University of Natural Resources and Life Sciences, Vienna

Curriculum

Advanced technologies in smart crop farming

Programme classification no Cat.III

Vienna 2018

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1 Qualification profile

1.1 Course overview

The continuing education short programme „Advanced technologies in smart crop farming" is a single certificate course that provides multidisciplinary education necessary to develop knowledge and skills in the utilization of advanced digital technology that monitors and optimizes agricultural production processes. The holistic approach of the programme provides participants with an opportunity to develop their individual competences for critical thinking, communication and working in teams, as well as problem solving skills. The course examines the concept of precision farming and provides an introduction of advanced technologies available to support precision farming covering tools and applications in GIS, remote sensing and variable rate technology. Through lectures and practical demonstrations the course examines processes of precision agriculture covering data collection, data analysis and analysis applications and provides highly specialized knowledge to the graduate for integrating of advanced technologies in smart crop farming appropriate to specific environment conditions and management practices.

Based on modern teaching and teaching methods through a balanced combination of theory-oriented and practice-oriented units, the certificate course provides adequate learning outcomes:

- Knowledge – the graduate will acquire highly specialized knowledge of control systems for the automation in agriculture, knowledge of data structures and network systems and will be able to define the science of site–specific farming and their benefits.
- Skills – the graduate will be able to:
    - Develop and apply proprietary technology in plant systems as well as in the automation and control of interpret, integrate and transmit the theoretical and methodological concepts required for the use of GIS and remote sensing techniques including discrimination and categorization of geospatial data according to their nature, conversion procedures and advanced processing techniques.
    - Integrate GIS tools and functions to store, manage, analyse and process geospatial data in order to extract relevant information for decision making.
- Competencies – The graduate will be able to:
    - Generate, assess, evaluate and manage data coming from crop production as well as soil and water resources in order to improve agricultural production efficiency through efficient and economical use of resources.
    - Use the sources of scientific and technical information in an efficient manner to develop research skills in the mentioned topics above
    - Handle complex contents and carry out a specific application of digitalization methodology in an agricultural process

1.2 Professional qualification

By completing the certificate course, the graduates acquire the comprehensive practical knowledge necessary for the application of geographical information systems in agricultural as well as the utilization of innovative smart systems in agriculture. The graduates will find career prospects and potential job opportunities in the high-tech agricultural sectors, technical consultancy, Government and international agencies, agronomy, farm management and agricultural engineering. The qualification will have a positive impact on promotions of the graduates within their current companies and will improve job opportunities in this sector as higher qualified professionals.

2 Admission requirements

The certificate course "Advanced technologies in smart crop farming" is a lifelong learning programme and vocation-oriented. Admission to the course requires a bachelor´s degree in natural resources, life sciences or technical sciences, or a degree from an advanced technical college. In individual cases also applicants without the above-mentioned degrees but with demonstrated long-standing relevant professional experience may be considered for admission to the certificate course. The certificate course is structured to provide subject-specific knowledge for selected professionals of the agricultural sector (e.g. farmers, farm managers, sales managers), public agricultural institutions and ministries of agriculture. It is required from the course participants to:

- Possess relevant competences and skills in mathematics, physics, chemistry, biology, geography and technological topics
- Basic knowledge in IT and advanced computer skills
- Basic knowledge in agriculture
- Adequate language skills of English

3 The Programme's structure

The continuing education certificate course "Advanced technologies in smart crop farming" comprises compulsory educational elements equivalent to 6 ECTS credits in one semester.

The key subject areas of the certificate course are:

1. Introduction to advanced technologies in smart crop farming
2. Data sources in precision farming:
    - GNSS in precision farming
    - Biosystem sensors
3. Spatial data analysis
4. Field controlled machine action

The courses will be taught in English.

3.1 Introduction to advanced technologies in smart crop farming (VO)

Workload*:* ECTS credits: 0,5

Course internal structure:

1.1 Introduction	1.1.1 Administrative Introduction and Security Information
1.2 Overview of precision farming	1.2.1. Principles of Precision Farming 1.2.2 Technology of precision farming
1.3 Overview of technologies and tools for smart farming	1.3.1 Differences precision and smart Farming 1.3.2 Limits and future callenges of Smart Farming
1.4 Future Aspects of Precision Farming	

Learning outcomes

- Participants are able to identify, to indicate and interpret the principals and the aim of precision farming
- Participants can differentiate between precision farming and smart farming applications
- Participants discover and apply the technological requirements

3.2 Data sources in smart crop farming (VX)

Workload: ECTS credits: 2

Course internal structure:

2.1 GNSS and steering systems in precision farming	2.1.1. Overview 2.1.2. Positioning, error correction and accuracy of GNSS systems 2.1.3. Automated steering systems in agriculture
2.2 Biosystem sensors	2.2.1 Sensors overview: sensible element -> transduction -> amplifier -> conditioning -> control 2.2.2. Proximal sensing: Electrical/electromagnetic, optical, electrochemical. Examples: NIRS, hyperspectral imaging, machine vision, RFID, proximity, on the go

Learning outcomes

- Participants are able to understand and applicate the functionality of existing GNSS tools to determine error corrections in agriculture and select appropriate systems for agriculture machinery. Participants are able to evaluate different technologies and tools offered on the market
- Participants can evaluate the potential, benefits and drawback of automated steering systems in agriculture and for precision crop farming
- Participants gain knowledge about the physical basics of biosensors to be able to design sensor concepts for future applications in agriculture and know about the errors which can appear

3.3 Spatial data analysis (VS)

Workload: ECTS credits: 2,5

Course internal structure:

3.1 GIS in precision farming	3.1.1 General overview 3.1.2 GIS and Remote Sensing 3.1.3 Available software
3.2 Spatial data management	3.2.1. Data bases and data formats 3.2.2 Coordinate reference systems 3.2.3. Import (integration of external data)/Export
3.3 Spatial data acquisition	3.3.1 Raster data: focus on remotely sensed images 3.3.2 Vector data: including integration of GNSS data from field measurements
3.4 Spatial data analysis	3.4.1 Spatial interpolation methods: from point to surface 3.4.2 Geometric intersection of spatial data 3.4.3 Spatial modelling and simulation
3.5 Data visualization and documentation	3.5.1 Map creation 3.5.2 Metadata: data documentation

Learning outcomes

- Participants distinguish and explain the principles of geographic information technology and remote sensing
- Participants asses, create and manage GIS projects and apply geodata within their field
- Participants gain the knowledge to apply the principles of GIS and know how to implement spatial data in a GIS environment
- Participants can create, synthesis and analyze their own spatial data sets according to GIS standards
- Participants investigate the pros and cons about spatial data management
- They acquire spatial data and have the ability to compare different GIS tools for their own field data for surface calculations and simulations as well to implement GIS data from different sources
- They know how to combine and analyze spatial data from different sources and are able to work with different geometric and thematic layers.
- Participants can visualize the spatial results for decision support and can document the spatial data according to international metadata standards
- They gain the competence to create different kind of maps and document spatial data sets.
- Participants have the competence to decide on the application of appropriate visualization tools and to establish actions in accordance to these results.

3.4 On-field machine action (UX)

Workload: ECTS credits: 1

Course internal structure:

4.1 Variable rate application	4.1.1 Introduction: technologies for variable rate 4.1.2 Technologies for map-based variable rate 4.1.3 Online approach 4.1.4 Combined strategies
4.2 Section control	
4.3 Communication and control	4.3.1 Machine-Machine interfaces
4.4 Automation and robotics	4.4.1 Automated steering: based on GPS, on field parameters, driving assistance & machine coupling 4.4.2 Automated weeding 4.4.3 Robotic applications

Learning outcomes

- Participants understand the technological principals of variable rate technology and know about the application accuracies to develop concepts for further innovation
- Participants can use the technologies and know about the data interfaces to create new solutions in “machine to machine”-communication
- Participants know examples of specific robotic solutions for crop production processes and the potential and drawback in agriculture

4 Teaching and working methods

The subject areas of the certificate course will be delivered in the form of e-learning, face to face lessons as well as hands-on exercises. The purpose of this systematic approach and varied teaching methods is that students acquire knowledge, skills and competences at the EQF-level 7 within the course´s key subject areas. In line with the Bologna declaration, learners and learning processes are the focus of the didactic concept developed within the framework of the continuing education certificate course.

5 Examination regulation

The choice of examination methods and the assessment of the participant performance is based on the structure of the course and is determined by the course instructor.

- The evaluation of online lectures is based on online tests and multiple-choice exams. The evaluation of seminars (SE) is based on written reflective protocols
- The evaluation of practical lessons is based on group assignments and projects, peer reviews and problem-solving exercises

In order to successfully complete the course, the participants have to pass a final examination that can be in a form of a written paper.

6 Completion of the continuing education course

Participants successfully completing the continuing education course worth a total of 6 ECTS credits will be awarded a certificate of completion of the course.

Annex A Types of courses

The following types of courses are available:

Lecture (VO)
Lectures are courses in which certain areas of a subject and the methods used in this area are imparted through didactic presentation.

Exercise course (UE)
Exercise courses are courses in which students are instructed in specific practical skills, based on theoretical knowledge.

Practical course (PR)
Practical courses are classes in which students deal with specific topics independently, based on previously acquired theoretical and practical knowledge.

Compulsory internship seminar (PP)
The compulsory internship seminar is a class in which students deal independently with topics related to their internship placements, based on previously acquired theoretical and practical knowledge.

Seminar (SE)
Seminars are courses in which students are required to work independently on the respective subject, deepen their knowledge of the topic and discuss relevant issues.

Field trips (EX)
Field trips are courses in which students have the opportunity to experience relevant fields of study in real-life practical application, to deepen their knowledge of the respective subject. Field trips can be taken to destinations both in Austria and abroad.

Master thesis seminar (MA)
Master thesis seminars are seminars intended to provide students with academic support during the thesis writing process.

Mixed-type courses:
Mixed-type courses combine the characteristics of the courses named above (with the exception of project-type courses). Integration of different course-type elements improved the didactic value of these courses.

Project course (PJ)
Project courses are characterized by problem-based learning. Under instruction, students work - preferably in small groups - on case studies, applying appropriate scientific methods.

Lecture and seminar (VS)
Lecture and exercise (VU)
Lecture and field trip (VX)
Seminar and field trip (SX)
Exercise and seminar (US)

Exercise and field trip (UX)

Annex B Course's overview

Advanced course's title	**Advanced technologies in smart crop farming**				
Advanced course module	***Compulsory***				
Advanced course module no.					
Workload	**ECTS credits**				**Total hours**
	6				**150**
Learning outcomes	The graduate will acquire highly specialized knowledge of control systems for the automation in agriculture, knowledge of data structures and network systems and will be able to define the science of site–specific farming and their benefits. The graduate will develop and apply proprietary technology in plant systems as well as in the automation and control of Interpret, integrate and transmit the theoretical and methodological concepts required for the use of GIS and remote sensing techniques including discrimination and categorization of geospatial data according to their nature, conversion procedures and advanced processing techniques. The graduate will integrate GIS tools and functions to store, manage, analyse and process geospatial data in order to extract relevant information for decision making. The graduate will generate, assess, evaluate and manage data coming from crop production as well as soil and water resources in order to improve agricultural production efficiency through efficient and economical use of resources. The graduate will use the sources of scientific and technical information in an efficient manner to develop research skills in the mentioned topics above The graduate will handle complex contents and carry out a specific application of digitalization methodology in an agricultural process				
Course					
Course title	**Introduction to advanced technologies in smart crop farming** (VO)				
ECTS credits	**0,5**				
Course					
Course title	**Data acquisition in smart crop farming** (VX)				
ECTS credits	**2**				
Course					

Course title	**Spatial data analysis** (VS)
ECTS credits	**2,5**
Course	
Course title	**On-field machine action** (UX)
ECTS credits	**1**

Universität für Bodenkultur Wien
University of Natural Resources and Life Sciences, Vienna

Anhang zum Curriculum: Studiendauer, Überschreitung

Laut Universitätsgesetz §56 kann im Curriculum eine Höchststudiendauer vorgesehen werden, die mindestens die vorgesehene Studienzeit zuzüglich zwei Semester umfasst.

Im Curriculum ist eine vorgesehene Studienzeit definiert.

Für diesen Universitätslehrgang gilt eine Höchststudiendauer im Umfang der vorgesehenen Studienzeit zuzüglich 2 Semestern.

Bei Überschreiten dieser Höchststudiendauer fallen zu Lasten der/des Studierenden seitens der Universität zusätzliche Gebühren an (siehe Allgemeine Geschäftsbedingungen für die Teilnahme an Universitätslehrgängen der Universität für Bodenkultur Wien).

Beschluss des Senats der Universität für Bodenkultur Wien vom 14. April 2020,
zur Geltung für alle bestehenden Curricula der BOKU Universitätslehrgänge

[Appendix to the curriculum: Duration of Studies, Exceedance

According to the Federal Act on the Organisation of Universities and their Studies (Universities Act 2002 – UG) §56, a maximal duration of studies may be determined in the curriculum, which shall comprise at least the requested duration of studies plus two semesters.

A requested duration of studies is defined in the curriculum.

For this University Programme a maximal duration of studies equal to the requested duration of studies plus two semesters is determined.

If this maximal duration of studies is exceeded, the student will be charged additional fees by the university (see General Terms and Conditions for attendance at continuing education university programmes of the University of Natural Resources and Life Sciences, Vienna).

Resolution of the Senate of the University of Natural Resources and Life Sciences, Vienna, April 14th, 2020]