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| **Title and code** of the subject: **Agricultural engineering, precision agricultural systems and technologies**  | **ECTS Credit Points: 3** |
| **Type** of the subject: compulsory |
| **Ratio of theory and practice:** (credit%) 30/70 |
| **Type and number of classes per semester**: 14 hour(s) lecture and 28 hour(s) practice per **semester** Number of teaching hours / week : 1 +2 (lecture and practice) |
| **Type of exam**: **exam** |
| **Subject in the curriculum:** semester 3 |
| Preliminary requirements: *The individually prepared reports during the practice, fulfillment of a complex precision management task. The condition for obtaining the signature is the attendance of the exercises solving an independent, complex practical precision farming task.* |

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| **Summary of content - theory**:  |
| Course objectives:The main aim of this course is to acquire theoretical and practical skills of precision agriculture. Students learn the precision technologies of data collection, data integration, and spatial decision support methods, including precision arable agriculture, precision horticulture and precision livestock farming. Students will be qualified for the application of the precision agriculture principles in environmental management and/or agriculture.1. Historical and theoretical background of precision agriculture. Parts and integration of precision agriculture into the practice.
2. Reasons of spatial variability in agriculture
3. Global Positioning System and its complementary systems
4. The role of GIS in precision agriculture
5. Usability of remote sensing data in precision agriculture
6. Databases, data infrastructure and map servers
7. Sensors, monitors, additional instruments
8. Precision plant protection
9. Precision nutrient management
10. Precision water management
11. Precision horticultural
12. Precision animal husbandry
13. Yield monitoring, site specific information after harvest
14. Economical aspects of precision agriculture
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| **Summary of content - practice**: |
| Students use spatial data from different data acquisition devices and mapping the soil and vegetation spatial and temporal heterogeneity by GIS software and evaluate the maps. Created maps could help in decision support in precision agriculture.An important part of the practice is that student learn the most relevant members of Hungarian precision agricultural corporations and their locations throughout the world. Student can visit the service and the precision agriculture tools of the integrators, which can be provided for farmers.1. Job computer – tractor mounted sensors – big data
2. Database management
3. Spatial heterogeneity in self-created digital maps I.
4. Spatial heterogeneity in self-created digital maps II
5. Spatial heterogeneity in self-created digital maps III.
6. Geo-statistically examination for more effective decision support
7. Processing of airborne survey (LiDAR and spectral remote sensing) data for precision agriculture I.
8. Processing of airborne survey (LiDAR and spectral remote sensing) data for precision agriculture II.
9. Processing of airborne survey (LiDAR and spectral remote sensing) data for precision agriculture III.
10. Processing of satellite remote sensing data for precision agriculture I.
11. Processing of satellite remote sensing data for precision agriculture II.
12. Processing of satellite remote sensing data for precision agriculture III.
13. Field exercise/farm visit I.
14. Field exercise/farm visit II.
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| **Literature, handbooks in English**  |
| Brase, T. (2005): Precision agriculture. Delmar Cengage Learning. 1st edition. 288 p.Kennedy, H. (2009) Introduction to 3D Data: Modelling with ArcGIS 3D Analyst and Google Earth. Wiley. 360 p.Kennedy, H. (2009) Introduction to 3D Data: Modelling with ArcGIS 3D Analyst and Google Earth. Wiley. 360 p.Qin, Z. (2015): Precision Agriculture Technology for Crop Farming. Taylor & Francis. 374 p.Srinivasan, A. (2006): Handbook of precision agriculture: Principles and applications. CRC Press. 683 p. (ISBN: 978-156-022-954-4)Tamás, J. (2011): Precision Agriculture. University of Debrecen. Centre for Agricultural and Applied Economic Sciences. Debrecen. 126 p. (<http://www.tankonyvtar.hu/hu/tartalom/tamop425/0032_precizios_mezogazdasag/adatok.html> |
| **Competencies gained** *(acc. to the Regulation on training and outcome requirements)* |
| 1. **Knowledge:**

- Has a high level of natural sciences and technical knowledge necessary for the operation of agricultural water management.- Know the applicability and the legal regulation of the latest agricultural water management technologies and procedures.- Acknowledges in detail the characteristics of agricultural water management and processes, recognizes the existing relationships among them.1. **Skills:**

- They are able to apply and further develop the latest agricultural water management technologies and processes- They are able to independently interpret and apply legislation related to his/her professional activity.- Capacity to analyse and evaluate agri-business and related sectors- Have the knowledge in a written and oral communication in Hungarian and foreign languages.1. **Attitude:**

**-** They are committed to environmental protection and a sustainable agricultural economy.- Recognize professional values, responsive to the application of effective methods and tools- Open and responsive to the knowledge and practical application of modern and innovative processes1. **Autonomy and responsibility:**

- Equal partner in professional and specialist co-operation.- Represent special science and is engaged to keep the ethical rules of engineering and environment of his/her field. |

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| **Responsible lecturer: Prof. János Tamás** |
| **Other lecturer(s): Dr. Bernadett Gálya** |

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| **Terms of course completion:** |
| 1. Completing assignments / exercises
2. Submitting essay
3. Giving presentation
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| **Form of examination:** |
| written exam |
| **Requirement(s) to get signature:** |
| Active participation in lectures and exercises, is a successful fulfilment of the tasks defined by the lecturer. |

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| **Exam questions:** |
| 1. Compare precision agriculture with traditional agriculture.
2. What is the main reasons of spatial variability in agriculture
3. Global Positioning System and its complementary systems
4. The role of GIS in precision agriculture
5. Usability of remote sensing data in precision agriculture
6. Sensors, monitors in soil sampling and cultivation
7. Sensors, monitors in sowing
8. Sensors, monitors in precision plant protection
9. Sensors, monitors in precision nutrient management
10. Sensors, monitors in precision water management
11. Sensors, monitors in precision horticultural and greenhouse technics
12. Sensors, monitors in Precision animal husbandry
13. Sensors, monitors in yield monitoring, site specific information after harvest
14. Economical aspects of precision agriculture
15. Job computers in precision agriculture
16. Geostatistics in precision agriculture
17. Time series analysis in precision agriculture
18. Decision supporting software in precision agriculture
19. Virtual reality in precision agriculture
20. Trend of robotics in precision agriculture
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