Universitat de Lleida

DEGREE CURRICULUM

AGRICULTURA DE PRECISIÓN, AUTOMÁTICA Y ROBÓTICA

Coordination: ESCOLÀ AGUSTÍ, ALEXANDRE

Academic year 2020-21

AGRICULTURA DE PRECISIÓN, AUTOMÁTICA Y R... 2020-21

Subject's general information

Subject name	AGRICULTURA DE PRECISIÓN, AUTOMÁTICA Y ROBÓTICA
Code	102574
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION
Typology	<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></table>
Course number of credits (ECTS)	6
Type of activity, credits, and groups	<table><tr><th>Activity type</th><th>PRACAMP</th><th>PRALAB</th><th>PRAULA</th><th>TEORIA</th></tr><tr><th>Number of credits</th><td>0.4</td><td>1.4</td><td>1.1</td><td>3.1</td></tr><tr><th>Number of groups</th><td>1</td><td>1</td><td>1</td><td>1</td></tr></table>
Coordination	ESCOLÀ AGUSTÍ, ALEXANDRE
Department	AGRICULTURAL AND FOREST ENGINEERING
Teaching load distribution between lectures and independent student work	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.
Important information on data processing	Consult this link for more information.
Language	Catalan
Distribution of credits	See table at the section Type of activity, credits and groups

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
ARNÓ SATORRA, JAIME	jaume.arno@udl.cat	1,5	
ESCOLÀ AGUSTÍ, ALEXANDRE	alex.escola@udl.cat	2	
POMAR GOMA, JESUS	jesus.pomar@udl.cat	2,5	

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 and general skills

CB2: Know how to apply the knowledge in a professional way and achieve the competencies for the elaboration and defense of arguments and the resolution of problems within their area of study.

CB4: Know how to convey information, ideas, problems and solutions to both specialized and non-specialized audiences.

CB5: Develop those learning abilities necessary to undertake further studies with a high degree of autonomy.

CG6: Be capable of managing and managing industries and farms, with knowledge of new technologies, quality processes, traceability and marketing techniques.

CG7: Be able to adapt to new situations or changing environments through continuous learning and knowledge of basic, scientific and technological subjects.

CG8: Know how to analyze specific situations, define problems, make decisions and implement action plans in the search for solutions.

CG12: Know how to work in multidisciplinary and multicultural teams.

CG15: Mastering information and communication technologies.

Specific competences

CEMC10: Transfer technology and understand, communicate and adopt advances in the agricultural field.

CEEA3: Engineering of agricultural holdings. Agricultural machinery.

CEHJ2: Engineering in green areas, sports spaces and fruit and vegetable farms. Machinery for fruit and vegetable.

CEMCR3: Mechanization and automatic agrarian.

Subject contents

Module I. Technologies of Information and Communication (ICT) in agriculture (0.2 ECTS)

1. Monitoring, control and efficiency of agrarian production systems

Information and Communication Technologies applied to agricultural production systems. Technological bases of automation and process control. Improvement of the efficiency and sustainability of agrarian production systems. Innovation in the processes of production and agricultural transformation.

Module II. Automation and control (2.4 ECTS)

2. Basis of automation and process control

Application of computers and other systems to automation. Data processing and automatic action. Control systems with intelligent behavior. Types of control systems. Introductory examples.

3. Control systems

Main components of physical nature: sensors, actuators and digital controllers. Signal type Conversion A / D and D / A. Signal conditioning. Hardware options available on the market. PACs and PLCs. Networks, communication and data transmission.

Practice 1: Acquisition of data and calibration of sensors

4. Programming of control systems

Bases of the computer programming of control systems and automatisms. Last generation programming languages. Software, data and fundamental structures. Introduction to the advanced environment of implementation of LabView control systems.

Practice 2: Design and implementation of a mini thermal camera with automatic control based on a thermoelectric heat pump

5. Design and implementation of control systems. Project development

Introduction to the analysis of requirements and incremental prototyping. Learning through the development of real applications. Integration of hardware and software components.

Practice 3: Design and implementation of an automatic weighing system

Module III. Robotic systems (0.6 ECTS)

6. Agricultural Robotics

Robot concepts Types of robots and their applications. Movement control Examples of robots for different tasks. Mobile robotics Prospects for the future.

Practice 4: Interacting with robots

Module IV. Precision Agriculture (2.4 ECTS)

7. Concept and cycle of Precision Agriculture

Agricultural production as a control process. Acquisition of data. Analysis and interpretation of information. Decision making and variable action. Real-time variable performance systems (sensor-based technologies). Variable action systems based on maps (map-based technologies).

8. Variability of crops

Spatial variability of the crop. Temporary harvest variability. Variability of quality.

9. Georeferencing of spatial data

Global Navigation Satellite Systems (SSNG / GNSS). Accuracy and corrections. Analysis of SSNG information.

Practice 5: Satellite Navigation Systems and Global Georeferencing

10. Data acquisition systems (I). Nearby sensors

Collection sensors and monitors - Collection maps. Ground sensors - Electrical resistance - Electromagnetic induction - Spectrometry - Radar. Cultivation sensors - Measurement of vegetation.

Practice 6: Acquisition and georeferencing of variables of the crop

11. Data acquisition systems (II). Remote sensors

Satellite images and aerial photography. Thermal photography Vegetation indexes. Acquisition and calibration of images. Terrestrial radiometers.

12. Mapping and information analysis systems

Geographic information systems (GIS). Interpolation and mapping of information. Analysis and interpretation of data. Opportunity for differential handling and zoning.

Practice 7: Mapping agronomic variables

Practice 8. Zoning at the plot level

13. Control and action systems. Examples of extensive crops and arboris

Actuators and technologies of variable application. Various solutions for different crops.

Module V. Precision Livestock (0.4 ECTS)

14. Concept and objectives of Precision Livestock

Applications of ICT in livestock farming to improve management efficiency.

Practical activities

All practical sessions will last 2 hours.

Laboratory practices:

Practice 1: Acquisition of data and calibration of sensors

Practice 2: Design and implementation of a mini thermal camera with automatic control based on a thermoelectric heat pump

Practice 3: Design and implementation of an automatic weighing system

Practice 4: Interacting with robots

Field Practices:

Practice 5: Satellite Navigation Systems and Global Georeferencing

Practice 6: Acquisition and georeferencing of variables of the crop

Computer classroom practices:

Practice 7: Mapping agronomic variables

Practice 8. Zoning at the plot level

Methodology

The course will be taught in a mixed way, combining virtual theoretical sessions and face-to-face practice sessions. At the beginning of the course will have the detailed schedule of the course.

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 Regulations of evaluation approved by the UdL. This norm establishes that the standard evaluation is the continuous evaluation.

The subject will be evaluated in two parts. On one side there will be Modules II, III and V and on the other Modules I and IV.

Modules II, III and V will be assessed through the realization of a practical workshops (Practice 1, 2, 3 and 4). It would also be possible to assign some exercise understood as small project or case study . The grade obtained will be the arithmetic mean of all the grades obtained and will represent a 40% of the final grade.

Modules I and IV will be evaluated by conducting a test type exam and the presentation of a dossier about the practices performed. The exam will have a weight of 30 % of the final grade and the practices another 30 %. In order to evaluate the practices, an individual dossier will be delivered individually, which will include practices 5, 6, 7 and 8. An arithmetic mean will be computed with both grades that will represent a 60 % of the final grade.

To pass the course, the weighted sum of the grades of each part must be equal to or greater than 5 points out of 10. In order to calculate the global grade it is essential to take a grade equal to or greater than 4 in each one of the three grades. If not, the maximum final grade will be a maximum of 4 points out of 10.

Likewise, attendance at all practical sessions is mandatory. If any of the practices sessions is not attended it will not be possible to pass the year, unless conveniently justified.

Type of activity	Evaluation activity		Weigth
	Procedure	#	%
Lecture	Examination of contents related to Precision Agriculture	**1**	**30**
Problems and cases	Delivery of practical cases related to automation, robotics and precision livestock farming	**5**	**40**
Laboratory/field Computer classrom	Delivery of the practical dossiers related to precision agriculture	**1**	**30**

Total	**100**

Observations

If a student can not follow the continuous assessment, they must inform the subject coordinator when they start the classes.

In order to be able to make a fair evaluation of all the students, the plagiarism in the activities carried out will be meticulously pursued. Any plagiarised activity will count 0 points in the evaluation. **In the case of plagiarizing any activity that is not remediated, the subject will be automatically failed.**

Bibliography

Basic references

- BASSO, B. 2007. *Manual de agricultura de precisión: conceptos teóricos y aplicaciones prácticas.* Madrid: Ministerio de Agricultura, Pesca y Alimentación/Eumedia.
- BÉGUYOT, P. 2004. *Le GPS en agriculture: principes, applications et essais comparatifs.* Dijon : Educagri
- BRASE, T. 2006. *Precision agriculture.* Clifton Park: Thomson/Delmar Learning.
- Ed. SRINIVASAN, A. 2006. *Handbook of precision agriculture : principles and applications.* New York; London; Oxford : Food Products Press.
- MAGDALENA, C. 2010. *Tecnología de aplicación de agroquímicos.* Allen: Área de Comunicaciones del INTA Alto Valle.PROFFITt, T. 2006. *Precision viticulture : a new era in vineyard management and wine production. Ashford, South Australia : Winetitles.*
- RODRÍGUEZ DÍAZ, F. 2004. *Control y robótica en agricultura.* Almería: Universidad de Almería.
- Whelan, B., Taylor, J. 2013. *Precision Agriculture for Grain Production Systems*. Sidney : CSIRO Publishing.
- Xu, G. 2007. *GPS : theory, algorithms, and Applications.* Berlin: Springer.

Complementary references

- Ed. OLIVER, M.A. 2010. *Geostatistical applications for precision agriculture.* New York: Springer.
- MENÉNDEZ, A. 2003. *Sistemas de control automático para zonas regables.* Sevilla: Junta de Andalucía, Consejería de Agricultura y Pesca.
- MARTÍNEZ, V. 2010. *Automatización y telecontrol de sistemas de riego.* Barcelona: Marcombo.