



## Study Plan

**School:** School of Sciences and Technology  
**Degree:** Master  
**Course:** Agronomical Engineering (cód. 448)

### 1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
ERU10436M	Bio-system Soil-Water-Plant-Atmosphere	Rural Engineering	6	Semester	156
MAT10167M	Experimental Design	Mathematics	6	Semester	156
ERU10437M	Applied Hydraulics	Rural Engineering	6	Semester	156
ERU10438M	Environmental Control	Rural Engineering	6	Semester	156
GES8066M	Agri-Business Planning	Management	6	Semester	156

### 1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIT10439M	Plant Breeding and Biotechnology	Agronomy	6	Semester	156
FIT10440M	Crop Protection	Agronomy	6	Semester	156
FIT10441M	Temperate fruit production	Agronomy	6	Semester	156
FIT10442M	horticulture Herbaceous	Agronomy	6	Semester	156
ERU10443M	Analysis and Technology of irrigation systems	Rural Engineering	6	Semester	156

### 2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
ERU10444M	Project in Agronomical Engineering	Rural Engineering	9	Semester	234
ERU10445M	Dissertation Seminar	Rural Engineering	3	Semester	78



## 2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
<b>Group of Options</b>					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIT10446M	Crop Protection II	Agronomy	6	Semester	156
FIT10447M	Conservation Agriculture	Agronomy	6	Semester	156
FIT10448M	Forest Management and Planning	Agronomy	6	Semester	156
FIT10449M	Crops and grass cultivation	Agronomy	6	Semester	156
FIT10450M	Postharvest and Quality Instrumentation of Horticultural Products	Agronomy	6	Semester	156
ERU10451M	Irrigation and Drainage Systems Design	Rural Engineering	6	Semester	156
ERU10452M	Precision Agriculture	Rural Engineering	6	Semester	156
ERU10453M	Planning of Rural Facilities and Equipment	Rural Engineering	6	Semester	156
ERU9682M	Farm Mechanisation Projects	Rural Engineering	6	Semester	156
Dissertation					

## 2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
Dissertation					

### Conditions for obtaining the Degree:

\*\*\* TRANSLATE ME: Para aprovação na componente curricular é necessário a aprovação (através de avaliação ou creditação das seguintes unidades curriculares:

1º Semestre { \ } newline

5 UC obrigatórias num total de 30 Ects { \ } newline

{ \ } newline

2º Semestre { \ } newline

5 UC obrigatórias num total de 30 Ects { \ } newline

{ \ } newline

3º Semestre: { \ } newline

2 UC Obrigatórias num total de 12 Ects { \ } newline

1 UC optativa num Total de 6 Ects { \ } newline

{ \ } newline

Para obtenção do grau é necessário também a aprovação em Dissertação, no total de 42 ECTS, no 3.º e 4.º Semestre. \*\*\*

## Program Contents



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### **Bio-system Soil-Water-Plant-Atmosphere (ERU10436M)**

Climate and its influence on crop growth; climate and weather conditions; balance of radiation; air temperature and flow of sensible heat; air humidity and flow of latent heat; wind and turbulent transportation; heat flux and soil temperature; degree-days; hours of cold; frost;

Energy balance; conservation of energy; transport of energy;

Soil water; balance of mass and soil water flux; flux and transport of water in saturated and non-saturated soils;

Crop water needs and crop productivity; water use efficiency; deficit irrigation; salinity and water stress in the productivity of crops;

Water movement in plants; mechanisms; stomata closure and water stress; photosynthesis and respiration; interception of radiation and crop development and growth; growth hormones; photo-periodism and vernalization; physiologic response of crop to climatic changes and conditions;

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### **Experimental Design (MAT10167M)**

Scientific method and experimental design.

Analysis of variance models: fixed effects (single and multiple factor), random effects (single and multiple factor) and mixed effects.

Split-plot and nested designs.

Multiple comparisons.

Complete and incomplete block designs. Latin square designs.

Non-parametric approaches.

Simple linear regression model and multiple regression model (estimation, inference, prediction, model adequacy and validation).

Diagnostics for influence points, outliers,

multicollinearity and autocorrelation. Model selection.

Analysis of Covariance.

Nonlinear Regression.

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### **Applied Hydraulics (ERU10437M)**

1. Fluids physical properties. 2. Hydrostatics: Hydrostatic pressure; Pressure measurement; Manometers; hydrostatic impulsion, calculation of impulsion over floodgates (plane and radial). 3. Hydrocinematics: Types of flow; Continuity equation; Applications.

4. Hydrodynamics: Bernoulli Theorem, application to real fluids; Hydraulic power. 5. Pressurized flows: Friction losses in irrigation pipes; Local friction losses; Calculation of installations and pipe trajectory. 6. Pumps: Pump selection; Problems in centrifugal pumps: cavitation; Pump stations. 7. Free surface flow: Types of flow; Application of the Bernoulli Th. to open channels flow; Uniform flow in channels; Gradually varied flow: backwater effect and hydraulic jump; Flow control in open channels; Irrigation and drainage channels design. 8. Holes and Weirs: Control and measurement of flow.

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### **Environmental Control (ERU10438M)**

1. Introduction. Importance of the environmental control in rural buildings

2. Energy and mass balances. General and simplified equations; Project conditions; Heat transfer processes.

3. Psychometrics. State equations; Temperature and air humidity; psychometric map; Environmental control processes.

4. Thermal insulation. Heat transfer through construction materials; Thermal resistance and global heat transfer coefficient.

5. Condensation. Surface condensation and control methods.

7. Ventilation. Objectives; methods to calculate ventilation rates; Natural and forced ventilation.

8. Acclimatization. Heating systems. Cooling systems; Resolution of problems to determine heating/cooling needs for greenhouses, cold facilities and animal buildings.



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### **Agri-Business Planning (GES8066M)**

1. Framing and basic concepts
  - 1.1. Planning as a step of decision process
  - 1.2. The concept of agribusiness
  - 1.3. Agribusiness levels of analysis and representation
  - 1.4. New concepts and trends
2. Strategic planning of agribusiness
  - 2.1. The value chain and its segments
  - 2.2. The environmental and market analysis in the agribusiness
  - 2.3. The strategic planning process
  - 2.4. The marketing-mix
  - 2.5. Planning and budgeting
3. The project of product in the agribusiness
  - 3.1. Project management
  - 3.2. Development strategy of new products
  - 3.3. Development process of new products
  - 3.4. Performance assessment of new products
4. Marketing and logistic channels in agribusiness
  - 4.1. The concept of logistic
  - 4.2. Decisions of logistic
  - 4.3. Logistic activities

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### **Plant Breeding and Biotechnology (FIT10439M)**

Genetic bases of plant breeding - Review of basic knowledge

Breeding Methods - self-pollinated, cross-pollinated and asexually propagated crops

Biotechnology and genetic engineering in plant breeding - Applications of Plant Genetic Engineering and biotechnology. In vitro culture techniques. Gene screening, isolation, synthesis, gene cloning and gene transfer. Biosafety issues of transgenic crops.

Molecular Breeding - Marker assisted selection

Breeding for specific purposes - breeding for resistance/tolerance to biotic and abiotic stress. Genetic, physiological and molecular mechanisms of disease and insect pest resistance. Breeding for tolerance to abiotic stresses: moisture, salinity, alkalinity, water logging, temperature etc. Morphological, physiological and genetic basis of abiotic stresses.

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### **Crop Protection (FIT10440M)**

1. Integrated Plant Disease Management. Study of methods, measures, strategies and tactics used in IDM: Exclusion; Eradication; Protection); and Resistance (includes resistant plants obtained by genetic engineering/GMOs, use of "plant activators" to potentiate systemic acquired resistance/SAR, etc).

Importance of crop scouting and use of combination of strategies, as monitoring climate factors, disease forecasting models and economic thresholds, in a coordinated integrated manner, to obtain maximum benefits.

2. Integrated Pest Management (IPM). Study of the relevant methods, measures, strategies and tactics used in IPMI, considered in 3 phases: Estimation of the Damage Risk, Economic Threshold and Control measures/Protection. Includes discussing and analysing pest control methods, as biological, cultural, biotechnical, genetic and chemical methods, their applicability, advantages and limitations, of their use within the framework of the Integrated Pest Management.



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### **Temperate fruit production (FIT10441M)**

1- The species of temperate fruit zone. Centre of origin and the actual fruit production region 2- Orchard establishment. Root system of fruit trees. Preparation and soil correction to planting. Plant distance, training system and project design.3- Floral biology and fruit set. Flower bud development.Hormonal control. Time of bloom and pollination process,events in fruit set and fruit growth.4- Prunus species and rootstocks.Training systems, Vigour management and productivity. Alternate bearing. Maturity process and quality.Pruning. 5- Pome fruit species and rootstocks. Training systems and pruning. Fruit set control and quality.6- Nut species and production systems. Mechanical harvesting and pruning. Fruit drying 7-Floor orchard management and soil conservation.8- Canopy fruit trees protection and microclimate control.9-Water and nutrient utilization by fruit trees. Water requirements, control of tree growth by water management. Nutritional status of fruit trees.

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### **horticulture Herbaceous (FIT10442M)**

1. Introduction  
Economic importance of vegetal production in Portugal  
Nutritional importance of vegetables

2. Forced crops  
Concepts and definitions  
Effects of the growing environment on plant development and fruit yield  
Carbon dioxide fertilization  
Technology of production of major vegetable crops

3. Open field production  
Seminal propagation  
Plant production  
Methods of crop establishment  
Technology of production of major vegetable crops

4. Organic agriculture

5. Irrigation-Moisture management

6. Mineral nutrition  
Sustainable fertilization in intensive vegetable production  
Fertigation, hydroponics.

7. Horticultural practices

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### **Analysis and Technology of irrigation systems (ERU10443M)**

Introduction: Soils, soil water, water retention by the soil, infiltration. Topographic survey.  
Crop water needs: Evapotranspiration, factors affecting water loss from plants, calculation methodologies.  
Water management: Management based on evapotranspiration, soil moisture content and canopy characteristics. Equipment.  
Irrigation scheduling.  
Irrigation systems:  
Surface Irrigation: Principles of surface Irrigation and management. Evaluation and improvement of irrigation quality. Automation and equipment.  
Sprinkler irrigation: General principles of sprinkler irrigation operation and design. Equipment. Pumps and hydraulic design. Evaluation.  
Drip irrigation: Principles of design and operation. Hydraulic design. Emitter hydraulics. Equipment: drippers, tubing, filters, pumps, electro valves, etc. Evaluation  
Irrigation automation: Systems and equipment for automatic management of irrigation



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### **Project in Agronomical Engineering (ERU10444M)**

1 – Introduction to Engineering design

Concepts and fundamental rules for the designer. Project conception, elaboration, presentation, and implementation. Designing phases. Project parts: graphic pieces, texts.

2 – Planning for the agricultural activities

Teachers' presentation of the Project Preliminary Program. Agriculture, cattle rising, forest management.

Choosing the activities according to the available resources and environmental constraints.

3 – Farm machinery and mechanization project

Field work. Economy. Energy.

4 – Farm buildings design

Space management. Environmental conditioning.

5 – Irrigation and drainage systems design

Irrigation and drainage technology. Soil and water conservation technology.

6 – Socioeconomic evaluation of the Project

Agricultural production economy. Farm management.

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### **Dissertation Seminar (ERU10445M)**

1 - Introduction

2 – The nature of scientific knowledge

2.1 Introduction

2.2 Knowledge and levels of knowledge

2.3 Scientific curiosity and applied research

3 – The scientific method

3.1 Introduction

3.2 The scientific method and processes to use it

4 – Organization and development of a scientific work

4.1 Introduction

4.2 Choice of a research topic

4.3 Problem identification

4.4 Definition of objectives for the research

4.5 Methodology and methods of analysis

4.6 Information gathering and data collection

4.7 Results and discussion

4.8 Conclusion and suggestions for further research

4.9 Bibliography

4.10 Timetable

5 – Concept and public presentation of the dissertation, monograph or thesis report.

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### **Crop Protection II (FIT10446M)**

The subject(s) of this course will change every year. Matters to be covered are related to plant protection in several ways, require previously knowledge on several areas, and will be dealt with by different conference speakers. These will be professors from both national and international universities, specialists and policy makers concerning agricultural/food industries related fields.

Examples of topics to be addressed: 'Climate

changes and risk of emergence of new parasites'; 'Biological control of plant parasites in agriculture – where do they come from and what is their fate'; 'Biofungicides – case studies'; 'Mycotoxins in crops, a threat to animal and human health'; 'Transgenic herbicide - resistance crops: a potential to increase food yield?'; 'Biosecurity and bioterrorism'; 'New strategies to stimulate plant innate defense mechanisms'; 'New developments in epidemic risk forecast'; etc.



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### **Conservation Agriculture (FIT10447M)**

Conservation tillage systems

Crop rotations

Management of crop residues

Evolution of soil properties under conservation agriculture

Weed management under conservation agriculture

Utilization of no-till seeders

Strategies to start conservation agriculture in different soils and cropping systems

Climatic variability and strategies to increase use efficiency of different production factors under Mediterranean environment.

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### **Forest Management and Planning (FIT10448M)**

The main topics of this course area:

1 Forest and natural resources management; 2 Valuation and characterization of forest sites; 3 Estimation and projection for forest stands according with site conditions; 4 Optimization of objectives at tree and stand levels; 5 Advance forest planning techniques; 6 Mathematical concepts of sustainability for forest and natural resources; 7 Modeling forest stand structures; 8 Control technique for amenities production and biodiversity enhancement objectives; 9 Hierarchical systems for planning and scheduling management activities; 10 Forest supply chain management; 11 Carbon sequestration; 12 Forest certification.

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### **Crops and grass cultivation (FIT10449M)**

Traditional field crops: cereals, oil crops, and pulse crops (economic importance, ecological requirements, botanical aspects, and respective technical itinerary.

Forage and pasture crops: establishment, species to establish ( annual and perennial legumes and grasses; types of mixtures for rainfed and irrigation conditions), and management techniques.

Forage conservation methods.

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### **Postharvest and Quality Instrumentation of Horticultural Products (FIT10450M)**

1.POST harvest Social AnD economical role

2.PHYSIOLOGY: Morphological aspects. Chemical composition and nutritional value of fruits and vegetables. Post harvest principal changes. Ripening processes. Changes in texture. Damages and bruises in fruits. Respiratory process. Vegetable senescence process. Water loss.

3.Fruits and vegetables Quality. Quality concept. Instrumental methods for measuring quality. Rheology concepts. Mechanical Impact, electronic fruit. Practical methods to assess physical and chemical characteristics: size / weight, color, texture, acidity, pH, soluble solids.

New applications: HPLC and NIR. Sensory evaluation.

4.POST harvest treatments.Storage strategies considering different goals. Ethylene use for ripe and quality control. Methods for ethylene use. Inhibition of ethylene biosynthesis. Enzymatic inhibitors. Genetic manipulation of ripening process. Cold storage. Pre-cooling."Delayed storage" in specific fruits. Controlled atmosphere. Metabolic effects.



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### **Irrigation and Drainage Systems Design (ERU10451M)**

1. Trends on Project elaboration and implementation.

Preliminary Program (PP)

Land surveying. Maps (topography and soil). Agricultural statistics.

Recommendations for the Base Program (BP) elaboration.

Irrigation delivering systems. Irrigation management. Crop water requirements.

Elaboration of the Base Program.

Methodologies used in public services and Project companies.

a) Presentation and discussion of the Base Program.

Presentation and discussion of the Preliminary Project. Evaluation.

First approach to environmental impact assessment.

Small dams design.

Ante-Project approach. Orientation.

Economical evaluation of the Project. Financial budget.

Presentation and discussion of the Ante-Project. Evaluation.

b) Advice for the Preliminary Project.

c) Revisions on sprinkling, trickle, and surface irrigation systems.

Designing Land planning and designing systems for irrigation, drainage, and soil and water conservation

Drainage systems design and evaluation.

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### **Precision Agriculture (ERU10452M)**

Introduction to Precision Agriculture: Precision Agriculture Cycle.

Precision Agriculture and GPS

The importance of GIS and Remote Sensing in Precision Agriculture

The decision: i) in real time; ii) based in previous information. Study cases: The yield spatial and temporal variability (cereals: dry and irrigation production), pasture quality differential management, grape quality differential management, precision irrigation.

Production factors differential application.





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### **Planning of Rural Facilities and Equipment (ERU10453M)**

1. Planning rural buildings
  - Legislation
  - environmental aspects
  - technical-economic aspects
  - Location and dimensions
  - Functionality
2. Construction technology
  - Structures and materials strength
  - construction materials
3. Dimensions for several rural buildings
  - Storage facilities
  - Cold chambers
  - Greenhouses
  - Animal housings
4. Environmental control
  - Thermal balances
  - Selection of environmental control systems
5. Technical and economic viability.

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### **Farm Mechanisation Projects (ERU9682M)**

- 1 - Basics of Agricultural Mechanization
- 2 – Operator Productivity
- 3 - Machine Performance
- 4 - Soil, Weather and workdays
- 5 – Tractive performance and power selection
- 6 – Tractor selection
- 7 – Machinery costs
- 8 – Machinery Selection and replacement