



Universitat de Lleida

# DEGREE CURRICULUM **IRRIGATION AND AGRICULTURAL MACHINERY**

Coordination: COTS RUBIO, LLUIS

Academic year 2022-23

## 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	1	1	1
Coordination	COTS RUBIO, LLUIS				
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 <a href="#">this link</a> for more information.				
Language	Catalan: 100%				

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
COTS RUBIO, LLUIS	lluis.cots@udl.cat	3	
LLORENS CALVERAS, JORDI	jordi.llorens@udl.cat	3	

## 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

CB1. That students have demonstrated to 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.

CG1. Capacity for the prior preparation, conception, drafting and signing of projects that have as their object the construction, reform, repair, conservation, demolition, manufacture, installation, assembly or exploitation of movable or immovable property that due to its nature and characteristics are included in the own technique of agricultural and livestock production (facilities or buildings, farms, infrastructures and rural roads), the agrifood 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 restoration).

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, agrifood 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.

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

CG10. Ability to search and use the rules and regulations related to its scope of action.

CG12. Ability to work in multidisciplinary and multicultural teams.

CT1. Correction in oral and written expression.

CEHJ2. Ability to know, understand and use the principles of: Engineering of green areas, sports spaces and fruit and vegetable farms. Civil works, facilities and infrastructures of green areas and protected areas. Electrification. Irrigation and drainage. Machinery for horticulture and gardening.

## 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	Total time	
		Goals	Hours	Student work	Hours		Hours	Hours
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
						2		

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Problemas y casos	Participatory class (Classroom. Large group)	Application of the theoretical concepts	4	Solve problems and cases	8		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'					

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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.
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## 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			
Computer Classroom	Delivery memory of practices	3	10
Technical visit			
Thematic block ‘Irrigation’			
Master lesson	Written tests on theory and practical cases	1	40
Problems and cases	To do at home and that they will have to explain in class how they have solved it and that they will comment	5	5
Laboratory	Delivery report of practices and evaluation with oral questions	1	5
Technical visit			
Total			100

### Observations

#### Thematic block 'Agricultural Equipment'

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 of the activity of cost calculation.

#### 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 grading the "Irrigation" block, students will take an exam where the knowledge acquired will be evaluated, which will have a weight of 40% of the final grade. The resolution of problems sent to the students and that they will have to explain in class how they have solved it and then they will comment will be worth 5% more. And the remaining 5% will be from laboratory practices, which will be assessed with 1% memory and 4% exam questions.

## 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

- Márquez Delgado, Luis. Maquinaria agrícola: preparación primaria, trabajo del suelo, Siembra, plantación y trasplante, Distribución de fertilizantes, Protección de los cultivos. Madrid: Blake y Helsey España, 2004.
- Mendieta, Julián, and Luis. Márquez Delgado. Vademécum de maquinaria agrícola 2009-2010: equipos de recolección para cereal, forraje, olivo, frutas, hortalizas, tubérculos y vid. Madrid: Blake & Helsey España, 2009.
- Márquez Delgado, Luis. Maquinaria para la preparación del suelo, la implantación de los cultivos y la fertilización. Madrid: Blake y Helsey España, 2001.
- Mendieta, Julián. Guía sólo de tractores y cargadoras telescópicas 2003. Madrid: Blake & Helsey España, 2003.
- Zhang, Qin. Precision Agriculture Technology for Crop Farming (Edition 1). 1st ed. Boca Raton: CRC Press, 2015. Web.
- Graham Matthews, Matthews, Miller Paul Miller, and Bateman Roy Bateman. Pesticide Application Methods. Wiley-Blackwell, 2014. Web.

#### 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](http://crea.uclm.es).