



Universitat de Lleida

DEGREE CURRICULUM
**IRRIGATION AND
AGRICULTURAL MACHINERY**

Coordination: COTS RUBIÓ, LLUÍS

Academic year 2020-21

Subject's general information

Subject name	IRRIGATION AND AGRICULTURAL MACHINERY				
Code	102566				
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION				
Typology	Degree	Course	Character	Modality	
	Bachelor's Degree in Agricultural and Food Engineering	3	COMPULSORY	Attendance-based	
Course number of credits (ECTS)	6				
Type of activity, credits, and groups	Activity type	PRACAMP	PRALAB	PRAULA	TEORIA
	Number of credits	1	0.2	1.6	3.2
	Number of groups	1	2	1	1
Coordination	COTS RUBIÓ, LLUÍS				
Department	AGRICULTURAL AND FOREST ENGINEERING				
Teaching load distribution between lectures and independent student work	Lecturers (Contact hours): 60 Independent student work (non-contact hours): 90				
Important information on data processing	Consult this link for more information.				
Language	Catalan: 100%				

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
ARNÓ SATORRA, JAIME	jaume.arno@udl.cat	1,2	
COTS RUBIÓ, LLUÍS	lluis.cots@udl.cat	3,2	
LLORENS CALVERAS, JORDI	jordi.llorens@udl.cat	1,8	

Subject's extra information

Subject / subject in the whole curriculum

In the field of the Horticulture and Gardening specialty, the agricultural and food engineer must know how to select and use the necessary technology for the correct development of the different phases that constitute the production process in which their activity is centered. In this sense, agricultural machinery and irrigation technology play a fundamental role, not only because of their condition as unavoidable means of production, but also because of the technical and economic importance of the design of irrigation facilities and the correct selection and use. in camp of agricultural machines and equipment.

The course Irrigation and Agricultural Equipment aims to train the student in those skills that enable him to choose the most appropriate mechanization system for a given farm, and for the agronomic and hydraulic design of irrigation facilities normally used in horticulture and in spaces green.

Recommendations

As prior knowledge, those related to the Fundamentals of Rural Engineering, Bases of Plant Production and Typography, GIS and Remote Sensing are especially relevant. On the other hand, it is advisable to take this subject simultaneously with the subjects of Fruit Growing, Horticulture and Gardening.

Warnings

The recording of voice and image during the course of the classes with any medium is totally prohibited. Mobile phones, digital watches, tablets and computers will remain closed as long as the teachers do not indicate otherwise to carry out any activity in the classroom that requires it. In the exams they are totally prohibited.

Covid-19

Due to causes derived from the health crisis caused by Covid-19, activities in face-to-face mode can be substituted by other equivalent ones in distance mode.

Learning objectives

The objectives to be achieved are:

Block 'Agricultural equipment'

- Publicize the basic principles of operation of the equipment and machines used in horticultural farms.
- To publicize the concepts and procedures that allow the selection and management of the necessary machinery in horticultural and gardening farms.

Block 'Irrigation'

- RA1: Understand the importance of irrigation and irrigation methods.
- RA2: Know the elements and equipment of irrigation facilities.
- RA3: Know how to do the agronomic design of irrigation and irrigation programming
- RA4: Know how to evaluate the quality of irrigation in an installation
- RA5: Sizing the pipes of the irrigation facilities

Competences

Basic (CB) and general (CG) competences

CB2: Know how to apply knowledge in a professional way and acquire the skills to prepare and defend arguments and solve problems within their field of study.

CB3: Ability to gather and interpret relevant data to make judgments that contain a reflection on relevant issues of a social, scientific or ethical nature.

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

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

CG1: Be able to conceive and write projects and reports related to horticultural production, gardening and landscaping

CG2: Be knowledgeable about technologies, machinery and water and energy supply systems.

CG8: Know how to analyze specific situations, define problems, make decisions and implement action plans to find solutions.

CG10: Know how to select and use the available written and computerized sources of information (rules and regulations) related to professional activity.

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

CG13: Know how to correctly present information orally and in writing.

Specific skills

CEHJ2: Engineering of horticultural farms. Irrigation and drainage. Machinery for horticulture and gardening.

- Determine the most appropriate type of machines according to the productive orientation of the exploitation, and know how to estimate the needs (dimensioning) and economic viability.
- Know the tasks and mechanized operations that can be carried out in a farm with a fruit and vegetable orientation, specifically, the machinery used for soil maintenance, fertilization, crop protection, pruning and harvesting.
- Know the bases of precision agriculture and the possibilities of its application in fruit growing, viticulture and green space management.
- Design irrigation based on environmental conditions: climate, soil, plant, topography, etc.
- Know how to choose and size the different elements of an irrigation installation.
- Evaluate the operation of irrigation facilities.

Subject contents

Program of class

Thematic block 'Agricultural Equipment'

- 1. Mechanization of the fruit and vegetable farm (1 h).** Cultivation techniques in horticulture. Mechanized operations in tree crops and horticultural crops. Classification of machines. Regulations on machinery.
- 2. Cost of use and management of agricultural machinery (1 h).** Fixed and variable costs. Amortization of machinery. Interest on invested capital. Insurance, rates and warehouse. Fuels Machinery repairs and maintenance. Workforce. Selection of machinery. Profitability and substitution limits.
- 3. The specialized tractor for horticulture (3 h).** Use of the tractor in the fruit and vegetable farm. Classification. Safety and ergonomics. Engine and power transmission. It was joined by tractor-implement. Hydraulic lift and tractor power take-off.
- 4. Machinery for the distribution of phytosanitary products (3 h).** Distribution of phytosanitary products and environmental impact. Spraying theory. Hydraulic, pneumatic, hydropneumatic, centrifugal, electrostatic and thermal spraying. Size and characterization of the spray droplets. Nozzle technology. Foliar treatments in tree crops. Hydropneumatic sprayers (atomizers). Pneumatic sprayers (nebulizers). Sprinklers.
- 5. Machinery for the distribution of fertilizers (2 h).** Types of fertilizers. Distribution of solid mineral fertilizers. Centrifugal disc and pendulum distributors. Functioning and adaptation to tree crops (location of the fertilizer). Distribution of organic fertilizers. Spreader trailers and manure locators.
- 6. Machinery for soil maintenance (2 h).** Soil maintenance techniques. Maintenance through soil work (tillage). Tools and mechanical equipment used in soil work. Disc harrow. Cultivators. Driven implements: power harrow. Maintenance through the application of herbicides (no cultivation). Equipment for the application of herbicides. Hydraulic spray bars. Portable equipment (backpacks) for hydraulic spraying. Portable equipment (battery powered machines) for centrifugal dusting. Vegetable covers. Natural and artificial covers. Equipment used in the maintenance of the ground covered with vegetation. Brush cutters and shredders.
- 7. Machinery for pruning and waste treatment (1 h).** Pre-pruning machines. Pneumatic pruning equipment (compressors and scissors). Aligners and collectors of pruning remains. Shredders (mincers).
- 8. Machinery for the harvesting of horticultural products (3 h).** Physical properties of the products. Harvesting in fruit growing. Assistance platforms for fruit harvesting. Individual platforms. Multiple platforms. Multiple platforms with conveyor belts. Harvesting in viticulture. Harvesters. Harvesting in olive growing and nuts. Vibrators. Fruit pickers from the ground. Collection of horticultural products.
- 9. Precision agriculture and new technologies (2 h).** Technological bases of precision agriculture. Obtaining georeferenced information through GNSS. Near sensors and remote sensors. Analysis and management of information. Decision making: application maps. Precision viticulture: obtaining harvest maps and identifying differential management areas.

Thematic block 'Irrigation'

- 1. Irrigation and irrigation methods (1 h).** The cycle of water and irrigation. Geographic distribution of irrigation. Water management and distribution: irrigation in shifts and on demand. Social, economic and environmental aspects of irrigation. Irrigation methods and selection criteria.
- 2. Components of pressure irrigation installations (2 h).** The irrigation head: irrigation pumps, filtration system and fertigation. The distribution network: pipes and singular elements. Types of drippers and sprinklers and their hydraulic characterization. Measurement, control and protection elements. Automatism.
- 3. Agronomic design and irrigation scheduling (5 h).** Calculation of water and salt washing needs. Effect of location in drip irrigation. Determination of irrigation parameters: dose, frequency and duration. Choice of type of emitter, number of emitters and irrigation arrangement or frame. Determination of the number of irrigation sectors in a farm. Irrigation scheduling and irrigation schedule establishment.

4. Irrigation quality indices and irrigation evaluation (3 h). Irrigation uniformity water use rates. Relationship of the indices with the management strategies. Evaluation of drip and sprinkler irrigation with full coverage.

5. Hydraulic side design with road service (7 h). Allowable pressure variation. Calculation of head losses. Pressure distribution on one side. Design of horizontal, ascending and descending sides.

6. Hydraulic design of tertiary pipes (4 h). Design of rectangular sectors with constant diameter and variable diameter. Design of non-rectangular sectors.

7. Hydraulic design of main and secondary pipes (3 h). Functional and economic methods.

Practical activities

Thematic block 'Agricultural Equipment'

Laboratory / field practices (6 h)

Practice 1: Regulation of a hydropneumatic sprayer (atomizer).

Practice 2: Regulation of a centrifugal distributor for the location of the fertilizer in tree crops.

Practice 3: Regulation of a dust bar and portable equipment for the application of herbicides in tree crops.

Computer classroom practices (4 h)

Practice 4: Use of a computer application to calculate the hourly cost, unit cost and profitability threshold of the machinery.

Practice 5: Precision viticulture. Analysis and management of georeferenced information in the vineyard.

Visits to companies and farms (2 h)

Practice 6: Visit a manufacturer of machinery for phytosanitary treatments and / or harvesting machinery.

Thematic block 'Irrigation'

Laboratory / field practices (2 h)

Practice 1. Hydraulic characterization and modeling of elements of an irrigation installation.

Practice 2. Evaluation of an irrigation installation.

Visits to companies and farms (3 h)

Practice 3: Visit to an irrigation installation.

Methodology

Learning activities

Type of activity	Description	Student face-to-face activity		Non-face-to-face activity Student		Evaluation Hours	Total time	
		Goals	Hours	Student work	Hours		Hours	ECTS
Thematic block 'Agricultural Equipment'								
Lección magistral	Master class (Classroom. Large group)	Explanation of the main concepts	14	Study: Know, understand and synthesize knowledge	14		29	1,2

IRRIGATION AND AGRICULTURAL MACHINERY 2020-21

Problemas y casos	Participatory class (Classroom. Large group)	Application of the theoretical concepts	4	Solve problems and cases	8	2	13	0,5
Laboratorio Camp	Laboratory Practice (Small Group)	Execution of the practice: regulation in the field	6	Make a memory (report) of the activity	12		18	0,7
Aula Informática	Practical activity (Medium group)	Execution of the practice: dimensioning and decision making	4	Make a memory (report) of the activity	9		13	0,5
Visitas técnicas	Practical Activity (Large Group)	Visit to companies and / or farms	2				2	0,1
Total Bloque 'Equipos Agrarios'			30		43	2	75	3
Thematic block 'Irrigation'								
Master lesson	Master class (Classroom. Large group)	Explanation of the main concepts	15	Study: Know, understand and synthesize knowledge	20	1	36	1,44
Problem and cases	Participatory class (Classroom. Large group)	Application of the theoretical concepts	10	Solve problems and cases	16	3	29	1,16
Field Laboratory	Laboratory Practice (Small Group)	Execution of the practice: understand, measure...	2	Make a memory (report) of the activity	5		7	0,28
Technical visit	Practical Activity (Large Group)	Visit to companies and / or farms	3	Make a memory (report) of the activity			3	0,12
Total Bloque 'Riegos'			30		41	4	75	3
TOTAL			60		84	6	150	6

Observations: 25 hours of total activity have been considered for ECTS credit.

Development plan

Type of activity	Content	Goals	Contact hours	Cumulative hours	Evaluation
Thematic block 'Agricultural Equipment'					

Master lesson	Unit 1	CEHJ2	1	1	Exam 1
Master lesson	Unit 2	CEHJ2	1	2	
Computer Classroom Practice	Practice 4	CEHJ2	2	4	
Master lesson	Unit 3	CEHJ2	2	6	
Problems and cases	Unit 3	CEHJ2	1	7	
Master lesson	Unit 4	CEHJ2	2	9	
Problems and cases	Unit 4	CEHJ2	1	10	
Laboratory / Field Practice	Practice 1	CEHJ2	2	12	
Visita técnica	Practice 6	CEHJ2	2	14	
Master lesson	Unit 5	CEHJ2	1	15	
Problems and cases	Unit 5	CEHJ2	1	16	
Laboratory / Field Practice	Practice 2	CEHJ2	2	18	
Master lesson	Unit 6	CEHJ2	2	20	
Laboratory / Field Practice	Practice 3	CEHJ2	2	22	
Master lesson	Unit 7	CEHJ2	1	23	
Master lesson	Unit 8	CEHJ2	2	25	
Problems and cases	Unit 8	CEHJ2	1	26	
Master lesson	Unit 9	CEHJ2	2	28	
Computer Classroom Practice	Practice 5	CEHJ2	2	30	
Thematic block 'Irrigation'					
Master lesson	Unit 1	RA1	1	31	Exam 2
Master lesson	Unit 2	RA2	2	33	
Master lesson	Unit 3	RA3	2	35	
Problems and cases	Unit 3	RA3	3	38	
Master lesson	Unit 4	RA4	2	40	
Problems and cases	Unit 4	RA4	1	41	
Master lesson	Unit 5	RA5	4	45	
Problems and cases	Unit 5	RA5	3	48	
Master lesson	Unit 6	RA5	2	50	
Problems and cases	Unit 6	RA5	2	52	
Master lesson	Unit 7	RA5	2	54	
Problems and cases	Unit 7	RA5	1	55	
Laboratories Practice	Practice 1,2	RA2, 4 i 5	2	57	
Technical visit		RA1, 2, 3 i 5.	3	60	
Totals			60		

The objectives to be achieved are:

Block 'Irrigation'

- RA1: Understand the importance of irrigation and irrigation methods.
- RA2: Know the elements and equipment of irrigation facilities.
- RA3: Know how to do the agronomic design of irrigation and irrigation programming
- RA4: Know how to evaluate the quality of irrigation in an installation
- RA5: Sizing the pipes of the irrigation facilities

Evaluation

Activities

Activity type	Evaluatory activity		Rating weight (%)
	Process	Number	
Thematic block 'Agricultural Equipment'			
Master lesson	Written tests on theory and practical cases	1	40
Problems and cases			
Laboratory / Field	Delivery memory of practices	3	10
Aula Informática			
Technical visit			
Thematic block 'Irrigation'			
Master lesson	Written tests on theory and practical cases	1	40
Problems and cases			
Problems and cases	Problems to do at home	5	5
Laboratory	Delivery memory of practices	1	5
Total			100

Observations

Thematic block 'Agricultural Equipment'

The block of 'Agrarian Teams' is developed in 9 theoretical sessions (14 hours), corresponding to the 9 topics in which the agenda is structured. These theoretical sessions are complemented with four practical activities: a) 4 classroom sessions (4 hours) focused on solving problems and cases; b) 2 practicals in the computer room (4 hours), where the student will become familiar with the possibilities of a spreadsheet when estimating the costs of using the machines and with specific software for geostatistical analysis and management data in precision agriculture; c) 3 field practices (6 hours), for learning the basic guidelines for regulating the machinery commonly used for the distribution of agrochemicals and the procedures that allow field trials; d) 1 visit (2 hours) to companies related to the agricultural mechanization sector.

Of the camp practices, the student will have to present a final report with the following sections: proposal and objectives of the practice, materials and methodology used, results and discussion. From the practices in the computer room, the student will have to present a report. Attendance at all practical sessions is compulsory.

For the purposes of grading the block 'Agricultural Equipment', the student will take a written test (exam) where the knowledge and skills acquired throughout the development of the subject will be evaluated. The exam syllabus for this test will include the concepts explained in the theoretical sessions and in the problem solving sessions. The weight attributed to the exam will be 40% of the final grade. The remaining 10% of the student's qualification will

result from the evaluation of the memory presented from the field practices, and from the report or course work.

Thematic block 'Irrigation'

The 'Irrigation' block will be developed in 7 theoretical sessions (15 hours), corresponding to the 7 topics in which the agenda is structured. These theoretical sessions are complemented by three types of practical activities: a) 5 classroom sessions (10 hours) focused on solving problems and cases; b) 2 laboratory and field practices (2 hours), aimed at the hydraulic characterization and modeling of elements of an irrigation installation, as well as the evaluation of irrigation installations; i c) 1 visit (3 hours) to irrigation facilities.

From the laboratory practices the student will have to present a final report with the results and their discussion. Attendance at all practical sessions is compulsory.

For the purposes of qualifying the 'Irrigation' block, the student will take a written test (exam) where the knowledge and skills acquired throughout the course of the course will be evaluated. The exam syllabus for this test will include the concepts explained in the theoretical sessions and in the problem solving sessions. The weight attributed to the exam will be 40% of the final grade. The remaining 10% of the student's qualification will result from the correction of the problems and exercises ordered (5%) and the memory presented from the laboratory practices (5%).

Subject set

To pass the subject per course it will be necessary to pass the two exams (being able to average from 4) and deliver the exercises, practices and reports. The final grade will be established according to the weighting assigned in the previous table. The block/s with failed exams may be recovered in the final call. The subject will be passed when a grade greater than or equal to 5 points is obtained.

Bibliography

Basic bibliography

A) Agricultural Equipment

- a. MÁRQUEZ, L. 2004. *Cuadernos de agronomía y tecnología. Maquinaria agrícola*. Torrelodones (Madrid): B&H Grupo Editorial.
- b. MÁRQUEZ, L. 2012. *Tractores agrícolas: tecnología y utilización*. Torrelodones (Madrid): B&H España S.L., Editores.
- c. VÁZQUEZ, J. 2003. *Aplicación de productos fitosanitarios. Técnicas y equipos*. Madrid: Ediciones Agrotécnicas, S.L.

B) Irrigation

- BARRAGÁN J, MONSERRAT J. 2004. *Algunas notas para clase de: Hidráulica y riegos*. Lleida: ETSEA. Universidad de Lleida.
- FERNÁNDEZ R, ORTIZ V, ANDALUCÍA, UNIÓN EUROPEA. 1999. *Vol 1: Fundamentos del riego. Vol 3 Riego por aspersión. Vol 4 Riego localizado*. Córdoba: Junta de Andalucía, Consejería de Agricultura y Pesca.
- PIZARRO F. 1996. *Riegos localizados de alta frecuencia (RLAF): Goteo, microaspersión, exudación*. 3ª ed. Madrid etc.: Mundi-Prensa.
- TARJUELO JM. 2005. *El riego por aspersión y su tecnología*. 3ª ed. Madrid etc.: Mundi-Prensa.

Further reading

A) Agricultural Equipment

- ARNÓ, J. ; GRACIA, F.J. ; MASIP, J. ; PLANAS, S. ; BARANDA, M. 1998. *Equipos mecánicos de asistencia para la recolección de fruta*. Estudios de Mecanización Agraria, 1. Madrid: Ministerio de Agricultura, Pesca y Alimentación.
- BOTO, J.A. ; LÓPEZ, F.J. 1999. *La aplicación de fitosanitarios y fertilizantes*. Universidad de León.
- GIL, E. 2003. *Tratamientos en viña. Equipos y técnicas de aplicación*. Barcelona: Edicions UPC, Polítext

145. Universitat Politècnica de Catalunya.

B) Irrigation

- ÁVILA R. 2004. *Manual de riego de jardines*. Sevilla: Junta de Andalucía Consejería de Agricultura y Pesca. Viceconsejería. Servicio de Publicaciones y Divulgación.
- KELLER J, BLIESNER RD. 1990. *Sprinkle and trickle irrigation*. New York etc.: Chapman & Hall.
- MONTALVO LÓPEZ, T., 2007. Riego localizado: diseño de instalaciones. 2ª ed. Valencia: Ediciones VJ.
- RODRIGO J, CENTRO NACIONAL DE TECNOLOGÍA DE REGADÍOS, ESPAÑA. 1997. *Riego localizado*. 2ª ed. Madrid: Ministerio de Agricultura, Pesca y Alimentación.
- SANTOS, L y col. 2010. *El riego y sus tecnologías*. (1ª ed. castellana). Albacete: Centro Regional de Estudios del Agua. Universidad de Castilla-La Mancha. Web: crea.uclm.es.