Topics in Automation of controlled-environment agriculture

COURSE IDENTIFICATION

CODE	SEM	HT	HP	HA	SCT	PREREQUISITES	COURSE LEVEL OR CATEGORY	RESPONSABLE UNIT
AG100536	Summer	1	0	2,1	2	Postgraduate inscription	Elective	Postgraduate School

One SCT credit point is equivalent to 25 student learning hours.

COURSE DESCRIPTION

In the training of professionals in agriculture, it is necessary a basic knowledge of introduction to the automatic control, since they are the ones who will be in contact with the reality of the problem, and must implement the new trends in the sector; not only for the mere advancement of technologies, but because they would improve the competitiveness and security of the agri-food sector. This course develops general aspects of automatic control and its applications in the agricultural sector, specifically in the greenhouse production (climate control and fertirrigation).

LEARNING STRATEGIES

Lectures, practices, group discussion.

COURSE COMPETENCIES (Type: B=Basic, G=Generic, E=Specific)

At the conclusion of this class, students will be able to:

- Acquire a solid knowledge base of automatic control (E).
- Show the student the agricultural tasks in which the computer can be used, the PLCs and the robots as tools. (G).
- Offer a vision of the systems that can currently be found in the agriculture sector (G).

LEARNING RESOURCES

Lectures. Case studies. Student debates.

COURSE OUTLINE

Chapter	Content
Control system engineering	The objective is to introduce and motivate the student in the problem of control, as well as both mathematical and practical and operational order necessary for the development of the subject. In this sense, the basic knowledge about control systems are introduced, emphasizing the idea of feedback and the problems of servomechanisms and regulators.
Analysis and modeling of continuous processes	The design of a control system for a certain process requires knowing its dynamic behavior. To do this, a system model must be designed and implemented that consists of the mathematical description of the existing dynamic relationships between the variables to be controlled and the input variables, both perturbations and control variables.
Continuous controllers design	In the agrifood sector, there is a wide range of systems in which automatic control techniques are used or can be applied to control a given process. From the control of the temperature and humidity of the seed germination chambers, to the processing of products in the food and beverage manufacturing industries, through the control of the pH and electrical conductivity of irrigation water or the control of the concentration of certain gases in the storage and transport of the conservation of products, it is necessary to use control techniques at each stage of the food chain.
Practice. Process modelling and control.	In order to design a control system for a certain process, it is necessary to know its dynamic behavior. In order to do so, it is necessary to design a model that relates the existing dynamics between the variables to be controlled and the input variables (disturbances as control variables). The terms modeling, simulation and control refer to the set of activities associated with the

	construction of real-world control system. Simulation relates models, controllers and computers, referring to the process of imitating important aspects of system behavior by designing, building, and experimenting with the system model.
Automatic Control in greenhouses.	The growth of a crop is fundamentally determined by the climatic variables of the environment in which it is found and by the amount of water and fertilizers that are applied to it by means of irrigation; therefore, controlling these variables will be able to control the growth of the crop. For this reason, a greenhouse is ideal to cultivate, since being a closed enclosure, these variables can be manipulated to reach an optimal growth of the plants.

Reading Materials

- F. Rodríguez, M. Berenguel, J.L. Guzmán, A. Ramírez. Modelling and Control for Greenhouse Crop Growth. Springer. 2015.
- von Zabeltitz, C.. Integrated Greenhouse Systems for Mild Climates: Climate Conditions, Design, Construction, Maintenance, Climate Control. Springer. 2011.
- G. Stanhill and H.Z. Enoch . Ecosystems of the World 20: Greenhouse Ecosystems. Elsevier. 1999.
- Kamp, P.G.H.; Timmerman, G.J.. Computerized environmental control in greenhouses. A step by step approach . IPC Plant. 1996. Hanan, J.J.. Greenhouses: Advanced Technology for Protected Horticulture. CRC Press. 1997.
- van Straten, G., van Willigenburg, G., van Henten, E. & van Ooteghem, R.. Optimal Control of Greenhouse Cultivation. CRC Press. 2010.
- Rodríguez, F.; Berenguel, M. Control y robótica en agricultura; Monografías de Ciencia y Tecnología. Servicio de publicaciones de la Universidad de Almería. 2004.
- Castilla, N. Invernaderos de plástico: tecnología y manejo . Mundi-Prensa. 2007.

INSTRUCTORS (List non-exclusive)

Instructor	*Department*	*Area or major field*
Jorge Antonio Sánchez Molina	Higher Engineering School	System Engineering and Automatic Control

GRADING (under review every term)

Activity	*Percentage (%)*
Case study presentation	50
Literature review	50