



## Study Plan

**School:** School of Sciences and Technology  
**Degree:** Master  
**Course:** Forestry Engineering: Mediterranean Systems (cód. 359)

### 1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT10014	Experimental Design Methodologies	Mathematics	6	Semester	156
MAT10015	Fundamentals of Operations Research	Mathematics	6	Semester	156
GEO10016	Soil, Climate and Forestry Systems	Geosciences	6	Semester	156
FIT10017	Fundamentals of Forestry	Forest Sciences	6	Semester	156
FIT10019	Dendrometry and Biometry	Forest Sciences	6	Semester	156

### 1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
PAO10020	Sustainability of Forestry Systems	Biology / Environmental Sciences and Ecology	6	Semester	156
GEO10021	Soil, Climate and Management of Forestry Resources	Forest Sciences	6	Semester	156
FIT10022	Applied Forestry	Forest Sciences	6	Semester	156
FIT10023	Forest Inventory and Modelling	Forest Sciences	6	Semester	156
ECN10024	Economics of Forestry Production	Economy	6	Semester	156

### 2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
ECN10025	Economics and Management of Forestry Systems	Economy	6	Semester	156

#### Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIT10026	Mediterranean Systems Forestry	Forest Sciences	6	Semester	156
FIT10027	Forestry-based Livestock Production	Forest Sciences/ Agronomy	6	Semester	156
FIT10028	Forestry Planning	Forest Sciences	6	Semester	156
FIT10029	Forest Use Planning	Forest Sciences	6	Semester	156
PAO10030	Forest Biology and Game	Biology / Environmental Sciences and Ecology	4	Semester	104
PAO10031	Inland Waters Planning	Biology / Environmental Sciences and Ecology	4	Semester	104
BIO10032	Forest Ecophysiology	Biology	4	Semester	104

#### Group of Free Options

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 deste Mestrado, é necessário a aprovação (através de avaliação ou creditação) das seguintes unidades curriculares: {\ }newline

1.º Semestre {\ }newline

- 5 UC Obrigatórias num total de 30 ECTS {\ }newline

2.º Semestre {\ }newline

- 5 UC Obrigatórias num total de 30 ECTS {\ }newline

3.º Semestre {\ }newline

- 1 UC Obrigatória num total de 6 ECTS {\ }newline

Os alunos têm de completar no 3.º semestre, 12 ECTS em optativas pertencentes ao Grupo I ou como optativas livres. {\ }newline

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

## Program Contents

[Back](#)

### Experimental Design Methodologies (MAT10014)

[Back](#)

### Fundamentals of Operations Research (MAT10015)

- 1-Introduction to the methodology of operations research
- 2-ProblemFormulation
- 3-Linear programming
- 4-Optimization in networks and graphs
- 5-Project management
- 6-Decision theory

[Back](#)

### Soil, Climate and Forestry Systems (GEO10016)

- 1.The climate in forest systems. Boundary layer. The active surface in forest ecosystems. 2. Physical and meteorological principles of Microclimatology. Energy and radiation at the soil surface. Atmospheric thermodynamics and Vertical Stability. Wind. The hydrologic cycle Soil water balance. Soil climate. 3. Heat, mass and momentum transfer in the boundary layer. Aerodynamic method. 4. Microclimate of simple non-vegetated surfaces. Bare soil and water surfaces. 5. Microclimate of vegetated surfaces. Forest microclimatology 6. The role of forests in the hydrological cycle. 7. Vegetable production and development. Insolation, water and temperature effects. Phenology. 8. Soil functions in forest ecosystems. 9. Soil Classification. Portuguese soil classification and the taxonomic system "World Reference Base for Soil Resources". 10. Soil mapping.



[Back](#)

### **Fundamentals of Forestry (FIT10017)**

1. Notion of tree, 1.1 Tree functioning, 1.2 Tree growth, 2. Notions of dendrology of forest species, 3. Ecological and cultural characteristics of the forest species, 4. Notion of forest system, 4.1 The forest, 4.2 The stand, 4.3 The site, 5. Distribution and evolution of the forest formations in Portugal and in the world, 6. Characterisation of the forest stands, 6.1 Regime, composition and structure, 6.2 Stand structure analysis, 6.3 Tree and stand growth, 6.4 Diagnosis of the present state of a stand, 7. Regeneration techniques, 7.1 Manipulation of forest seeds, 7.2 Seed producing areas, 7.3 Methods of propagation and production of plants, 8. Forestations, 8.1 Site preparation, 8.2 Species, provenances and spacing selection, 8.3 Stand installation operations, 8.4 Special forestations, protection stands and clonal forest.

[Back](#)

### **Dendrometry and Biometry (FIT10019)**

1 The mathematical and statistical concepts of mensuration; 2 Individual tree mensuration; 3 Stand mensuration; 4 Tree growth mensuration; 5 Stand growth mensuration; 6 Herbaceous and shrub strata mensuration; 7 Soil organic layer mensuration.

[Back](#)

### **Sustainability of Forestry Systems (PAO10020)**

1 ? Introduction 1.1 ? Course Overview 1.2 - Biogeography and bioclimatology. Concepts review and consolidation 2 - Characterization of the main vegetation within forest ecosystems 2.1 ? Woodlands 2.2 ? Scrublands 2.3 - Shrublands, 2.4 - secondary scrub communities 2.5 - Perennial grasslands 2.6 ? Annual grasslands 3 - Major Vegetation Series and geoseries 3.1 - Ecological succession (progressive and regressive) 3.2 ? Climatophilous series 3.3 - Edapho-hygrophilous, and edapho-xerophilous series 3.4 - Vegetation Geoseries and geopermaseries 3.5 - Vegetation dynamic analysis as basis for natural systems management and conservation. 4- Forest sustainable management. 4.1 - Legal background to the flora and vegetation conservation and management 4.2 - Management and conservation of unique habitats 4.3 ? Monitoring 4.4 - Natural and semi-natural habitats recovery and enhancement: particular cases study.

[Back](#)

### **Soil, Climate and Management of Forestry Resources (GEO10021)**

1. Examples of interactions of trees with the soil and climatic environment with emphasis on feedback systems. 2. The effects of spatial inhomogeneity and topography on microclimate. 3. Man-modified environments. 4. Influence of forest interventions on microclimate and hydrology of forest systems. 5. The climatology of the forest fires. 6. Torrential control 7. Regulating water regime of forest stands 8. Influence of the forests in the hydrologic system 9. Soil quality and productivity of forest systems. Land evaluation for forestry uses. 10. Major biogeochemical cycles, carbon cycle and major nutrient cycles. Consequences of management practices on the dynamics of biogeochemical cycles and the maintenance of long-term productivity. 11. Logging operations, its impacts on soil and runoff. Techniques of land preparation for afforestation. 12. Processes of soil degradation of natural and anthropogenic origin. 13. Conservation and reclamation in forested areas.

[Back](#)

### **Applied Forestry (FIT10022)**

1. Classical and modern silviculture, 2. Even-aged stands, 2.1. Structure analysis and tree spatial distribution in the stand, 2.2. Models of silviculture, 2.3. Regeneration, 3. Uneven-aged stands, 3.1. Structure, diversity and tree spatial distribution in the stand, 3.2. Models of silviculture, 3.3. Regeneration, 4. Mixed stands, 4.1. Structure, diversity and tree spatial distribution in the stand, 4.2. Models de silviculture, 4.3. Regeneration, 5. Stand structure alteration, 5.1 Conversion, 5.2 Transformation, 6. Close to nature silviculture, 6.1 Frame and definitions, 6.2 Models of silviculture, 6.3 Regeneration, 7. Stand and forest management, 7.1 Uneven-aged stand, 7.2 Mixed stands, 7.3 Protection and conservation stands, 8. Forest certification, 9. The Portuguese case, 9.1 Uneven-aged stands of cork oak, umbrella pine and sweet chestnut, 9.2 Mixed stands of oak and umbrella pine, maritime pine and sweet chestnut, 9.3 Stands directed towards protection and conservation.



[Back](#)

### **Forest Inventory and Modelling (FIT10023)**

Forest inventory. Sampling theory and statistical inference: 1 Sampling units; 2 Simple and stratified random sampling; 3 Regression estimators and proportions; 4 Double sampling; 5 Double Sampling; 5 Sampling proportionally with the dimension; 6 Multistage sampling; 7 Systematic sampling; 8 Rare populations sampling.

Modeling : 1 Importance of growth models and its classification; 3 Growth function from empirical to mechanistic theory; 4 Growth curves and its application; 5 Stand growth models with and without diameter distribution simulation; 6 Spatial and non spatial tree growth models; 7 Simulation studies using Portuguese available growth models.

[Back](#)

### **Economics of Forestry Production (ECN10024)**

The main topics of this course are:

- Economics of production: how to produce, how much to produce and what to produce;
- How to take decisions when variable time is involved in the production process;
- Evaluation of receipts and expenditures through out the time;
- Explanation of basic notions of the decision theory;
- The market: characteristics of the most important market organizations;
- Causes and consequences of government market interventions.

[Back](#)

### **Economics and Management of Forestry Systems (ECN10025)**

The main topics of this course area:

- ? Multifunctionality of forestry systems
- ? Most relevant sources of costs and revenues of forest
- ? How to value the goods and services produced in forest
- ? Rational exploitation of renewable natural resources
- ? Cost benefit analysis
- ? Forestry policies: national and of the European Union.

[Back](#)

### **Mediterranean Systems Forestry (FIT10026)**

(1) The forest systems in a ecological and economical perspective; (2) The concept of multifunctionality and multiple use of forest systems; (3) Multifunctional silviculture; (4) Forest system functionality concepts; (5) The forests systems and its biodiversity; (6) Aforestation and silviculture methods; (7) Special conditions of application of silviculture methods, the Mediterranean forests and oak woodland forests ("montado").

[Back](#)

### **Forestry-based Livestock Production (FIT10027)**

History of land use.

Silvopasture systems

Characterization and role of this systems

The Alentejo and Mediterranean forestry (Montado) in the past:

Ager, The Saltus and sustained Silva;

The degradation of the systems (ex:Montado).

Biodiverse permanent pasture rich on legumes in the forestry systems

(Species, installation and management).

The agricultural and environmental multifunctionality of the forestry systems.



[Back](#)

### **Forestry Planning (FIT10028)**

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 Linear problems and graphical solution techniques; 6 Linear programming applied to forest management problems; 7 Advance forest planning techniques; 8 Mathematical concepts of sustainability for forest and natural resources; 9 Modeling forest stand structures; 10 Control technique for amenities production and biodiversity enhancement objectives; 11 Spatial restrictions and considerations for forest planning; 12 Hierarchical systems for planning and scheduling management activities; 13 Forest supply chain management; 14 Carbon sequestration; 15 Forest certification.

[Back](#)

### **Forest Use Planning (FIT10029)**

1. Frame, 2. Concepts and definitions, 3. Planning at National Level, Territorial Planning Plan, National Forest Strategy, National Forest Inventory, Forest Defence Against Forest Fires, 4. Planning at Regional Level, Municipality Plan, Municipality Plan of Forest Defence Against Forest Fires, National Ecological Reserve, Protected Areas, 5. Methodologies for the elaboration of planning plan, characterisation and general and specific objectives, frame, scale, territorial frame, legal frame, space characterisation, land and forest use, geomorphological and biophysical characterisation, protection areas, trees and forest stands of special value, forest infra-structures, accessibility and recreation, hazards identification and characterisation, aptitude areas for the forest species, homogeneous zones and functionalities, plan characterisation, objectives, territorial organisation models, proposals of intervention, 6. Forest certification.

[Back](#)

### **Forest Biology and Game (PAO10030)**

Bio-ecology of the main sedentary game species in Portugal. Game management basis: spatial ecology (habitat use) and population dynamics of small and big game most important species. Management design: carrying capacity, population estimation and harvesting plan. Game management special problems: releasing; management of migratory species; predator control. Designing Management Plans.

[Back](#)

### **Inland Waters Planning (PAO10031)**

- Planning and Management basis for sustainable exploitation of aquatic resources
- Structure and functioning of inland aquatic ecosystems and riparian areas. Production factors
- Fisheries resources: fish fauna and decapods. Bio-ecology on main species, stock assessment and recruitment.
- Threatened species and conservation values. Impact and control of invasive species. Mitigation of impacts and beneficitation of target species
- Policy of Fisheries and Aquaculture and legislation
- Water Quality and Ecological status
- Conservation and rehabilitation of habitats
- Bio-manipulation and restocking. Potentialities and constrains.
- Planning and managements programs: study cases

[Back](#)

### **Forest Ecophysiology (BIO10032)**

Forest Systems and Environment. Microclimate and Energy Exchange. Water Relations and Hydraulic Architecture. Forest Productivity (Carbon Acquisition and Respiration). Stable Isotopes. Nutrient Acquisition, Allocation and Recycling. Plant Functional Responses to Disturbances (Fire, Clear-Cutting, Thinning, Drought, Herbivory, etc.) Modelling: Scaling from Plant to Forest. Techniques and Equipment in Forest Ecophysiology. Field Experiments.