13. Analysis of variance
14. “Post-hoc” tests, simultaneous multiple mean comparison tests

**Literature, handbooks:**

Required reading:

Anderson, Sweeney, Williams, Freeman and Shoesmith: Statistics for Business and Economics, Second edition, Cengage Learning EMEA, 2010. UK, 928. p. ISBN: 1408018101

Howitt, D. – Cramer D.: Introduction to Statistics in Psychology, 6/E Pearson, Harlow. 2014. 744. p. ISBN-13: 9781292000749

Recommended reading:

Field A.: Discovering Statistics Using SPSS (Introducing Statistical Methods), 4th Edition, SAGE Publications Ltd., London, 2013. 915. p. ISBN-13: 978-9351500827

**Hydraulics, pneumatics**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The aim of the subject education is to summarize the structure, peculiarities and basic concepts of hydraulic and pneumatic systems. In this way, the student should have a comprehensive picture and knowledge of the hydraulic and pneumatic basics as a graduate engineer. Graduated student can recognize possible issues at the equipment in use. Thereby contributing to the provision of a stable production process. All of these skills are indispensable at the workplaces and for the solution of individual work situations.

The student acquires basic knowledge at machine design and methods, technologies, operational processes. Course gains the knowledge of the principles and structure of the working and power machines and other tools in use. Graduated students at their workplace are able to uncover and identify emerging issues.

**lectures:**

1. Historical overview
2. Understanding the basic of fluid dynamics
3. Equations (energy balance of fluid dynamics, Bernoulli equation)
4. System model (fluid flow)
5. Material knowledge 1 (metallic materials in use)
6. Material knowledge 2 (polymers in use)
7. Hydraulic and pneumatic equipment review
8. Hydraulic and pneumatic equipment (Pumps, pipelines, valves, actuators)
9. Advantages and disadvantages of hydraulic and pneumatic equipment
10. Hydraulic and pneumatic systems
11. Comparison of hydraulic and pneumatic systems
12. Review of PLC and control systems
13. Review of system design and modeling systems
14. Practical uses

**Literature, handbooks:**

Required reading:

Rudolf Brankopf: Hydraulics in Practice - Manual from Design to Operation ISBN: 9789639412859

Recommended reading:

Andrew parr: hydraulics and Pneumatics ISBN 000809667448

**Knowledge topic: Natural science knowledge**

**Credit range (15-20 cr.): 20 cr.**

**Courses: 1) Inorganic and organic chemistry, 2) Agro-chemistry, 3) Botany, 4) Physics,**

**5) Plant physiology, 6) Agrometeorology, 7) Microbiology**

**Inorganic and organic chemistry**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

In the subject of Inorganic and Organic Chemistry, students will learn the basics of general, inorganic and organic chemistry and the importance of this knowledge in precision agriculture. In addition, they will learn about basic laboratory operations and working with chemicals, as well as the classical analytical process of analysis.

**lectures:**

1. Structure of the periodic table, concepts of atom, molecule, ion and isotope, stoichiometry, electron structure of atoms
2. Basics of chemical calculations, mole, concentration and dilution calculations
3. Primary and secondary chemical bonds, electronegativity
4. Basic types of chemical reactions, writing a reaction equations
5. Redox processes and oxidation number
6. Chemical equilibria, Le Chatelier principle, acids, bases, acid-base equilibria,
7. Buffer solutions, solubility, hydrolysis of salts,
8. formation of complex compounds, chelates, complexes of transition metals
9. Grouping of organic compounds, aliphatic and aromatic compounds
10. Function groups and reactions of organic compounds
11. Carbohydrates and their reactions
12. Protein structure and reactions
13. Nucleic acids, lipid structure and reactions
14. Enzymes (plant) and vitamins

**Practice:**

1. 1-2: Accident prevention. Use of laboratory equipment, weight and volume measurement.
2. 3-4: Basics of chemical calculations in practice.
3. 5-6: Chemical compound knowledge, performing test tube reactions
4. 7-8: Exercises related to acid-base equilibria
5. 9-10: Solubility, hydrolysis and pH of salts
6. 11-12: Acid-base titration
7. 13-14: Summary of practice, writing ZH

**Literature, handbooks:**

Raymond Chang, Kanneth A. Goldsby, General Chemistry, McGraw-Hill, 2011, New York, USA, ISBN: 9780073402758

Frederick A. Bettelheim, William H. Brown, Mary K. Campbell, Shawn O. Farrell, Omar J. Torres, Introduction to General, Organic, and Biochemistry, Cengage Learning, 2014 Boston, USA, ISBN: 9781285869759

**Agrochemistry**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The general objective of the subject is to train students who are familiar with the chemical and agrochemical basics of plant nutrition and environmentally friendly precision nutrient management, the theoretical and practical features of plant nutrition, and the role and possibilities of nutrient supply.

**Lectures:**

1. The aim of precision nutrient management. Achieving site-specific nutrient supply, Plant nutrients and their classification.
2. Chemical composition of plants (water, ash, organic matter content).
3. Nutrient uptake through roots, and leaves and factors influencing it.
4. Effect of nutrient supply on yield and quality.
5. Forms of nutrients in the soil. The importance of ion adsorption in soils.
6. Nitrogen in soil, plant uptake, role in plant.
7. Phosphorus, potassium in soil, their uptake, role in plants.
8. Calcium, magnesium, sulphur in soil, uptake, role in plants
9. Nitrogen fertilizers and their application
10. Phosphorus fertilizers and application, potassium and magnesium fertilizers.
11. Micronutrient fertilizers and their uses. Compound and mixed fertilizers.
12. Chemical soil amendments, lime fertilisation.
13. Formation, properties and uses of organic fertilizers.
14. Assessment of soil nutrient status, the basics of fertilizer recommendation

**Practices:**

1. Rules for precision soil and plant sampling for agricultural purposes. Measuring of plant moisture content, dry matter content, ash content.
2. Measurement of soil pH and EC content in the field and in the lab.
3. Determination of plant available phosphorus content of the soil, interpretation of the results.
4. Plant tissue analysis, measurement of nitrate in plant tissue, interpretation of results.
5. The physical and chemical properties of NPK fertilizers
6. Basics of precision fertilizer recommendation I.
7. Basics of precision fertilizer recommendation II.

**Literature, handbooks:**

Raymond Chang, Kanneth A. Goldsby, General Chemistry, McGraw-Hill, 2011, New York, USA, ISBN: 9780073402758

Frederick A. Bettelheim, William H. Brown, Mary K. Campbell, Shawn O. Farrell, Omar J. Torres, Introduction to General, Organic, and Biochemistry, Cengage Learning, 2014 Boston, USA, ISBN: 9781285869759

**Botany**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The aim of the course is to provide students with comprehensive, thorough botanical knowledge that can be applied in practice. Knowledge of cytology and histology provides a sound basis for plant physiology studies. Detailed morphological knowledge, together with plant taxonomy, provides the basis for later crop production and herbology studies.

**Literature, handbooks:**

James D. Mauseth: Botany (2014): An Introduction to Plant Biology. Jones & Bartlett Learning USA ISBN-13: 978-1449665807

Baloghné Nyakas A. (2015): Basics of Agricultural Botany. Debrecen, University of Debrecen

Gábor Turcsányi (ed.) (2001): Agricultural botany. Agricultural Expertise Publishing House, Budapest. ISBN: 9633563593.

**Physics**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content – theory**

The aim of teaching the subject is to acquaint students with the basic physical knowledge of mechanics, rheology, fluid science and optics required for the acquisition of engineering professional subjects.

1. Mechanics: Basics of classic mechanics
2. Mechanics: Newton's laws, laws of kinematics and dynamics on the mass center
3. Mechanics: Vibration movements, Wave motion
4. Mechanics of liquids and gases: Hydrostatics, Characterization of liquids
5. Mechanics of liquids and gases: Pressure in stagnant liquids, buoyancy, swimming
6. Flow of fluids: Description and distribution of flows, The continuity equation, The Bernoulli equation and its applications
7. Flow of liquids: Sources and vortices, Circulation flow, Internal friction (viscosity), Layered flows
8. Flow of fluids: The laws of Poiseuille and Stokes. Turbulent flow.
9. Fluid flow The Reynolds number; hydrodynamic similarity law,
10. Fluid flow: Vortex generation, Hydrodynamic resistance
11. Flow of fluids: The dynamic buoyancy, The Magnus effect
12. Rheology. Basic rheological models (Hooke and Newton model)
13. Complex rheological models, viscoelastic behavior
14. Optics: Geometric optics, Physical optics, Particle nature of light, Simple and complex optical devices

**Literature**

Cutnell J.D., Johnson, K.W. (2012) Physics 9th edition. John Wiley and Sons. ISBN 978-0-470-87952-8

Singh, V. (2017) Agricultural Physics. ‎ Bioscientific Publisher, ISBN‎ 978-9383284153

Sipos, P. (2015) Rheology in Food Analysis. University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management, 57 p.

**Plant physiology**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The knowledge to be acquired is the knowledge of the life functions and life processes of plants. Students should be able to improve the efficiency of precision crop production by understanding plant life functions. Basic biological concepts, Photosynthesis I (light reaction).

1. Photosynthesis II (CO2 reduction)
2. Photosynthesis III (ecophysiology)
3. Plant biology of respiration
4. Plant biology of water management
5. 6 Nutrient management, mineral metabolism I (uptake, transport, assimilation)
6. 7 Nutrient management, mineral metabolism I (uptake, transport, assimilation)
7. Hormonal regulation I (auxins, gibberellins)
8. Hormonal regulation II (cytokinins, abscisic acid, ethylene, etc.)
9. Growth, development
10. Photomorphoses
11. Flowering and fruiting
12. Physiology of ageing
13. Plant physiological testing methods in precision plant production
14. Assesment

**Literature**

Required reading:

Taiz, L., Zeiger, E.: Plant Physiology 3. kiadás, Sinauer Assoc., Sund., Massachusets, USA 2002

Recommended reading:

Pethő Menyhért: Mezőgazdasági növények élettana. Tankönyv. Akadémiai Kiadó, Budapest. 1993. 508 oldal. ISBN 963 05 7486 3

Pethő Menyhért: A növényélettan alapjai. Tankönyv. Akadémiai Kiadó, Budapest; 1998. 177 oldal. ISBN 963 05 8035 7

Erdei László: Növényélettan. Tankönyv. JATEPRESS, Szeged, 2004.366 oldal. ISBN 963 482 668 7

Gergely Pál – Penke Botond – Tóth Gyula: Szerves- és bioorganikus kémia. Tankönyv. Semmelweis Kiadó, Budapest. 1994. 375 oldal. ISBN 963 815 44 2X

**Agrometeorology**

ECTS Credit Points: 2

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

Main topics of the subject: Weather elements and their effects on crop production. Agrometeorological measurements, database, forecasts. Possibilities to reduce the harmful effects of weather. Utilization of agrometeorological information in precision crop production. Climate of Hungary, the effect of climate change and the adaptation to it.

**Lecture**

1. Agrometeorology in precision crop production. Atmospheric processes and phenomena.
2. Meteorological networks and observation systems. Agrometeorological measurements and stations. Weather forecast. Meteorological/agrometeorological information on Internet.
3. Physical properties of solar radiation, radiation balance of the surface, short- and longwave radiation balance. Effect of solar radiation on plants. Measurement of solar radiation.
4. Soil-, plant- and air temperature, their measurement. Thermal needs of plants, phenology, growing degree days. Role of temperature in crop production.
5. Air pressure and wind, general characteristics, measurement. Parameters describing air humidity, measurement.
6. Types and formation of precipitation. Measurement of precipitation. Precipitation information in crop production.
7. Evapotranspiration (definitions, role, effecting factors, typical values). Measurement and calculation of air humidity. Water balance equation, irrigation scheduling systems.
8. Drought, drought indices, drought management. Inland excess water and its agrometeorological aspects. Hail, hail protection.
9. Microclimate, climate of canopies, effect of surface properties and topography on microclimate Frost (types, effecting factors, occurrence, forecast and agronomical aspects). Frost protection.
10. Agrometeorological aspects of agrotechnics (soil cultivation, weed management, crop protection, irrigation, harvest etc.).
11. Weather-crop simulation models, crop protection models (forecasts) and other useful agrometeorological tools/information in precision crop production.
12. Climate of Hungary.
13. Climate change and its agronomical aspects. Possibilities of adaption in crop production.
14. Climate database, statistical analysis of climate data and utilization in precision agriculture.

**Literature**

Required reading:

Lomas, J. – Wieringa, J. (2001): Lecture Notes for Training Agricultural Meteorological Personnel. WMO No. 551. ISBN 978-92-63- 10551-6

Gombos B. (2015): Agrometeorology. E-notes. SZIE

Recommended reading:

Harpal S. Mavi - Graeme J. Tupper (2004): Agrometeorology. Principles and Applications of Climate Studies in Agriculture. Food Products Press

Sitanshu Sekhar Patra, Sandeep Rout, Neelam Khare, Prema Narayan Jagadev, Dharanidhar Patra (2017): Short Notes on Agrometeorology. Ideal International E – Publication Pvt. Ltd. ISBN:978-93-86675-12-5

**Microbiology**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

Within the course, students will learn about the structure, metabolism, and genetics of microbial cells. The evolution of microbes, the prokaryotes and the main phylogenetic groups of eukaryotic microbes and their characteristics are described. We present the ecological, environmental, food, biotechnological role of microbes, plant, animal and human diseases.

1. Microorganisms and Microbiology

2. Brief History of Microbiology

3. Cell Chemistry

4. Metabolism

5. Microbial Growth

6. Environmental effects of microbial growth

7. Molecular Biology of Microorganisms – Genes and Replication

8. Molecular Biology of Microorganisms –Transcription

9. Molecular Biology of Microorganisms – Translation

10. Protein synthesis

11. Microbial Evolution and systematics

12. Taxonomy of the Prokaryotes

13. Taxonomy of the Eukaryotes

14. Viruses

**Literature**

Required reading:

Madigan, M. T, Martinko, J. M., Bender K., Buckley, D., Stahl, D (2015): Brock Biology of Microorganisms, Benjamin Cumming, 14th edition 1030 p, ISBN 978-1-292-01831-7

Hogg S (2005): Essential Microbiology, John Wiley & Sons Ltd, 481 oldal, ISBN 0 471 49753 3

Recommended reading:

Talaro, K. P. (2015): Foundations in microbiology, Pasadena City College, Barry Chess, Pasadena City College. – Ninth edition. 929 oldal, ISBN 978–0–07–352260–9

**Knowledge topic: Basic knowledge of agriculture**

**Credit range (30-40 cr.): 32 cr.**

**Courses: 1) Soil science, 2) Agricultural basics, 3) Horticulture, 4) Water management,**

**5) Plant pathology, 6) Environmental management, 7) Crop production, 8) Animal physiology,**

**9) Animal husbandry, 10) Land use, 11) Integrated crop protection**

**Soil science**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The aim of the course is for students to learn the possibilities of monitoring the properties and condition of soils and the use of precision devices. The aim is to describe the physical and chemical properties of the soils and to characterize the processes taking place in the soil. Further aim is to get to know the method of precision soil sampling, and to get knowledge about digital soil maps.

The aim is also to describe the most important digital, precision devices during performing laboratory soil examinations. It is important to develop the view of conscious land use, and in the transfer of knowledge, the relationship between sustainable, environmentally friendly farming and land use will be emphasized. The acquisition of the curriculum allows for students to apply possibilities of digital devices, to interpret the results, to synthesize the knowledge and to use it in an understanding way in their later work.

**Lecture**

* 1. The concept of soil, its components and functions. Modelling of the soil as an environmental factor, describing of the soil profile. The role of soil examinations in precision agriculture.

1. Soil-forming minerals and rocks, and their grouping.
2. Soil forming factors. The concept of weathering.
3. Soil organic matter. The humus. The role of humus in maintenance of soil fertility. Humus quality.
4. Soil chemical properties. Soluble salts in the soil. Colloid-sized components of soil. Use of digital devices to determine the soil pH. Forms of soil acidity (pH, hydrolytic and exchange acidity).
5. Physical properties of soils. Soil particles, texture and structure of the soil. Morphological and agronomic evaluation.
6. The concept of soil bulk density and particle density. Total porosity of the soil.
7. Soil water management. Soil moisture perception in precision farming. Moisture forms, water movement in the soil.
8. Principles and methods of soil classification. Soil types in Hungary and the WRB. Skeletal and lithomorphous soils, their characterization.
9. Soil formation under forest vegetation. Formation and classification of chernozem soil.
10. Formation of hydromorphic soils, their unfavourable properties. Characteristics and types of salt-affected and meadow soils.
11. Precision soil sampling, types of soil measurements, soil geography.
12. The condition of soils. Preservation of soil fertility, soil melioration. The potential of precision soil improvement.
13. Soil Conservation Information Monitoring System (SIMS) and its application in practice. Description of digital soil maps.

**Practice**

* 1. Description of soil profile: on-site soil tests: color, structure, texture, determination of Na2CO3 - soda, CaCO3 - lime.
  2. Describing of soil profile: On-site soil tests: phenolphthalein alkalinity test, soil reaction (pH), parameters influencing the soil pH.
  3. Determination of soil texture by laboratory methods: silt and clay fraction (SC%) and plastictity index according to Arany (PIA) from different soil types.
  4. Determination of soil texture by laboratory methods: hygroscopicity of soils (hy) and capillary water lifting capacity during 5h-1 in different soil types.
  5. Characterization of pore conditions in soil: determination of soil bulk density (p).
  6. Characterization of pore conditions in soil: determination of particle density (pm).
  7. Calculation of soil moisture content in different units.
  8. Calculation of irrigation water amount.
  9. pH conditions in soil: measurement of pH with digital tools by a laboratory method.
  10. pH conditions in soil: forms of acidity in soil.
  11. Measurement of humus in the laboratory: methods for determine the humus content of soils.
  12. Measurement of humus in the laboratory: standard curve creating, calculating of N content of soils, evaluation.
  13. Measuring of Na2CO3 by laboratory quantitative methods, evaluation.

1. Measuring of CaCO3 by laboratory quantitative methods, evaluation.

**Literature**

Required reading:

D. Kent Shannon, David E. Clay, Newell R. Kitchen (2018): Precision Agriculture Basics. ISBN:9780891183662. Online ISBN:9780891183679.

G. W. Leeper, N.C. Uren (1993): Soil Science an introduction (Fifth Edition) 300. p.

Introduction in Soil Science (2016): Development of E-Courses for B.Sc. (Agriculture) Degree Program https://agrimoon.com/wp-content/uploads/Introduction-to-Soil-Science.pdf. 193. p.

D. L. Rowell (1994): Soil Science, Methods & Applications. ISBN 0 582 087848.

Recommended reading:

David L. Lindbo, Deb A. Kozlowski, C. Robinson (2012): Know Soil, Know Life. ISBN-13: 978-0891189541; Online: ISBN-10: 0891189548.

Glenn, D., William, C., Ray, M. (2014): Precision Agriculture: An Introduction. <https://extension.missouri.edu/media/wysiwyg/Extensiondata/Pub/pdf/envqual/wq0450.pdf>

**Agricultural basics**

ECTS Credit Points: 3

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

Type of exam: practical grade

Requirements:

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

- for a grade: written exam

**Summary of content**

Within the framework of the course, we give students an insight into the work processes and certain operations of agriculture, including crop production and animal husbandry. The student acquires knowledge about the practical technical and technological components of these sectors, the different work processes of crop production and animal husbandry. The aim of the teaching of the subject is to establish the later studies of plant breeding and animal husbandry, and to acquaint the student with the practice of plant breeding and animal breeding at the basic level.

1. The nature and specifics of agricultural production, their practical connections, the practical evaluation of cultivation factors and their most important connections in crop production. The practical connections of the cultivation branches, the place of crop production in the structure of Hungarian agriculture.
2. Practical specifics of ecological factors in crop production.
3. Aspects of the practical choice of biological bases in crop production, variety use in practice.
4. Practical knowledge of the technical basis of crop production.
5. Practical evaluation of agronomic factors of crop production.
6. The practice of crop rotation, tillage, nutrient replenishment.
7. The most important practical operations of sowing technology, plant care and irrigation, plant protection practice, harvesting and primary processing.
8. Basic concepts of animal husbandry. Domestication. Hungary's economic livestock today.
9. Digestive characteristics of ruminants, bases of feeding.
10. Basics of cattle breeding: Keeping and feeding dairy cows, beef cattle husbandry technology. Basics of sheep breeding: Housing technology, feeding.
11. Basics of pig breeding: Sow keeping and piglet rearing, pig fattening. Basics of poultry breeding and keeping: commodity and breeding egg production, broiler rearing.
12. Slaughterhouse operations.
13. Basics of horse breeding and keeping.
14. Basics of reproductive biological care of farm animals.

**Literature**

Required reading:

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

Recommended reading:

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

Gurbir S. Bhullar - Navreet K. Bhullar (2013): Agricultural Sustainability. Elsevier Inc. 292 p. ISBN: 978-0-12-404560-6

**Horticulture**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

Characterization of major vegetable and fruit species, including environmental requirements and cultivation technology. Selection of the best location for production, presentation of the factors influencing quality, and application in agriculture. The expectations of fresh markets and processing industries, as well as their raw material requirements, are described.

1. The role of vegetables in nutrition; the situation and peculiarities of domestic vegetable production; grouping of vegetables according to heat demand and propagation methods used. Peculiarities of growing leafy vegetables.
2. General characterization of root vegetables - characterization and cultivation of carrots, parsley, beets, horseradish.
3. Environmental needs of onions, growing from seeds (annuals) and bulbs. Characterization and cultivation of garlic.
4. Legumes - environmental needs, botanical characterization and cultivation technology of green peas and green beans.
5. Cucurbitaceae - characterization and support system cultivation of cucumbers. Environmental needs and cultivation of melons.
6. Species belonging to Solanaceae - environmental needs and cultivation of tomatoes. Characterization needs and field cultivation of sweet peppers.
7. Environmental needs, varieties and cultivation of sweet corn and cabbage.
8. The international and domestic situation of fruit production, directions of the development.
9. Taxonomy and practical grouping of the fruit species produced in Hungary.
10. Ecological demands of the fruit species.
11. Establishment of plantations, aspects of production site, rootstock and cultivar choice.
12. Traditional and intensive canopies of fruit trees.
13. Principles of the training and maintaining pruning of fruit crops.
14. Soil, water and nutrient management of orchards.

**Literature**

Required reading:

Sánchez, E. S. (2010): Vegetable Gardening, The Pennsylvania State University, 64 p. <http://www.webgrower.com/regional/pdf/PA_Veg_agrs115.pdf>

Ric Bessin, R. (ed.) (2012): Vegetable Production Guide for Commercial Growers. Cooperative Extension Service • University Of Kentucky College of Agriculture, Lexington, 132 p. <http://www2.ca.uky.edu/agcomm/pubs/id/id36/id36.pdf>

Parshant Bakshi V.K.Wali (2011): Practical manual for fruit production. <https://www.researchgate.net/publication/270509577_Practical_manual_of_fruit_production>

Recommended reading:

Kemble, J. M. (2020): Vegetable Crop Handbook, Southeastern U.S.,355 p. <https://www.aces.edu/wp-content/uploads/2019/12/2020_SEVG_final_web.pdf>

Tree FruitProduction Guide. Pennsylvania 2012–2013. <https://polk.extension.wisc.edu/files/2014/02/Tree-Fruit-Production-Guide-Penn-State-2013.pdf>

Jackson, D., Thiele, G., Looney, N., Morley-Bunker, M. (2010): Temperate and Subtropical Fruit Production. ISBN 9781845935016. 336. p.

Ghosh, S. N., Kumar, A., Rehman, M. U., Sharma, R. R. (2018): Temperate Fruit Crops: Theory to Practical. New India Publishing Agency- Nipa. ISBN: ‎ 9387973158. 1070 p.

**Water management**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

Familiarization with the technical tasks of water management activities related to agricultural production, their operation and the acquisition of the related theoretical and practical knowledge. Analysis of plant-soil-water relations, evaluation and analysis of the hydrological processes and water-holding conditions in the crop production area. Technical background of precision irrigation and implementation of precision irrigation.

**Lecture**

1. The importance of water. The concept, importance and sub-areas of water management.
2. Fundamentals of hydrology, the natural cycle of water, water balance studies.
3. Water management in Hungary. Surface and groundwater forms.
4. Basic knowledge of hydraulics.
5. Water classification. Water quality protection.
6. Flood protection.
7. Soil conservation and water management in hilly areas.
8. The concept, components and complexity of melioration. Water management in plain areas
9. Basic concepts of irrigation, irrigation development opportunities in our country.
10. Irrigation methods.
11. Relationship of irrigation with other elements of crop production technology.
12. Technical background of precision irrigation, steps of its implementation.
13. Precision irrigation regime.
14. Water management control, water administration. The Water Framework Directive. Environmental impacts of water management.

**Practice**

1. Precipitation curve, calculation of precipitation probability
2. Evaporation and transpiration calculations
3. Estimation and calculation of runoff, infiltration and accumulation.
4. Measuring inland water yield calculation.
5. Inland drainage and channel sizing tasks.
6. Calculation of sewer leakage loss.
7. Soil water resources calculation, irrigation planning.

**Literature:**

Required reading:

Sharma P.: (2013). Agricultural Water Management. Genetech. ISBN: 978-818-972-923-3.

Wheatley K.: (2015). Agricultural Water Management: Insights and Challenges. Callisto Reference. ISBN: 978-163-239-127-8.

Recommended reading:

OECD (2014): Climate Change, Water and Agriculture: Towards resilient systems, OECD Studies on Water. OECD Publishing. ISBN: 978-926-420-912-1.

van Wijk L.-Wesseling J.: (1986). Agricultural Water Management. CRC Press. ISBN: 978-906-191-639-0.

**Plant pathology**

ECTS Credit Points: 4

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The aim of the course is to acquaint students with the pest assemblages and diseases of the major cultivated crops of Hungary, their diagnostics, the environmental needs and life cycle of pests, the control methods provided by integrated pest management (IPM) and precision technology, and the basic concepts of pest and pathogen protection.

**Lectures:**

1. Introduction: History of crop production and plant protection. Factors and processes leading to ‘the evolution of pest populations’. Comparison of natural and agricultural habitats determining composition of pest populations.
2. Plant protection ecology, Process of invasions, major invasive pests and pathogens in the Hungarian fauna.
3. General characteristics of major pest groups: Nematoda, Insecta I.
4. General characteristics of the major pest groups: Insecta II.
5. Methods of pest monitoring and forecast and pest diagnostics
6. Possibilities of pest control, control strategies, plant protection aspects of cultivation methods
7. Biological control of pests, the most important natural enemies and their use in pest control
8. Diagnostics of diseases, etiology, symptomatology.
9. Etiology: non-infectious diseases, viruses, virus-like particles
10. Etiology: Prokaryotes, Fungi I.
11. Etiology: Fungi II.
12. Etiology: Fungi III.
13. Epidemiology, control of plant diseases I.
14. Protection against plant diseases II.

**Literature:**

Required reading:

Marczali Zs. (2020): Modul of applied entomology: Field pests in temperate zone of Europe http://dtk.tankonyvtar.hu/xmlui/handle/123456789/2953

Pénzes-Kónya, E. & Varga J (2020): Ecology for students of Medical Plant Production Expert higher level vocational training programme. https://dtk.tankonyvtar.hu/handle/123456789/3634

Plant Pathology 5th ediion George Agrios No. of pages: 952 Academic Press 2005 Hardcover ISBN: 9780120445653

Recommended reading:

Marczali Zs. (2020): Insect ecology https://dtk.tankonyvtar.hu/handle/123456789/2949

Marczali Zs. (2020): Insect Physiology [https://dtk.tankonyvtar.hu/handle /123456789/3205](https://dtk.tankonyvtar.hu/handle%20/123456789/3205)

**Environmental management**

ECTS Credit Points: 2

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

Students of precision agricultural engineering course will learn about the living and non-living environmental elements associated with agriculture. The course will provide an overview of the cause and effect relationships of environmental problems and basic options for their control. The aim is to learn the input and output methods of pollution control and the basic design context of technical interventions. It is also an objective to provide practical knowledge in the field of environmental management, while emphasizing scientific, problem-solving thinking.

**Lecture**

1. The concept of environment, environmental protection, environmental management, environmental pollution.
2. Grouping of environmental elements. Criteria and major types of systems. The concept of model and modeling, the characteristics of the model. Principles of environmental protection.
3. The concept and grouping of natural resources. Biogeochemical cycles (carbon, nitrogen, sulfur cycle). Biodegradability of substances.
4. The effects of societies on the environment (agricultural societies, urbanization, achievements of economic and technical development, their negative environmental effects).
5. International environmental protection in an organized form. Overview of major environmental conferences. Concept of sustainable development.
6. Global environmental problems (war and peace, overpopulation, food crisis, material and energy crisis, environmental crisis).
7. Environmental pollution, grouping of pollutants, forms and causes of environmental pollution.
8. Soil protection. The concept and functions of soil. The concept of soil degradation, its causes, factors inhibiting soil fertility.
9. Sources of soil pollution. Heavy metal and oil pollution of soils. Remediation technologies, phytoremediation. Self-cleaning of soils.
10. The concept, structure and composition of the atmosphere. Ozone depletion, greenhouse effect, odorous substances in the atmosphere, air pollution caused by landfills. Atmospheric aerosols. Smog grouping, characteristics. Self-purification of air.
11. Basics of water protection. Classic water rating. Municipal wastewater collection, treatment, disposal of by-products.
12. Environmental effects of agricultural production. Erosion, deflation, salinization, acidification. Impact of crop and livestock production on soil, water and air status.
13. The concept of waste, waste management. Waste grouping.
14. Environmental models, modelling.

**Literature:**

Required reading:

Ram Naresh Bharagava (editor).: (2018). Recent Advances in Environmental Management. Routledge. Taylor and Francis Group. ISBN 9780815383147.

Bruce Mitchell.: (2018). Resource and Envrionmental Management. 3rd edition. Oxford University Press. Print ISBN-13: 9780190885816.

**Crop production**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

Integrated production technology for main cereals, pulses, oilseeds, feed crops. Complex crop production technology analysis from agronomic, environmental and economical points of view. Analysis of integrated production technology models with different intensities.

1. Theoretical knowledge of integrated crop production.
2. Elements of integrated crop production
3. Integrated production of wheat I.
4. Integrated production of wheat II.
5. Integrated production of maize I.
6. Integrated production of maize II.
7. Integrated production of sunflower I
8. Integrated production of sunflower II.
9. Integrated production of alfalfa I.
10. Integrated production of alfalfa II.
11. Integrated production of soybean I.
12. Integrated production of soybean II.
13. Integrated production of rapeseed (canola) I.
14. Integrated production of rapeseed (canola) II.

**Literature:**

Required reading:

Pepó, P. Csajbók, J. (2013) Integrated crop production I. Debrecen, Debreceni Egyetem, 161 p. ISBN: 9789634736509

Pepó, P. Csajbók, J. (2013) Integrated crop production II. Debrecen, Debreceni Egyetem, 208 p. ISBN: 9789634736516

Pepó, P. Csajbók, J. (2013) Integrated crop production III. Debrecen, Debreceni Egyetem, 178 p. ISBN: 9789634736523

Recommended reading:

McMahon, M., Kofranek, A. M., Rubatzky, V.E.: 2010. Plant Science: Growth, Development, and Utilization of Cultivated Plants. Prentice Hall, ISBN: 9780135014073 674. p.

Bradshaw J.E.: 2012. Root and Tuber Crops. 7/Handbook of Plant Breeding Springer New York, ISBN: 9781461426691, 298 p

**Animal physiology**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The role of this course includes the study of vital activities in cells, tissues and organ processes such as, contractility of muscle tissue, coordination through nervous system, feeding, digestion, respiration, circulation, reproduction and hormone secretion. Virtually, every specialized field in the biological functions involves some consideration of the physiological aspect.

1. Main parts of the animal body and their function
2. Tissues of the animal body and their function and homeostasis
3. Cellular Physiology and Homeostasis
4. Animal digestive system and its function
5. Movement and locomotion
6. Animal endocrine system and its function
7. Animal respiratory system and its function
8. Animal circulatory system and its function
9. Animal reproduction
10. Physiology of Excretion and Osmoregulation
11. Body water and Fluids
12. Metabolism
13. Animal Nutrition
14. Coordination Physiology of Nervous System.

**Literature**

Required reading: The material of the course will be available in pdf format.

Recommended reading:

R.D. Frandson, W.L. Wilke, A.D. Fails, Anatomy and Physiology of Farm Animals, 7th ed., Wiley-Blackwell, Iowa, 2009, ISBN9780813813943, 512 pp.

P.B.Reddy: Text Book of Animal Physiology. Ratna Prasad Multidisciplinary Research & Educational Society 2015 DOI: 10.13140/RG.2.1.4807.9441

**Animal husbandry**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The student gets to know the role of animal husbandry in agriculture, the characteristics to be developed, the connection between the economically important traits. The aim of the course is to acquaint students with the breeding characteristics of poultry, pigs, cattle and sheep species within animal husbandry. It also covers the breeding methods and production processes used and the characteristics of the species.

1. Economic significance of animal husbandry, trends
2. External and internal factors affecting the animal
3. Traits for improvement I.
4. Traits for improvement II.
5. Data collection, performance testing, registration
6. Heritability, repeatability value, correlations, breeding value estimation
7. Selection, selection progress
8. Breeding procedures. Protection of genetic resources
9. Reproduction of domestic animals. Biotechnological and zootechnical methods
10. Behavior of domestic animals.
11. Characteristics of poultry farming
12. Characteristics of pig breeding
13. Characteristics of cattle and sheep breeding
14. Sustainable animal husbandry systems

**Literature**

Required reading:

Heather s. T. (2010): Storey's Guide to Raising Beef Cattle, 3rd Edition: Health, Handling, Breeding (Storey's Guide to Raising). Storey Publishing LLC, 3rd edition 1-340. ISBN: 9781635860412

Recommended reading:

Czeglédi (2013): Animal Husbandry III. Some aspects of dairy and beef cattle production. University of Debrecen. 1-181.

K. Cardell (2013): Practical sheep keeping. 2nd edition. Crowood. 1-160. ISBN: 1847973396

**Land use**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

Students will acquire the knowledge necessary to maintain and increase soil productivity and to make wise use of the energy that can be incorporated into arable production through the soil. They will be able to apply soil fertility enhancement techniques and methods at the level of proficiency. Understand the concepts, interrelationships and processes involved in the overall use and protection of arable land.

1. The object and function of land use, its history and development. The relationship between precision farming and ecological conditions.

2. Purpose, importance and development of soil tillage.

3. Factors influencing the quality of soil tillage and changes in soil conditions

4. Soil tillage systems

5. Factors determining the quality and depth of ploughing methods. Deep tillage of the soil

6. Soil degradation processes and their prevention. New tillage systems.

7. Principles of crop rotation

8. Need and purpose of fertilisation. Factors determining the utilisation of nutrients

9. Basic principles for nutrient balances and nutrient replenishment

10. Methods of weed control

11. Cultivation of irrigated soils

12. Erosion and deflation control

13. Improvement of acid, saline and sandy soils

14. Land use systems

**Literature**

Required reading:

Birkás M. (2014): Book of soil tillage. Szent István University Press, Budapest. 322 pp. ISBN: 978-963-269-447-4

Recommended reading:

Adel El Titi (Ed). (2014): Soil Tillage in Agroecosystems. CRC Press. 376 pp. ISBN: 9780849312281

**Integrated crop protection**

ECTS Credit Points: 2

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

To present guidelines for the integrated pest management of key arable and horticultural crops. Description of the main pests of the given crops and the basics of mechanical, agrotechnical, chemical and biological plant protection interventions.

1. Basic concepts of integrated pest management. Basics of plant protection forecasting.

2. The concept of weeds, forms of damage, the most important weed species in the world and in Hungary.

3. The weed life system.

4. Agrotechnical, mechanical, weed control. Biological weed control methods.

5. Chemical weed control. Integration of weed control methods.

6. Herbicide resistance. Weed control of field crops.

7. Weed control of vegetable crops. Weed control of fruit crops.

8. Fundamentals of integrated pest management for major cereals (cereals, maize).

9. Basics of integrated plant protection of oilseeds (sunflower, rapeseed).

10. Fundamentals of integrated pest management for butterflies (peas, beans, alfalfa).

11. Fundamentals of integrated pest management of vegetables (tomatoes, peppers, onions).

12. Fundamentals of integrated pest management for industrial crops (potatoes, tobacco, sugar beet).

13. Fundamentals of integrated pest management for apple and stone fruits.

14. Fundamentals of integrated pest management for grapes and other berries.

**Literature**

Required reading:

Radócz L.: Modern plant protection I-IV. University Press, Debrecen (2015). (ISBN: 978-606100181-1). <http://www.tankonyvtar.hu/en/tartalom/tamop425/0010_1A_Book_08_Plant> Protection/.html

Recommended reading:

https://ec.europa.eu/food/plants/pesticides/sustainable-use-pesticides/integrated-pest-management-ipm\_en

**Knowledge topic: Agroeconomic and human knowledge**

**Credit range (20-30 cr.): 24 cr.**

**Courses: 1) Communication, 2) Agricultural Marketing and Prices, 3) Principles of Microeconomics, 4) Global Food Systems, 5) Technical writing in Engineering, 6) Quality management systems, 7) Management and organsational knowledge**

**Communication**

ECTS Credit Points: 3

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

Type of exam: practical grade

Requirements:

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

- for a grade: written exam

**Summary of content**

The course lets students recognize those basic management theories, methods, proceedings and communication technics, which can provide help for students to practice effective managerial tasks.

**Literature**

Guffey, Mary Ellen – Loewy, Dana: Essential of Business Communication. <http://www.cengagebrain.com.mx/content/9781133991465.pdf>

Allan Pease: Bodylanguage

McLean, S. (2005). The basics of interpersonal communication. Boston, MA: Allyn & Bacon

Pearson, J., & Nelson, P. (2000). An introduction to human communication: Understanding and sharing. Boston, MA: McGraw-Hill.

Davis Kenneth (2010): The McGraw-Hill 36-Hour Course in Business Writing and Communication, **ISBN13 (EAN):** 9780071738262

**Agricultural Marketing and Prices**

ECTS Credit Points: 4

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The aim of the course is to acquaint students with the basic contexts and environment of agricultural marketing. Particular emphasis is placed on the description of community marketing activities (eg community marketing of milk). The characterization of SME marketing will also play an important role in the course. Students will learn about the specifics of agricultural marketing in terms of shopping and consumer behavior. Among other things, the role of place of origin and quality indicators in marketing communication will be an important topic.

1. Description of requirements / description of requirements
2. Characteristics and peculiarities of agricultural marketing / Case study processing and / or introducing student’s presentation
3. The environment of agricultural marketing / Case study processing and / or introducing student’s presentation
4. Basics of Community agri-food marketing/ Case study processing and / or introducing student’s presentation
5. The role of Community trademarks and markings in agricultural marketing / Case study processing and / or introducing student’s presentation
6. Special features of SME marketing in agricultural marketing / Case study processing and / or introducing student’s presentation
7. Shopping and consumer behavior in agricultural marketing 1st part/ Case study processing and / or introducing student’s presentation
8. Shopping and consumer behavior in agricultural marketing 2nd part/ Case study processing and / or introducing student’s presentation
9. The role of consumer ethnocentrism and patriotism in the positioning of Hungarian food / Case study processing and / or introducing student’s presentation
10. Place of origin and the role of quality indicators in marketing communication / Case study processing and / or introducing student’s presentation
11. Strategic directions in agricultural marketing / Case study processing and / or introducing student’s presentation
12. Marketing of traditional and regional foods / Case study processing and / or introducing student’s presentation
13. New trends in agricultural marketing / Case study processing and / or introducing student’s presentation

Pre-examination option

**Literature**

Required reading:

K. N. Ravi Kumar: Agricultural Marketing in 2 Vols, Daya Publishing House, 2014

Recommended reading:

James Vercammen: Agricultural Marketing: Structural Models for Price Analysis 1st Edition, Routledge, 2012

Rachel E. Helwig (2015): Transparent Food Marketing: A Clear Understanding of Food Marketing Terminology. CreateSpace Independent Publishing Platform; First edition. pp. 1-112 ISBN: 9781514869864

Stephen F. Hall (2015): Sell Your Specialty Food: Market, Distribute, and Profit from Your Kitchen Creation. Stephen F. Hall; 6th edition. pp. 1-210. ISBN: 9780692572078

Gordon W. Fuller (2011): New Food Product Development: From Concept to Marketplace, Third Edition. CRC Press; 3 edition. pp. 1-508. ISBN: 9781439818640

**Principles of Microeconomics**

ECTS Credit Points: 4

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The course is aimed at making students familiar with the basic concepts of microeconomic analysis. Particularly, the course will be focused on the analysis of how economic actors, consumers and firms, choose between different alternatives. By the end of the course, the student should be able to use the basic tools and models of microeconomics, and apply them in solving problems.

1. Principles of economics
2. Understanding the main principles of economic analysis
3. Principles of microeconomics, equilibrium analysis, Opportunity cost, optimisation, models
4. Demand, supply, and equilibrium, Price elasticity and other elasticities,
5. Demand, Supply, Price elasticity The budget constraint - Income, marginal rate of transformation, opportunity set
6. Consumer preferences and utility
7. Indifference curves, marginal rate of substitution, marginal utility
8. Consumer choice constrained optimisation, interior solution, corner solution
9. Management and owner of firms, Economic cost, Production profit maximisation, explicit and implicit costs, production function, short-run, long-run
10. Short-run production, Returns to scale average product of labour, marginal product of labour
11. Cost functions marginal cost, long-run cost, economies of scale
12. Perfect competition price-takers, shut-down decision
13. Consumer and producer welfare consumer surplus, producer surplus
14. Monopoly marginal revenue, market power, entry barriers, natural monopoly, deadweight loss

**Literature**

Required reading:

Perloff, Jeffrey M. (2015): Microeconomics. Seventh Edition, Pearson Education Limited, ISBN: 9781292215624

Recommended reading:

Besanko, David – Breautigam, Ronald R.: Microeconomics. Third Edition (International Student version). John Wiley and Sons, Inc., New York, 2014. ISBN: 1119666139

Besanko, David – Breautigam, Ronald R.: Microeconomics. Study Guide. Third Edition. John Wiley and Sons, Inc., New York, 2014. ISBN-10 : ‎1118854993

**Global Food Systems**

ECTS Credit Points: 4

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The objectives of the course is to get students acquainted with the theoretical and practical parts of logistics and their application in the chain. Our aim is to introduce the basics of modern logistics based on the main functions and processes serving the goods flow.

1. Introduction to supply chain and logistics management
2. Food supply chains
3. Logistics
4. Retailing
5. Production and Manufacturing
6. Sourcing and procurement
7. Technology trends in supply chains
8. Risk management
9. Regulation, safety and quality
10. Collaboration and relationship
11. Security and future challenges
12. Challenges in international supply chains
13. Supply chain and logistics performance
14. Sustainability in supply chains

**Literature**

Required reading:

Dani, S. (2015): Food supply chain management and logistics. pp 260, KoganPage, ISBN: 9780 7494 7364 8

Recommended reading:

Deloitte (2013): The food value chain: a challenge for the next century. Deloitte Touche Tohmatsu, London

**Technical writing in Engineering**

ECTS Credit Points: 4

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

Fulfilling the course, students will be familiar with the challenges in R+D+I in precision agriculture, will be able to consider solution alternatives based on scientific knowledge to work out related research plans, and to understand the conditions needed for planning and designing them. Additionally, they will acquire skills in communicating scientific findings to different target groups through discussing case studies, and completing individual projects.

1. Processes in R+D+I, conditions of successful researching in the subjects of agriculture
2. Communication channels to share new results, target groups
3. Sources of data and information with scientific value, ways of using them, patents, scientific articles, books, Internet
4. Reviewing up-to-date knowledge in science and engineering
5. Problem-formulation, hypothesis, aim, objectives, research plan, research design
6. Mathematical methods, experiment designing
7. Modelling in science and engineering, interpretation of outputs
8. Relationship analysis in agricultural environmental protection, deduction, induction
9. Use of figures in communication
10. Target groups and the related structure of original scientific articles
11. Target groups and the related structure of reviews
12. Target groups and the related structure of articles for non-professionals
13. Target groups and the related structure of oral presentation
14. Measures of scientific performance, ethical issues in science

Practical tasks serve to apply the theoretical knowledge on agriculture-related scientific communication methods, to discover the R+D+I potentials in subjects of individual interests, and to practice the communication tools towards different target groups.

**Literature**

Required reading:

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

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

Recommended reading:

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

**Quality management systems**

ECTS Credit Points: 2

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The aim of the subject is the introduction of the standards, furthermore the development, operation and audit of the quality, environmental and food safety systems. The acquisition of knowledge contributes to the development of a quality approach and helps the student to participate in quality activities.

1. Concepts of quality and quality management. The main goals of quality management

2. Development history of quality management

3. GHP

4. GMP

5. GAP

6. GLOBALGAP

7. HACCP

8. ISO 9000

9. ISO 9001

10. ISO 14001

11. EMAS

12. TQM

13. Quality awards

14. Audit of management systems

**Literature**

Required reading:

Peles, F. – Juhász, Cs. (2014): Quality assurance. University lecture notes. University of Debrecen. /ISBN 978-963-473-656-1/ TÁMOP 4.1.2.A/1-11/1-2011-0009. 177p.

Recommended reading:

Vasconcellos, J.A. (2004): Quality Assurance for the Food Industry. A Practical Approach. CRC Press. 448 p.

Jacxsens, L. – Devlieghere, F. – Uyttendaele, M. (2009): Quality Management Systems in the Food Industry. Ghent University. 153p.

**Management and organsational knowledge**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The aim of the course is to provide students with basic management theories, methods and procedures to prepare them for the management tasks of business organizations. To this end, the history of the formation and development of leadership in the course of the course is processed in the basic management and organizational schools, trends and mindset. We will explain in detail the basic management tasks and roles. The framework of the course is the teaching of the well-defined tasks of the management process such as communication, information management, planning, decision-making, disposition, organization and control. Within the framework of the exercises related to the subject, the students acquire knowledge about the design and operation of the organization through an interactive teaching method.

Competencies: This enables graduated engineers to formulate expectations, tasks and problems related to leadership and organization. To select the most appropriate procedures and to develop the most appropriate methods for solving the given management organization situation. Consciously and plannedly able to apply them systematically. Having gained practical experience, it will be able to coordinate, organise and manage the activities of the organisation and its departments.

1. Introduction, Concept of the Organisation, Organizational Theory Models Introduction and requirements

2. Development of leadership Creativity training

3. Structural characteristics of organisational forms Group Dynamics Training

4. Management concept, management tasks Leadership Decision - Prisoner Dilemma

5. Organizational typologies Leadership Communications

6. Organizational design, process management Leadership method, style

7. Concept and basis of organization and work organization Work organisation practice

8. Work organization process, job planning

9. Basis of norma preparation

10. Group Management

11. Changemanagement

12. Organizational and managerial communication

13. Organisational culture

14. Organisation development

**Literature**

**Required reading:**

Williams, C. (2011): Management. South Western, Cengage Learning, Mason. 852.p. ISBN: 0-538-74597-6.

Griffin, R. W. (2015):Management. 12th Editon. Cengage Learning. 704.pp. ISBN:978-1-305-50129-4

Lussier, L.R. (2019): Management fundamentals, Concepts, apllications, and skill developmnet. 8th Editon. SAGE Publications. 597.pp. ISBN: 978-1-544-33133-1

**Recommended reading:**

David A. Whetten, Kim S. Cameron (2020): Developing Management Skills, 10th Edition. Pearson

Mandy Flint, Elisabet Vinberg Hearn (2019): The Leader's Guide to Impact: How to Use Soft Skills to Get Hard Results. Pearson

**Knowledge topic: Knowledge of agricultural information systems**

**Credit range (15-20 cr.): 18 cr.**

**Courses: 1) Agricultural Computer Applications, 2) Geospatial Data Analysis, 3) Technical consulting in precision farming, 4) Organization and economics of precision farming, 5 Precision feeding and animal husbandry)**

**Agricultural Computer Applications**

ECTS Credit Points: 4

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

In this course, students will learn about the software packages most commonly used in precision agriculture. The student will learn basic software applications.

1. Excel basics - database management

2. QGIS basics

3. QGIS vector operations - points and lines

4. QGIS vector operations - polygons

5. QGIS raster operations

6 QGIS database operations

7. UAV imagery processing software

8. Vendor-independent precision agriculture software package

9. Elements of expert software

10. Online cloud-based farm management software

11. power and implement monitor basics

12. URH based RTK corrected monitors

13. Internet based RTK corrected monitors

14. Riska cattle management system

**Literature**

Required reading:

Anita Graser (2016): Learning QGIS Third Edition. Packt Publishing. pp: 207. ISBN 978-1-78588-033-9

Gábor Farkas (2017):Practical GIS Packt Publishing. pp: 417. ISBN 978-1-78712-332-8

Recommended reading:

Kurt Menke, Richard Smith Jr., Luigi Pirelli, John Van Hoesen (2015): Mastering QGIS. pp: 420,. ISBN 978-1-78439-868-2

**Geospatial Data Analysis**

ECTS Credit Points: 5

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The general aim of the course is to acquaint students with GIS data, data collection and management methods. During the course the student gets acquainted with the spatial databases with different topics (soil science, topography, hydrometeorology, crop production and animal husbandry, etc.).

The general aim of the teaching of the subject is to acquaint the students with the basic concepts of geoinformatics and to give an insight into the practice of the design and operation of geographic information systems. The student gets acquainted with the most important applications of the GIS in relation to the environmental aspects. During the course, students will be prepared to be able to perform tasks in the fields of general agricultural economics and precision agriculture with a GIS approach and a set of solutions.

1: Subject and classification of surveying and geodesy. Units for measuring length, area and angle. Principle of location. Plane measurement points and their marking.

2. Horizontal plan measurements, horizontal angle measurement. Area surveying (in rectangular and polar coordinate systems), length and distance measurement. The national triangulation network.

3. The principle of leveling, the leveling point network. Base point, longitudinal and cross section leveling. Area leveling, processing of area leveling data.

4. Map and projection knowledge, map orientation.

5. Global Positioning Systems, GNSS network: GPS, Beidou, GLONASS, Galileo systems.

6. Spatial models, spatial concepts. Use raster and vector data models.

7. Structure of GIS data systems.

8. Surface and subsurface spatial database construction and related analyzes.

9. Spatial databases on the Internet, data warehouses, metadata.

10. Thematic maps: data collection and processing, spatial analyzes I .: topography and surface models.

11. Thematic maps: data collection and processing, spatial analyzes II .: hydrometeorological and soil mapping.

12. Construction of field, horticultural and animal husbandry database.

13. Geoinformatics model of one-factor decision making systems.

14. Applied, complex, multifactor decision-making systems.

**Literature**

Required reading:

SIMLEY, J.: GIS for Surface Water: Using the National Hydrography Dataset, Redlands CA, ESRI Press, CROMPVOETS, Joep 2014: Building European Spatial Data Infrastructures, Redlands CA, 2018.

D. SMITH, N. STROUT, C. HARDER, Dr. S. MOORE, T. ORMSBY, T. Balstrøm: Understanding GIS: An ArcGIS Project Workbook, Redlands CA, 2017.

Recommended reading:

<https://www.esri.com/en-us/industries/water/segments/water-resources>

**Technical consulting in precision farming**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The aim of the course is to introduce the planning, technical advice and operational tasks of precision agriculture processes. Students will be able to design, implement and monitor sustainable, environmentally sound precision farming production technologies.

1. The process, procedure and cornerstones of precision advice. Introduction of precision farming on a farm.

2. The importance of data in precision farming

3. The role and use of satellite imagery in precision farming

4. The process of precision soil sampling

5. Surface water management using precision technology

6. Fertility maps as a basis for technological planning

7. Precision soil tillage and deep tillage consulting

8. Precision nutrient management advisory system

9. Precision meteorological station network and the data that can be derived from it

10. Technological background of precision irrigation

11. Machine operation

12. The role of drones in precision farming

13. Precision advisory services systems I.

14. Precision advisory services systems II.

**Literature**

Required reading:

D. Kent Sharon, David E. Clay, Newell R. Kitchen (2020): Precision agriculture basics. American Society of Agronomy. 272 pp. ISBN: 0891183663

Recommended reading:

Zhang Qin (2015): Precision agriculture technology for crop farming. Apple Accademic Press Inc. 374 pp. ISBN: 9781482251074

**Organization and economics of precision farming**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The objective of the course is to provide students with the basic concepts necessary for the economic evaluation of precision farming and in view of the significant investment needs, to enable them to apply the investment analysis in practice. They should be familiar with the importance, advantages and disadvantages of precision technologies and be able to carry out and evaluate economic calculations correctly. They should also be aware of the social and scientific aspects of technology.

1. Introduction to the requirements system, basic concepts of business. TE: Concepts, characteristics, creation, dissolution of enterprises: Classification of types of enterprises Size, activity Structure of the semester, necessary knowledge/ Calculation of production value, costs
2. Basic concepts of production value and cost. TE. Factors determining the value of production, types of yield, types of prices, other factors affecting the value of production. Factors determining the cost of production, types of inputs
3. Cost of production II, Cost of production calculation. TE: Cost of production, categories of cost of production, categories of income, interpretation of its calculation, factors influencing it. Calculation of income, complex exercises on the basic concepts studied so far.
4. Basic concepts related to income, TE: categories of income, how to calculate it, interpretation, factors influencing it.
5. Basic concepts related to efficiency, TE: Categories of economic efficiency, interpreting productivity, demand, supply and income ratios, calculating average, marginal and surplus efficiency Complex exercises related to the basic concepts learnt so far
6. Value chain management: production and service , TE: Characteristics of production and service, areas of production management.
7. Optional test I. Depreciation calculations, Calculations of investment profitability
8. Resources: fixed assets, TE: Categories of fixed assets, economic characteristics of a company. Groups of intangible, tangible and financial fixed assets, characteristics of maintenance and depreciation costs
9. Investment analysis I., TE: The importance of the time value of money, its calculation Calculation of investment economics
10. Investment analysis, the monetary value of time II., TE: Calculating NPV, IRR, PI, DDP, their correlations
11. Resources: current assets, TE: Characteristics of inventories, receivables, short-term financial investments and cash. Examination of factors affecting the need for current assets. Calculations related to current asset management
12. Stock management
13. Basic concepts of human resource management, TE: Human resource management, Understanding human resource management, its influencing factors, understanding the characteristics of wage management.
14. Enterprise planning

**Literature**

Required reading: Slides of the lectures

Recommended reading:

Richard A. Brealey, Stewart C. Myers, Alan J. Marcus: Fundamentals of Corporate Finance Third Edition UNIVERSITY OF PHOENIX. ISBN 0-07-553109-7. McGraw-Hill Primis Custom Publishing (pp. 33-109, 163-201, 339-407, 435-485)

**Precision feeding and animal husbandry**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

One of the biggest challenges of today's livestock farming practice is the lack of adequate labour and the increase in the cost of living labour. Therefore, already at the end of the 1900s, the first sensors appeared that sought to replace employees who worked with inadequate dedication and attention (heat signaling systems in cows). Our knowledge of animal nutrition and the development of sensors, and the IT developments to connect this information, have now made it possible to develop much more complex systems, thereby reducing the demand for a living workforce. Within the framework of the course, students will learn about the physiological basics of precision feeding, the basics of precision animal husbandry technologies, the individual sensors, their operation, their use, and the technologies already used.

1. Protein evaluation systems of farm animals
2. Energy evaluation systems of farm animals
3. Role of bioactive substances and performance enhancers.
4. Modeling physiological processes and production responses
5. Precision compound feed production technologies
6. Precision sensors and technologies
7. Data collection and processing techniques
8. Precision technologies in dairy dairy farming
9. Precision technologies in beef cattle farming and sheepherds
10. Precision pig farming
11. Different use of sensors and techniques in poultry farming
12. Sensors and automatic monitoring systems for horses
13. Sensors and automatic monitoring systems for companion animals
14. Consultation

**Literature**

Required reading:

Berkmans (2022) Avances in precision livestock farming. Burleigh Dodds Series in Agricultural Science: no. 105, UK

E. Van Erp-Van der Kooij (2021) Precision technology and sensor applications for livestock farming and companion animals. Wageningen Academic Publisher, NL

Recommended reading:

Course material, relevant scientific publications.

**Knowledge topic: Remote sensing, geolocation data collection devices**

**Credit range (5-15 cr.): 9 cr.**

**Courses: 1) Precision Agr Data Mapping, 2) Use of Soil and Plant Sensors in Crop Production**

**Precision Agr Data Mapping**

ECTS Credit Points: 4

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

Within the framework of this course, students will learn the basic knowledge and data sources needed to produce thermal maps. They will also learn about different data formats and their conversion into databases. Students will learn the steps to produce differentiated input maps.

1. Geodesy basics, applied projection systems

2. Positioning systems

3. GIS basics

4. Vegetation indices

5. Use of vector-based data sources

6. Interpolation procedures

7. Production of maps from soil sample data with GPS coordinates

8. using vector data for map production

9. production of raster-based satellite and UAV-based maps

10. Production of maps for precision soil sampling

11. Use of yield data for mapping

12. Precision water management mapping

13. Production of soil patch maps based on multiple data sources

14. Use of maps from multiple data sources for input differentiation

**Literature**

Required reading:

Qin Zhang. (2016): Precision Agriculture Technology For Crop Farming. CRC Press, Chapter 2 Sensing Technology for Precision Crop Farming, Chapter 2 Sensing Technology for Precision Crop Farming.; Chapter 7 Site-Specific Nutrient Management; Chapter 8 Precision Water Management ISBN: 978-1-4822-5108-1

Recommended reading:

Hamid Reza Pourghasemi (2019): Spatial Modeling in GIS and R for Earth and Environmental Sciences. Elsevier, pp: 766. ISBN: 978-0-12-815226-3

Marie-Josee Fortin, Mark R. T. Dale (2005): Spatial Analysis, Cambridge University Press. pp: 380. ISBN: 978-0-511-11135-8

Brett Whelan, James Taylor (2013): Precision Agriculture for grain production systems. Chapter 6 Making and interpreting maps for Precision Agriculture. ISBN: 9780643107489

**Use of Soil and Plant Sensors in Crop Production**

ECTS Credit Points: 5

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

In this subject of Soil and Plant Sensors, students will learn about the operation and applicability of proximal and remote sensing sensors used in precision agriculture. During the semester, students also use soil-organic matter, conductivity, pH and other proximity sensors, as well as the processing of sensor data.

**Lecture:**

* 1. Introduction to sensor operation, basics of microcontroller programming
  2. Principle of operation of optical sensors, electromagnetic spectrum, the phenomenon of absorption and reflectance
  3. Structure, the principle of operation and definable soil parameters of optical proximal soil sensors.
  4. Structure, the principle of operation and determinable soil parameters of potentiometric proximal soil sensors.
  5. Operating principle of electrically conductive based soil sensors and definable soil parameters.
  6. Structure and operation of proximal plant sensors
  7. Application of IoT for proximal sensors, possibilities of automation in precision agriculture.
  8. Moving sensor platforms for proximal sensors and their role in precision agriculture
  9. Remote sensing technologies for data collection (satellites, UAVs) in precision agriculture
  10. Organize sensor data and create databases
  11. Basics of GIS
  12. Analysis of soil and vegetation indices and maps
  13. Further Opportunities and Future for the Development of Soil and Plant Sensors
  14. Writing a test

**Practice:**

1-2. Practical application of programming knowledge related to sensor operation

3-4. Establishment and application of a simple soil moisture sensor

5-6. Create and use a simple optical sensor

7-8. Possibilities of connecting the sensors to other devices and connecting them to the Internet

9-10. Processing of data provided by sensors

11-12. Analysis of soil and vegetation maps

13-14. Application of sensors in practice.

**Literature**

Required reading:

Ruth Kerry, Alexandre Escolà, Sensing Approaches for Precision Agriculture, Springer, 2021, ISBN: 978-3-030-78433-1

Alexandru Mihai Grumezescu, New Pesticides and Soil Sensors, Elsevier, 2017, London, United Kingdom, ISBN: 978-0-12-804299-1

Recommended reading:

Ian R. Sinclair Sensors and Transducers, Newnes, Oxford, Great Britain 2001, ISBN: 0750649321

**Knowledge topic: Precision farming technologies**

**Credit range (30-40 cr.): 31 cr.**

**Courses: 1) Agricultural mechanics and robotics, 2) Intro to Precision Agriculture and Lab, 3) Farm Machinery System Management, 4) Climate Risk Management and Precision Agriculture, 5) Crop Management with Precision Farming, 6) Electrical Diagnostics for Farm Machinery, 7) Project work**

**Agricultural mechanics and robotics**

ECTS Credit Points: 3

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The aim of the education is for the students to have the necessary technical knowledge for agricultural production, to get acquainted with the basics of agricultural mechanization: the structure and the operating of the machines, the different types, application areas and conditions of agricultural machines and implements. Students will gain knowledge in robotics and precision technology.

1. Tractors I. - Transmission system

2. Tractors II. - Tractor-implement connection

3. Basics of precision agriculture and robotics

4. Mechanization of tillage

5. Mechanization of nutrient management

6. Mechanization of sowing

7. Technical knowledge of plant protection

8. Mechanization of harvesting

9. Basics of precision animal husbandry

10. Cattle breeding machines, equipment, buildings I. - Dairy farming

11. Cattle breeding machines, equipment, buildings II. - Milking parlors, milking machines, milking robots

12. Cattle breeding machines, equipment, buildings III. - Beef cattle breeding

13. Pig and poultry farming machines, equipment, buildings

14. Sheep and horse breeding machines, equipment, buildings

**Literature**

Required reading:

J. B. Jones (2003): Agronomic handbook – Management of Crops, Soils and Their Fertility. ISBN 0-8493-0897-6

**Intro to Precision Agriculture and Lab**

ECTS Credit Points: 4

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

Students will acquire a basic knowledge of precision agriculture. They will learn about the concept of precision agriculture, its development, characteristics, technical conditions, technological elements, economic and environmental impact. Students will gain an insight into the operation of a field crop farm where all the elements of precision farming are applied.

1. Definition and characteristics of precision farming

2. Comparison of conventional and precision farming

3. Positioning and navigation systems

4. Soil mapping

5. Technical background of precision farming

6. Precision farming technologies

7. Precision growing of vegetables, vines and fruit

8. Precision livestock production

9. Use of drones in precision farming

10. Economic impact of precision farming

11. Environmental impacts of precision farming, climate risk mitigation

12. Precision farming prevalence and practices in foreign countries

13. Case study of a precision farming enterprise

14. Future perspectives of precision farming

**Literature**

Required reading:

D. Kent Sharon, David E. Clay, Newell R. Kitchen (2020): Precision agriculture basics. American Society of Agronomy. 272 pp. ISBN: 0891183663

**Farm Machinery System Management**

ECTS Credit Points: 5

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The aim of teaching the subject is to acquaint students with machines, equipment and buildings of crop production. By completing the subject, students will be able to operate and participate in the operation of plant production works through their theoretical and practical knowledge

1. Mechanical works, tractors and implements of crop production farms I.

2. Mechanical works, tractors and implements of crop production farms II.

3. Organizational aspects of agricultural farms I.

4. Organizational aspects of agricultural farms II.

5. Maintenance, repair and storage of agricultural machinery I.

6. Maintenance, repair and storage of agricultural machinery II.

7. Typical costs of machine operation I.

8. Typical costs of machine operation II.

9. Legal conditions of machine operation affecting machines and machine stores I.

10. Legal conditions of machine operation affecting machines and machine stores II.

11. Personal legal conditions of machine operation I.

12. Personal legal conditions of machine operation II.

13. Operating characteristics of precision agriculture, documentation I.

14. Operating characteristics of precision agriculture, documentation II.

**Literature**

Required reading:

D. Kent Sharon, David E. Clay, Newell R. Kitchen (2020): Precision agriculture basics. American Society of Agronomy. 272 pp. ISBN: 0891183663

J. Stafford, A. Werner (2003): Precision Agriculture, Wageningen Academic Publishers ISBN: 9789076998213

**Climate Risk Management and Precision Agriculture**

ECTS Credit Points: 4

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

At present, adverse weather extremes, drought and water scarcity caused by climate change are critical constraints to crop growth and development, yields and quality worldwide. The aim of this course is to provide students with a comprehensive understanding of the impact of climate change on crop production. They will learn about soil and crop sensors that can be used to predict adverse weather impacts. Learn about new technological processes and innovations to optimize production costs and reduce climate risk.

1. climate change - water use efficiency, drought tolerance

2 Climate change - heat stress

3 Climate change - soil fertility

4. soil and plant sensors in precision agriculture I.

5. Soil and plant sensors in precision farming II.

6. Plant biology responses to water scarcity - stomatal conductance

7. Plant biology responses to water deficit - leaf temperature

8. Plant biology responses to water deficit - leaf area change

9. Plant biology responses to water deficit - chlorophyll decline

10. Drought and heat stress interaction responses - phenological phases

11. Precision technologies for climate change mitigation I.

12. Precision technology solutions for climate change mitigation II.

13. Use of location-based systems

14. Practical experience with soil and plant sensors in precision maize production

**Literature**

Required reading:

Nagy J. Maize Production 2008. Akadémia Kiadó. ISBN: 9789630586368

Pepó P. – Csajbók J. 2013. Integrated Crop Production. University of Debrecen, Service Sciences Methodology Centre

Nagy J – Rátonyi T. 2013. Soil Cultivation and Land use. University of Debrecen, Service Sciences Methodology Centre

Recommended reading:

Birkás M. 2017. Földművelés és földhasználat. Mezőgazda Kiadó, Budapest.

Huzsvai L.–Rajkai K.–Szász G. 2004. Az agroökológia modellezéstechnikája. Egyetemi jegyzet. Debrecen.

Nagy J. (szerk.): 2021. Kukorica. A nemzet aranya. Élelmiszer, takarmány, bioenergia. Szaktudás Kiadó, Budapest.

Ángyán I. – Menyhért Z. 1997. Alkalmazkodó növénytermesztés, ésszerű környezetgazdálkodás. Mezőgazda Kiadó, Bp.

Berzsenyi Z. 2013. Növénytermesztés. Környezeti, növekedési és termésreakciók. Agroinform Kiadó, Budapest.

**Crop Management with Precision Farming**

ECTS Credit Points: 5

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

The general aim of teaching the subject is to provide a comprehensive understanding of the current situation, expected directions, and need for precision agriculture. Students will acquire the latest theoretical and practical knowledge in the application of precision and site-specific technologies. We present the latest modern technologies in a variety of ways, guidance and automatic steering systems for site-specific and chlorophyll content based nutrient replenishment. The course introduces the precision field and horticulture plant protection, precision sowing and demonstrates fleet management systems.

1. The future of crop production. The concept of precision crop production.

2. Comparison of conventional and precision crop production.

3. Basic principles of satellite positioning.

4. How gps works, how dgps works.

5. Basic concepts of GIS.

6. Operations with spatial objects.

7. Spatial heterogeneity in crop production.

8. Power and implement optimization in precision crop production.

9. Precision soil sampling in crop production.

10. Precision sowing technology technologies in crop production.

11. Precision nutrient management in crop production.

12. Precision plant protection in crop production.

13. Precision technological elements in the harvesting of field crops.

14. Determining the heterogeneity of crop elements

**Literature**

Required reading:

D. Kent Shannon, David E. Clay, Newell R. Kitchen (2018): Precision Agriculture Basics. 265. p. Print ISBN:9780891183662 Online ISBN:9780891183679 |DOI:10.2134/precisionagbasics, American Society of Agronomy Crop Science Society of America Soil Science Society of America

Recommended reading:

Hermann J. Heege (2013): Precision in Crop Farming. 356 p. ISBN: 9400767595. Springer

**Electrical Diagnostics for Farm Machinery**

ECTS Credit Points: 5

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

Type of exam: colloquium

Requirements:

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

- for a grade: written exam

**Summary of content**

Within the framework of the course, the student will learn about the diagnostic methods and procedures of the instruments used in precision agriculture. This knowledge is essential for future agricultural production. The aim of the course is to summarise the basic measurement and diagnostic knowledge and concepts that the student will encounter in his future working environment.

The student will gain a basic understanding of the construction of precision instruments and the operating processes and communication channels of the various sensor systems. During the course of the training, the student will develop his/her knowledge of data collection, data processing and data analysis, which will also be essential in his/her future work, as it will contribute to the identification and solution of possible technical-informatics problems

1. Basic knowledge of metrology

2. Basic mechatronics

3. Electronic measuring instruments

4. Digital measuring instruments

5. Basics of diagnostics

6. Diagnostic systems and their communication

7. Advanced testing and diagnostic tools and methods

8. Data collection methodology

9. Data collection tools

10. Data transmission tools

11. Data storage tools

12. Data analysis and evaluation using artificial intelligence

13. Data archiving

14. Quality management systems, knowledge of standards

**Literature**

Required:

Atkinson Jack (2020): Agricultural Machinery and Technologies. Larsen & Keller Education ISBN9781641724418 Tom Denton 2017: Automobile Electrical and Electronic System ISBN: 9780415725774- Tom Denton 2020: Advanced Automotive Fault Diagnosis ISBN: 9780367330521  
Bonnic Allan 1998: Vehicle Electronic Systems and Fault Diagnosis ISBN: 9780415503013

**Project work**

ECTS Credit Points: 5

14 hour(s) lecture and 56 hour(s) seminar per semester

Type of exam: practical grade

Requirements:

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

- for a grade: written exam

**Summary of content**

Within the framework of the course, the student will learn about the diagnostic methods and procedures of the instruments used in precision agriculture. This knowledge is essential for future agricultural production. The aim of the course is to summarise the basic measurement and diagnostic knowledge and concepts that the student will encounter in his future working environment.

The student will gain a basic understanding of the construction of precision instruments and the operating processes and communication channels of the various sensor systems. During the course of the training, the student will develop his/her knowledge of data collection, data processing and data analysis, which will also be essential in his/her future work, as it will contribute to the identification and solution of possible technical-informatics problems

1. Basic knowledge of metrology

2. Basic mechatronics

3. Electronic measuring instruments

4. Digital measuring instruments

5. Basics of diagnostics

6. Diagnostic systems and their communication

7. Advanced testing and diagnostic tools and methods

8. Data collection methodology

9. Data collection tools

10. Data transmission tools

11. Data storage tools

12. Data analysis and evaluation using artificial intelligence

13. Data archiving

14. Quality management systems, knowledge of standards

**Literature**

Required reading:

Nagy, János és Rátonyi, Tamás (2013): Soil Cultivation and Land Use University of Debrecen, Service Sciences Methodology Centre pp: 159.

Pepó, Péter Csajbók, József (2013): Integrated Crop Production I. & II. & III

**Other compulsory subjects: Language training**

**Credit range (6 cr.): 6 cr.**

**Courses: 1) Technical foreign language I., 2) Technical foreign language II.**

**Professional Language Skills I.**

ECTS Credit Points: 3

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

Type of exam: practical grade

Requirements:

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

- for a grade: written exam

**Summary of content**

The general aim of the internship is to provide students with knowledge corresponding to the level of the complex secondary language examination defined by the Common European Framework of Reference (CEFR) in all four main language skills. At this level, the language user can understand the main message and important information of more complex general and technical texts. Able to compose detailed and clear texts orally and in writing on the required general and professional language topics. In order to achieve these goals, during the course, students will acquire a significant vocabulary on the general topics required for the language exam, as well as become acquainted with the most important agricultural specializations in a foreign language and acquire the specific vocabulary of the field.

In the first semester, students review, practice, and deepen the structures that form the backbone of English grammar, which are necessary for further professional language studies and to enable students to participate effectively in conversation on general and subject-related topics at the end of the course. Among the language skills, special emphasis is placed on the comprehension of written and audible text, the development of speaking skills and writing skills.

1. Level assessment, orientation, introduction, professional goals
2. Systematic overview of verb tenses Family 1. external, internal properties, characterization
3. Practice of verb tenses, Family holidays, Historical overview of agriculture 1.
4. Practice of verb tenses, Comparison of place of residence, types of dwellings, comparison of urban-rural existence, Historical overview of agriculture 2.
5. Passive structure, Housing, household costs, housing, housing equipment, Historical overview of agriculture 3.
6. Passive structure, Work 1. (prestige of works, fashionable professions), Sectors of Hungarian agriculture
7. Mid-term test, assessment of the knowledge and skills acquired so far (business) correspondence required for the language exam: inquiry, request for quotation
8. Auxiliary verbs 1., Work 2. (mental and physical work, unemployment), Energy, agricultural equipment and machinery
9. Mode Aids 2., Job 3., Job Interviews, Energy, Agricultural Equipment and Machinery
10. Conditional Modals 1, Learning 1. (Continuing Education Plans, School Experiences), Renewable Energy Sources 1.
11. Conditional Modals 2, Learning 2. (schooling traditions, school types), Renewable Energy Sources 2.
12. Reported speech 1., Agenda, Environment 1.
13. Reported speech 2., Environmental protection 2., Writing a letter from friends and readers
14. End-of-semester test, written and oral assessment of knowledge and skills acquired during the semester

**Literature**

Oxford Exam Excellence. CUP, 2006

Channel your English.Upper- intermediate, MM Publication

Jones: New Progress to First Certificate. CUP 1997

To the Top 3, MM publication

Neil O’ Sullivan, James D. Libbin:Career path: Agriculture Express Publishing 2011. 40 oldal, ISBN: 978-1-78098-378-3

Online materials: www.bbc.com , www.agendaweb.org, www.nationalgeographic.com

**Professional Language Skills II.**

ECTS Credit Points: 3

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

Type of exam: practical grade

Requirements:

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

- for a grade: written exam

**Summary of content**

The general aim of the exercise is to lay the foundations for achieving the level of the intermediate general language test set by the Common European Framework of Reference (CEFR) in reading, writing, speaking and listening comprehension. At this level, the language user can understand the main message and more important information of more complex texts (including technical texts). Able to create detailed and clear text on expected topics. He is constantly communicating with his native-speaking partner, uses general and professional language vocabulary appropriately, can argue, express opinions, and take a stand.

1. Exercise of B2 level complex test language exam tasks, Comprehension of written and heard text, speaking skills, writing skills
2. Repetition and practice of grammatical elements reviewed in the first semester, Leisure 1. (hobby, keeping pets), Soils, soil science
3. Infinitive Leisure 2. (cinema, theater, concerts, exhibitions, reading), Cereal production in different parts of the world
4. Gerund, Leisure 3., Sports, Grain growing in different parts of the world
5. Comparison of Infinitive and Gerund, Telecommunications (mobile phone, computer), Horticulture, vegetable and fruit producing
6. Infinitive and gerund structures, exercise, Meal 1., Gardening, vegetable and fruit growing
7. Mid-term test, assessment of the knowledge and skills acquired so far required for the language exam, (business) correspondence: complaint letter, reply to complaint letter
8. Participle 1., Healthy Eating, Recipes, Application of Agricultural Technologies 1.
9. Participle 2., Healthy lifestyle, Use of agricultural technologies 2.
10. Relevant adverbs, relevant pronouns, Diseases, at the doctor, Application of agricultural technologies 3.
11. Adjective adverbs (target adjectives, adjectives and permissive adverbs), Services 1., Plant protection
12. Nouns, pronouns, Services 2., Genetics, GMO food
13. Adjectives, enhancement, summary, practice, Repetition and practice of general and professional topics taken during the semester, situational dialogues, student's independent topic
14. End-of-semester test, written and oral assessment of knowledge and skills acquired during the semester

**Literature**

Tímár Eszter: Words, words, words. Tematikus angol szókincsgyűjtemény. Nemzeti Tankönyvkiadó

Norman Coe, Mark Harrison, Ken Paterson : Oxford Angol Nyelvtan

Andrew Jenkins-Murphy: Language of Agriculture

Némethné Hock Ildikó:1000 questions, 1000 answers. Társalgási gyakorlatok az angol „A” típusú

nyelvvizsgákhoz

Oxford Exam Excellence. CUP, 2006

Channel your English.Upper- intermediate, MM Publication

Jones: New Progress to First Certificate. CUP 1997

To the Top 3, MM publication

Neil O’ Sullivan, James D. Libbin: Career path: Agriculture Express Publishing 2011. 40 oldal, ISBN: 978-1- 78098-378-3

Online materials: www.bbc.com , www.agendaweb.org, www.nationalgeographic.com

**Knowledge topic: Optional courses**

**Credit range (min. 10 cr.): 10 cr.**

**Courses: 1) Precision vegetable production, 2) Operation of agricultural drones, 3) Maize production, 4) Plant production decision support models, 5) Environmental risk analysis and impact assessment,**

**6) Precision tillage and sowin, 7) Adaptive tillag, 7) Data sources in precision agriculture**

**Precision vegetable production**

ECTS Credit Points: 2

14 lecture / 14 seminar pemester, and the total number: 28 hours in the given semester.

Type of exam: practical grade

Course classification: optional

Requirements:

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

**Summary of content :**

Possibilities of using site-specific information technology tools based on GPS positioning in vegetable production. Knowledge of soil properties to select the right place to grow, adapting to the needs of the given vegetable species. Site-specific agrotechnical interventions for different crop species to ensure sustainability and profitability.

1. The concept of precision vegetable production. The role of information in precision farming
2. Precision Horticultural Technologies - Precision Farming and Biological Foundations
3. Product specifications for precision vegetable seeds. Tasks and objectives to be solved in precision vegetable production
4. From soil preparation to harvest - tillage, sowing (plant number control, sowing depth maintenance), nutrient replenishment
5. Precision plant protection - weed sampling (weed patches, weed maps); weed detection systems, site-specific, infection-proportional spraying system, plant detection systems (drones, robots)
6. Harvest - production of yield maps; moisture content measurements; quality mapping,
7. Precision horticultural methods for more efficient vegetable production
8. Precision technological methods in the cultivation of leafy vegetables
9. Application of precision technologies in the cultivation of root vegetables
10. Precision technological methods in the cultivation of onions and legumes
11. Precision technological methods in the cultivation of Cucurbitaceae species
12. Precision technological methods in the cultivation of sweet corn
13. Use of precision tools in vegetable sprouting
14. Precision technological methods in the field and greenhouse cultivation of tomatoes and peppers

**Literature:**

- Kaushik, P. Precision Vegetable Farming Technologies: An Update. DOI: http://dx.doi.org/10.5772/intechopen.97805

Recommended reading:

- Addicott JE (2020) The Precision Farming Revolution. In: The Precision Farming Revolution. Springer, pp 1-35

- R. Shamshiri R, Weltzien C, Hameed IA, J. Yule I, E. Grift T, Balasundram SK, Pitonakova L,

- Ahmad D, Chowdhary G (2018) Research and development in agricultural robotics: A perspective of digital farming. 1-14. https://doi. org/10.25165/j.ijabe.20181104.4278

**Operation of agricultural drones**

ECTS Credit Points: 2

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

Type of exam: practical grade

Course classification: optional

Requirements:

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

- for a grade: written exam

**Summary of content :**

The aim of teaching the subject is to acquaint students with the theoretical and practical knowledge related to the operation of agricultural drones. By completing the subject, students will be able to operate agricultural drones, plan fly missions, and evaluate results through their theoretical and practical knowledge.

1. Introduction to precision agriculture and imaging technology
2. Drone regulation, legal background, personal conditions required for UAV application
3. Types and structure of drones
4. Sensors and cameras required for agricultural drone image capture
5. Background knowledge of the preparation of monitoring plan
6. Vegetation indexes (bNDVI, GNDVI, TrueNDVI, TrueNDRE)
7. Possibilities of stitching the images taken during the recordings, operation of the programs used for stitching
8. The role of satellites in imaging
9. The basic conditions and settings for taking orthophotos
10. UAV route planning programs and knowledge for optimal selection
11. Orthophoto Data Processing I. (Sentera Fieldagent)
12. Orthophoto data processing II. (QGIS)
13. Orthophoto data processing III. (other programs)
14. The process of evaluating orthophotos

**Literature:**

Required reading: Felipe G. T., Antonio T. 2018. UAV-Based Remote Sensing Vol. 2. MDPI. ISBN 978-3-03842-856-5

Recommended reading: S. Liang, X. Li, J. Wang 2012. Advanced Remote sensing. ISBN: 978-0-12-385954-9

**Maize production**

ECTS Credit Points: 2

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

Type of exam: practical grade

Course classification: optional

Requirements:

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

- for a grade: written exam

**Summary of content :**

The aim of the course is to familiarise students with the importance of maize cultivation in the world economy, its domestic production and its potential uses. To learn about the morphology and development of maize. To learn the technology of precision maize cultivation and to be able to apply the technological elements and methods at a proficient level. Gain additional knowledge of the ecophysiological relationships of precision maize nutrient and water supply.

1. present and market of maize production

2. origin and history of maize cultivation

3. morphology and development of maize

4. the potential for maize improvement using traditional and precision methods

5. The importance of maize seed production

6. Climate and soil requirements of maize

7. Precision farming techniques: rotation, monoculture,

8. Precision farming techniques: sowing, plant number

9 Precision farming: fertilisation

10. precision farming: plant care, harvesting

11. Irrigation of maize

12. quality parameters (moisture, starch, protein, oil content)

13. drying, storage and processing of maize

14. summary and practical approach to the whole growing cycle

**Literature**

Required reading:

C. Wayne Smith (Editor), Javier Betrán (Editor), Edward C. A. Runge (Editor): Corn: Origin, History, Technology, and Production. John Wiley & Sons, Inc. 2004 p: 968, ISBN: 978-0-471-41184-0

Nagy J. Maize Production 2008. Akadémia Kiadó. ISBN: 9789630586368

**Plant production decision support models**

ECTS Credit Points: 2

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

Type of exam: practical grade

Course classification: optional

Requirements:

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

- for a grade: written exam

**Summary of content :**

The subject matter includes an introduction to the structure of plant growth models, their data requirements and the importance of their application in the process of scientific understanding. The immediate aim of simulation crop production models is to describe the processes of a complex soil-plant-atmosphere system using mathematical tools and to simulate them using computers. The main advantage of simulation models is that they can be used to approximate processes within a complex system or to describe interactions between complex systems. The models allow the chronological monitoring of biomass, grain weight, leaf area, leaf number and phenophases for a given soil, nutrient supply and climate conditions. The main objective of the course is to present these models, their databases and their applications in the context of sustainability and precision farming technology.

1. Physical and biological processes of the soil-plant-atmosphere system
2. Development, history and structure of plant growth models (general part); importance of decision support models
3. Structure of plant growth models and their data requirements
4. radiative energy and mass transfer in soil, inside and above the plant stand; photosynthesis; plant evapotranspiration, plant water requirements
5. Field measurements for the data requirements of the models, validation of the models
6. climate change and plant growth: incorporation of climate models, their application in plant physiology models
7. the relationship between tillage, sowing, plant care and harvesting: physiological impact of agrotechnology on the growth and development of crops, taking into account model results
8. model applications in precision farming, Application and use of sensor technology, remote sensing and IoT systems in models
9. Case study: studying the growth and development of a maize hybrid given different input data
10. Case study: study of the growth and development of a wheat variety under different input conditions
11. 12-14: Exercise: data processing in models

**Literature**

Recommended reading:

Castrignano, A., Buttafuoco, G., Khosla, R., Mouazen, A., Moshou D., Naud, O. 2020. Agricultural Internet of Things and Decision Support for Precision Smart Farming.Academic Press.

Hoogenboom, G., Jones, J. W., Porter, C. H., Wilkens, P. W., Boote, K. J., Hunt, L. A. ,Tsuji, G. Y. (2010): Decision Support System for Agrotechnology Tranfer (DSSAT) Version 4.5 (CD-ROM), volume 1. Overview. University of Hawaii, Honolulu. Hoogenboom, G., Jones, J., Porter, C. H., Wilkens, P. W., Boote, K. J., Batchelor, W. D., Hunt, L. A., Tsuji, G. Y. (2003): Decision Support System for Agrotechnology Transfer (DSSAT) Version 4.0, volume 1. Overview. University of Hawaii, Honolulu.

**Environmental risk analysis and impact assessment**

ECTS Credit Points: 3

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

Type of exam: practical grade

Course classification: optional

Requirements:

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

- for a grade: written exam

**Summary of content :**

Fulfilling the course, students will know the potential sources of environmental risks, factors determining and controlling the exposition and transport processes within the ecological systems, and the methodology of environmental risk analysis, assessment and management. The students will be familiar with the EU legislation related to use of environment, and risk assessment for the sectors of agriculture, and the relevant best available techniques, to understand the environmental aspects of precision agriculture.

1. Physical and biological processes of the soil-plant-atmosphere system
2. Development, history and structure of plant growth models (general part); importance of decision support models
3. Structure of plant growth models and their data requirements
4. radiative energy and mass transfer in soil, inside and above the plant stand; photosynthesis; plant evapotranspiration, plant water requirements
5. Field measurements for the data requirements of the models, validation of the models
6. climate change and plant growth: incorporation of climate models, their application in plant physiology models
7. the relationship between tillage, sowing, plant care and harvesting: physiological impact of agrotechnology on the growth and development of crops, taking into account model results
8. model applications in precision farming
9. 9 Application and use of sensor technology, remote sensing and IoT systems in models
10. Case study: studying the growth and development of a maize hybrid given different input data
11. Case study: study of the growth and development of a wheat variety under different input conditions
12. 12-14: Exercise: data processing in models

**Literature**

Required reading:

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> Recommended reading:

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>

**Precision tillage and sowing**

ECTS Credit Points: 3

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

Type of exam: practical grade

Course classification: optional

Requirements:

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

- for a grade: written exam

**Summary of content :**

Students will learn about soil conservation and how to mitigate the effects of climate change on crops. They will learn about the relationship between site specificities and precision farming conditions. They will learn about precision farming technologies and the associated operations.

1. The role of soil in precision farming.
2. Determination of soil heterogeneity in the field and soil management solutions.
3. Soil management objectives. Operational elements and procedures of soil tillage. Factors affecting tillage quality and changes in soil condition.
4. Tillage and maintenance. Basic tillage.
5. Conventional and moisture-saving tillage systems.
6. Melioration tasks in soil cultivation, the need for deep tillage of soils and how to implement it.
7. Strip tillage and seeding.
8. Precision methods of sowing.
9. Variable rate drilling, intercropping and depth delimitation.
10. Soil cultivation in the crop stand, intercropping
11. Precision solutions for soil improvement, level cultivation.
12. Learning practical solutions and applications.
13. Technical solutions for precision tillage.
14. Application of sensor technology to support precision seeding.

**Literature**

Required reading:

Pekrun C, Kaul H.P, Claupein W. (2003) Soil Tillage for Sustainable Nutrient Management. In: El Titi (ed) Soil tillage in Agroecosystems. CRC Press, Boca Raton. ISBN: 13: 978-0849312281

Coughenour C.M., Chamala S. (2000) Conservation Tillage and Cropping Innovation. Iowa State University Press, Ames, Iowa. 360 pp. ISBN: 978-081381947

Rattan Lal, Stewart B.A. Soil-Specific Farming. CRC Press. 400pp. ISBN: 978-1-4822-4534-9

**Adaptive tillage**

ECTS Credit Points: 3

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

Type of exam: practical grade

Course classification: optional

Requirements:

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

- for a grade: written exam

**Summary of content :**

Students will gain knowledge on how to improve and protect soil quality and the interrelationship between site, mechanisation and management conditions. They will learn the technological methods of soil cultivation to create soil conditions for safe crop production and to mitigate the adverse effects of climate change. They will learn about degradation processes that threaten soil conditions, methods of soil condition assessment, the characteristics of conventional and adaptive conservation tillage, their effects on soil and the environment, and tillage methods to prevent environmental damage.

1. The concept, purpose, function and importance of soil cultivation. Soil degradation processes that threaten soil
2. Relationship between tillage and soil condition
3. Soil testing tools and methods for planning and testing the quality of soil cultivation
4. operational elements and procedures of soil tillage
5. Traditional tillage systems and their characteristics
6. Adaptive, environmentally friendly tillage systems and their characteristics
7. New tillage trends and systems
8. guidelines for the cultivation of areas subject to erosion and deflation
9. guidelines for the cultivation of brown forest soils and chernozem soils
10. Guidelines for the cultivation of saline and grassland soils
11. guidelines for the cultivation of extreme skeletal and moorland soils
12. Moisture-saving tillage systems
13. Aspects of planning and implementing deep tillage
14. Precision tillage management and implementation

**Literature**

Required reading:

Birkás M. (2014): Book of soil tillage. Szent István University Press, Budapest. 322 pp. ISBN: 978-963-269-447-4

Recommended reading:

Coughenour C.M., Chamala S. (2000) Conservation Tillage and Cropping Innovation. Iowa State University Press, Ames, Iowa. 360 pp. ISBN: 978-081381947

**Data sources in precision agriculture**

ECTS Credit Points: 3

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

Type of exam: practical grade

Course classification: optional

Requirements:

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

- for a grade: written exam

**Summary of content :**

The student will become familiar with the available data sources and data formats in precision farming and learn the basics of precision agriculture database management.

1. GNSS data usability
2. Manual measurement data with GNSS coordinates
3. Historical table data
4. installed ground sensor data
5. Installed crop sensor data
6. Laboratory plant and soil data
7. Force and implement data
8. crop quality data from harvester
9. UAV data
10. Satellite data
11. Contact and non-contact soil scanner data
12. meteorological data in precision agriculture
13. Data integration in precision agriculture
14. Animal farm data

**Literature**

Required reading:

Qin Zhang. (2016): Precision Agriculture Technology For Crop Farming. CRC Press, Chapter 2 Sensing Technology for Precision Crop Farming, Chapter 2 Sensing Technology for Precision Crop Farming.; Chapter 3 Data Processing and Utilization in Precision Agriculture ISBN: 978-1-4822-5108-1

Brett Whelan, James Taylor (2013): Precision Agriculture for grain production systems Chapter 3 Hardware for Precision Agriculture., Chapter 5 Data management for Precision AgricultureISBN: 9780643107489

Recommended reading:

Krishna K.R. (2013): Precision Farming Soil Fertility and Productivity Aspects ISBN: 978-1-4665-7829-6

Hermann J. Heege (2013): Precision in Crop Farming Site Specifi c Concepts and Sensing Methods: Applications and Results pp: 361 ISBN 978-94-007-6760-7

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