Universitat de Lleida

DEGREE CURRICULUM

AGRICULTURA DE PRECISIÓN, AUTOMÁTICA Y ROBÓTICA

Coordination: ESCOLA AGUSTI, ALEXANDRE

Academic year 2022-23

AGRICULTURA DE PRECISIÓN, AUTOMÁTICA Y R... 2022-23

Subject's general information

<table>
<tr><td>Subject name</td><td>AGRICULTURA DE PRECISIÓN, AUTOMÁTICA Y ROBÓTICA</td></tr>
<tr><td>Code</td><td>102574</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Agricultural and Food Engineering</td><td>3</td><td>COMPULSORY</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
<table>
<tr><th>Activity type</th><th>PRACAMP</th><th>PRALAB</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>0.4</td><td>1.4</td><td>1.1</td><td>3.1</td></tr>
<tr><td>Number of groups</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>ESCOLA AGUSTI, ALEXANDRE</td></tr>
<tr><td>Department</td><td>AGRICULTURAL AND FOREST ENGINEERING</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>Each ECTS credit is assigned 25 hours of student work. 10 hours per ECTS are devoted for in-person student work attending the different academic activities and 15 hours per ECTS are devoted to independent student work.</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Catalan</td></tr>
<tr><td>Distribution of credits</td><td>See table at the section Type of activity, credits and groups</td></tr>
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Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
ARNO SATORRA, JAIME	jaume.arno@udl.cat	1,5	
ESCOLA AGUSTI, ALEXANDRE	alex.escola@udl.cat	2,5	
LLORENS CALVERAS, JORDI	jordi.llorens@udl.cat	2	

Subject's extra information

Subject / subject in the whole curriculum

In the field of the specialty of Rural and Environmental Engineering, the agricultural and food engineer must know how to select and apply information and communication technologies (ICTs) in agriculture and livestock. Global navigation satellite sensors and systems (SSNG) for monitoring crops and livestock, spatial information analysis and variable-action electronic devices in agricultural equipment and machinery are technologies that are increasingly used at agrarian sector On the other hand, the automation and control systems and the robotic systems are a key element in many processes of agrarian production. The vision integrating these technologies and their practical application are the fundamental objectives of the subject.

Recommendations

The previous knowledge obtained in the Foundations of Rural Engineering and Topography, GIS and Remote Sensing and Statistics and Computing are especially useful. On the other hand, it is advisable to study this subject simultaneously in the Agrarian Mechanisms, Irrigation and GPS, MDT and CAD courses.

Important notice

It is MANDATORY the students wear the following individual protection equipment (EPI) in the course of laboratory teaching practices:

- white lab gown
- Mechanical protection gloves

The EPI must be purchased at the ÚDELS store of the UdL, located at:

Centre de Cultures i Cooperació Transfronterera – Campus Cappont

Carrer de Jaume II, 67 baixos

25001 Lleida

http://www.publicacions.udl.cat/

Learning objectives

The goals to be achieved include:

1. Unveil the basic elements that are part of an automation and control system.
2. Unveil and know how to apply systems for the acquisition and monitoring of crops and livestock.
3. Introduce the navigation and georeferencing systems and the technologies of variable application in equipment and agricultural machinery.
4. Use and apply spatial data analysis for zoning at the plot level.
5. Unveil the different methodologies and techniques proposed by agriculture and livestock of precision.
6. Introduce the robotic systems and their application in agriculture and livestock.

Competences

Basic skills:

CB1. That students have demonstrated that they possess and understand knowledge in an area of study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply knowledge from the forefront of your field of study.

CB2. That students know how to apply their knowledge to their work or vocation in a professional way and possess the competencies that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.

CB3. That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include reflection on relevant issues of a social, scientific or ethical nature

CB4. That students can transmit information, ideas, problems and solutions to both specialized and non-specialized audiences

CB5. That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

General competences:

CG1. Capacity for the prior preparation, conception, drafting and signing of projects aimed at the construction, reform, repair, conservation, demolition, manufacture, installation, assembly or operation of movable or immovable property that by its nature and characteristics are included in the own technique of agricultural and livestock production (facilities or buildings, farms, infrastructures and rural roads), the agri-food industry (extractive, fermentation, dairy, canning, fruit and vegetable, meat, fishing, salting industries and, in general, any other dedicated to the elaboration and / or transformation, conservation, handling and distribution of food products) and gardening and landscaping (urban and / or rural green spaces –parks, gardens, nurseries, urban trees, etc.–, public or private sports facilities and environments subjected to landscape recovery).

CG2. Adequate knowledge of physical problems, technologies, machinery and water and energy supply systems, the limits imposed by budgetary factors and construction regulations, and the relationships between facilities or buildings and agricultural holdings, agri-food industries and spaces related to the gardening and landscaping with their social and environmental surroundings, as well as the need to relate those and that environment with human needs and the preservation of the environment.

CG6. Ability to direct and manage all kinds of agri-food industries, agricultural and livestock farms, urban and / or rural green spaces, and public or private sports areas, with knowledge of new technologies, quality processes, traceability and certification and the marketing techniques and commercialization of food products and cultivated plants.

CG7. Knowledge of basic, scientific and technological subjects that allow continuous learning, as well as an

ability to adapt to new situations or changing environments.

CG8. Ability to solve problems with creativity, initiative, methodology and critical reasoning.

CG9. Leadership, communication and transmission of knowledge, abilities and skills in the social fields of action.

CG11. Ability to develop their activities, assuming a social, ethical and environmental commitment in tune with the reality of the human and natural environment.

CG12. Ability to work in multidisciplinary and multicultural teams.

CG13. Correction in oral and written expression

CG15. Mastery of Information and Communication Technologies

CG16. Respect for the fundamental rights of equality between men and women, the promotion of Human Rights and the values of a culture of peace and democratic values

Specific skills:

CEFB3. Basic knowledge about the use and programming of computers, operating systems, databases and computer programs with applications in engineering.

CEMC6. Surveys and topographic stakeouts. Cartography, Photogrammetry, geographic information systems and remote sensing in agronomy.

CEMC9. Decision making through the use of available resources for work in multidisciplinary groups.

CEMC10. Technology transfer, understanding, interpreting, communicating and adopting advances in the agricultural field.

CEMCR3. Agrarian mechanization.
Agricultural engines and machines. Characteristics and design of machinary to agrary instalations. Agricultural automatic.

Subject contents

Module 0. Information and Communication Technologies (ICT) applied to agriculture (0.2 ECTS)

1. Monitoring, control and efficiency of agricultural production systems
Information and communication technologies applied to agricultural production systems. Technological bases of automation and process control. Improving the efficiency and sustainability of agricultural production systems. Innovation in agricultural production and transformation processes.

Module 1. Process automation (2,8 ECTS)

2. Basics of process automation
Automatic systems. Main hardware components: sensors, controllers and digital actuators. Acquisition, data processing and automatic actuation. Supervision and control systems: types and introductory examples. Hardware options available on the market: PCs, embedded systems, PACs and PLCs.

3. Sensors for process monitoring
Types of signals and types of sensors. A/D conversion. Signal conditioning. Sensors to measure the most common parameters in agriculture.

Practice 1.1 - Data acquisition and sensor calibration

4. Controllers for process monitoring and control

Types of controllers and applications in agriculture. Digital logic and combinational and sequential circuit design.

Practice 1.2 - Practical examples of automatic processes

Practice 1.3 - Process control through digital logic

5. Design and implementation of control systems. Project development.
Introduction to the analysis of requirements and variables to monitor and control. Learning by developing a real application. Integration of hardware and software components.

Practice 1.4a - Connecting a PLC
Practice 1.4b - Control of a water supply system through a PLC
Practice 1.5 - Precision feeding in pig farming

Module 2. Robotic systems (0.6 ECTS)

6. Agricultural robotics
Basic concepts about robotics. Type of robots and their applications. Movement control. Examples of robots for different tasks. Mobile agricultural robotics.

Practice 2.1 - Interacting with robots

Module 3. Precision Agriculture (2.4 ECTS)

7. Concept and cycle of Precision Agriculture
Agricultural production as a process to control. Data acquisition. Analysis and interpretation of information. Decision making and site-specific management. Real-time variable-rate systems (real-time sensor-based technologies). Variable-rate systems based on maps (map-based technologies).

8. Variability and site-specific management of crops
Spatial variability of the harvest. Seasonal variability of the harvest. Quality variability.

9. Georeferencing of spatial data
Global Navigation Satellite Systems (GNSS) and applications in Precision Agriculture.

Practice 3.1 - Global Navigation Satellite Systems and discrete data georeferencing

10. Data acquisition systems (I) - Proximal sensors.
Harvest sensors and monitors: Obtaining harvest maps. Soil sensors: Electrical resistivity, Electromagnetic induction, Spectrometry, Radar. Crop sensors: Radiometers and spectral reflectance sensors.

Practice 3.2 - Continuous acquisition and georeferencing of soil and crop variables

11. Data acquisition systems (II) - Remote sensors.
Satellite images and aerial photography. Thermal photography. Vegetation indices. Image acquisition and calibration.

12. Mapping and information analysis systems
Geographic Information Systems (GIS). Interpolation and mapping of information. Analysis and interpretation of data. Opportunity for differentiated management and zoning.

Practice 3.3 - Mapping spatial information

Practice 3.4 - Zone delineation at plot level

13. Control and actuation systems: variable-rate technologies
Variable-rate actuators and technologies. Different solutions for different crops.

Practical activities
All practical sessions will last 2 hours.

Laboratory practices

Practice 1.1 - Data acquisition and sensor calibration
Practice 1.2 - Practical examples of automatic processes
Practice 1.3 - Process control through digital logic
Practice 1.4a - Connecting a PLC
Practice 1.4b - Control of a water supply system through a PLC
Practice 1.5 – Precision feeding in pig farming
Practice 2.1 - Interacting with robots

Field practices
Practice 3.1 - Global Navigation Satellite Systems and discrete data georeferencing
Practice 3.2 - Continuous acquisition and georeferencing of soil and crop variables

Computer classroom practices
Practice 3.3 - Mapping spatial information
Practice 3.4 - Parcel level zoning

Methodology

The course will be given in person whenever the anti-pandemic measures allow it. At the beginning of the course will have the detailed schedule of the course a the Resources (Recursos) folder of the Virtual Campus.

Tipus d'activitat	Descripció	Activitat presencial alumne		Activitat no presencial alumne		Avaluació	Temps total
		Objectius	Hores	Treball alumne	Hores	Hores	Hores/ECTS
Lliçó magistral	Classe magistral (Aula. Grup gran)	Explicació dels principals conceptes	34	Estudi: Conèixer, comprendre i sintetitzar coneixements	34	7	74h/3ECTS
Problemes i casos	Classe participativa (Aula. Grup gran)	Aplicació dels conceptes teòrics impartits a les classes magistrals	8	Resoldre problemes i casos i aplicar-ho a un cas concret avaluable	8	13	27h/1.2ECTS
Laboratori Camp	Pràctica de Laboratori (grup reduït)	Execució de la pràctica: aplicació pràctica dels conceptes teòrics	14	Realitzar memòria (informe) de l'activitat	14	8	38h/1.4ECTS
Aula d'informàtica	Activitat pràctica (Grup mitjà)	Execució de la pràctica: dimensionament i presa de decisions	2	Realitzar memòria (informe) de l'activitat	2	1	5h/0.2ECTS
Visites tècniques	Activitat pràctica (Grup gran)	Visita a empreses i/o explotacions	2	Realitzar memòria (informe) de l'activitat	2	1	5h/0.2ECTS
Totals			**60**		**60**	**30**	**150h/6 ECTS**

Observacions:

S'han considerat 25 hores d'activitat total per crèdit ECTS.

La distribució d'hores i d'activitats poden variar lleugerament.

Development plan

A detailed planning of the subject will be loaded in the Resources section of the Virtual Campus at the beginning of the course. The planning will contain the distribution of the credits in the different activities and the dates, places and professors of each one.

Evaluation

The evaluation of the subject will be done in accordance with the Evaluation Regulations approved by the UdL. These regulations state that the standard assessment is Continuous Evaluation.

The subject is evaluated in two blocks. On one side is Block 1, Automation and Robotics, which contains Modules 0, 1, and 2, and on the other, Block 2, Precision Agriculture, which contains Module 3.

In Block 1, Automation and Robotics, Modules 0,1 and 2 will be evaluated through the realization and presentation of exercises and practical workshops (practices 1.1, 1.2, 1.3, 1.4 and 1.5), participation and attitude in the sessions, the realization of possible extra exercises and the realization of an examination in the 1st Partial. The exam has a weight of 55 % on the mark of Block 1. The practical exercises have a weight of 35 % on the note of the Block 1 and the attitude and the participation in class a weight of 10 % on the grade of the Block 1. Block 1 represents 50 % of the overall grade of the subject.

In Block 2, Precision Agriculture, Module 3 will be assessed by taking an exam, submitting a dossier about the practice sessions and writting a document for the Repositori Digital d'Agricutura de Precisió (RDAP). The exam has a weight of 40 % on the mark of Block 2. In order to evaluate the practices, the students will have to submit a unique dossier elaborated individually that will include the practices 3.1, 3.2, 3.3 and 3.4. The weight of the dossier is 40 % on the grade of Block 2. Finally, the document for the RDPA will weight a 20 % of Block 2. This Block 2 will represent 50 % of the final grade.

In order to determine the overall grade, it is essential to obtain a grade equal to or higher than 4 points out of 10 in each of the two Blocks. Otherwise, the maximum overall mark that can be obtained in the subject will be 4 points out of 10.

Attendance to all hands-on practice sessions is mandatory. Failure to attend will not allow the subject to be passed, unless it is due to force majeure and justified.

Activity type	Evaluation activity		Weight
	Procedure	Number	%
Lectures	Examen of Block 1	**1**	**27,5**

Exercicies and cases	Submission of sensor, automation an robotics practice reports of Block 1	**3-5**	**17,5**
Participation and attitude in the classes	A totes les sessions del Bloc 1	**1**	**5**
Lectures	Examen of Block 2	**1**	**20**
Lectures	Document per al RDPA al Bloc 2	**1**	**10**
Laboratory, Field and Computer class practices	Submission of Precision Agriculture practice reports of Block 2	**1**	**20**
Total			**100**

Observations

If a student is unable to follow the continuous assessment for any justifiable reason, he/she must inform the ETSEA Department of Studies and the subject coordinator at the beginning of the classes and request the alternative assessment procedure officially within the established period.

In order to be able to make a fair assessment of all students, plagiarism will be meticulously pursued in the activities carried out.

Bibliography

Basic references

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Complementary references

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- MARTÍNEZ, V. 2010. *Automatización y telecontrol de sistemas de riego.* Barcelona : Marcombo.