



## Study Plan

**School:** School of Sciences and Technology  
**Degree:** Bachelor  
**Course:** Ecology and Environment (cód. 526)

### 1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS2670	General Physics	Physics	6	Semester	156
MAT11377	Mathematics	Mathematics	6	Semester	156
PAO11378	Flora, Vegetation and Fauna of Portugal	Environment and Ecology Sciences	6	Semester	156
QUI1090	General Chemistry	Chemistry	6	Semester	156
PAO2390	Ecology	Environment and Ecology Sciences	6	Semester	156

### 1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS11379	Climate and Climate Change	Physics	3	Semester	78
PAO11380	Principles Landscape Ecology	Environment and Ecology Sciences	6	Semester	156
ERU2592	Geographical Information Technologies I	Biosystems Engineering	6	Semester	156
GEO11381	Introduction to Earth Sciences	Geosciences	9	Semester	234
QUI1038	Analytical Chemistry	Chemistry	6	Semester	156

### 2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
PAO0769	Space Analysis	Geography	6	Semester	156
MAT0911	Biostatistics with Computer Software	Mathematics	6	Semester	156
PAO11382	Methods, Techniques and Communication in Ecology and Environment	Environment and Ecology Sciences	6	Semester	156
PAO2378	Characterisation and Assessment of Territory	Environment and Ecology Sciences	3	Semester	78
BIO11383	Evolutionary Biology	Biological Sciences	3	Semester	78
BIO0408	Microbiology	Biological Sciences	6	Semester	156

### 2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI7211	Fundamentals of Biochemistry	Biochemistry	6	Semester	156
PAO2064	Ecological Modelling	Environment and Ecology Sciences	5	Semester	130
PAO11384	Air and Noise Pollution	Environment and Ecology Sciences	3	Semester	78
PAO2081	Terrestrial and Aquatic Ecosystems	Environment and Ecology Sciences	5	Semester	130
PAO0043	Human Ecology	Environment and Ecology Sciences	5	Semester	130



### 2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
<b>Group of Options</b>					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
PAO11392	Ecotourism	Environment and Ecology Sciences	6	Semester	156
PAO11393	Environment and Development in Tropical Regions	Environment and Ecology Sciences	6	Semester	156
MAT2557	Multivariate Data Analysis	Mathematics	6	Semester	156

### 3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
PAO11385	Fundamentals of Environmental Assessment and Impact	Environment and Ecology Sciences	6	Semester	156
PAO11386	Environmental Monitoring	Environment and Ecology Sciences	6	Semester	156
PAO11050	Regional Planning	Landscape and Planning Sciences	6	Semester	156
PAO11387	Water and Soil Pollution	Environment and Ecology Sciences	3	Semester	78
PAO11388	Waste Management	Environment and Ecology Sciences	3	Semester	78
<b>Group of Options</b>					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
PAO11394	Ecology of Agricultural Systems	Environment and Ecology Sciences	3	Semester	78
PAO11395	Estuaries and Coastal Systems	Environment and Ecology Sciences	6	Semester	156
PAO11396	Phytogeography	Environment and Ecology Sciences	3	Semester	78
GEO11397	Health and Safety at Work	Geological Engineering	3	Semester	78
GEO2387	Habitat Microclimatology	Geosciences	3	Semester	78

### 3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
PAO11389	Final Paper	Environment and Ecology Sciences	18	Semester	520
PAO11390	Fundamentals of Conservation and Management of Ecological Systems	Environment and Ecology Sciences	6	Semester	156
PAO11391	Introduction to Environmental Restoration	Environment and Ecology Sciences	6	Semester	156



## Conditions for obtaining the Degree:

\*\*\* TRANSLATE ME:

Para obtenção do grau de licenciado em Ecologia e Ambiente é necessário obter aprovação a 168 ECTS em unidades curriculares obrigatórias e 12 ECTS em unidades curriculares optativas (através de avaliação ou creditação) distribuídas da seguinte forma:

1º Ano

1º Semestre:

5 UC obrigatórias num total de 30 Ects

2º Semestre:

5 UC obrigatórias num Total de 30 Ects

2º Ano

3º Semestre

6 UC obrigatórias num total de 30 Ects

4º Semestre

5 UC obrigatórias num total de 24 Ects

1 UC optativa num total de 6 ECTS

3º Ano

5º Semestre

5 UC obrigatórias num total de 24 Ects

1 UC optativa num total de 6 ECTS

6º Semestre

3 UC Obrigatórias num total de 30 ECTS

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## Program Contents



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### **General Physics (FIS2670)**

Chapter 1. Physics as a science and Review of fundamental physics-mathematical concepts;

Chapter 2. Space and Time - motion of the particle

Chapter 3. Dynamics of particle;

Chapter 4. Work and Energy

Chapter 5. Dynamic of particle system

Chapter 6. Static;

Chapter 7. Deformation and elasticity;

Chapter 8. Fluids;

Chapter 9. Thermodynamics;

Chapter 10. Heat and Mass Transfer.

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### **Mathematics (MAT11377)**

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### **Flora, Vegetation and Fauna of Portugal (PAO11378)**

Revision of concepts in ecology. Major factors contributing to the distribution of fauna and flora. Distribution of the main families, genera and species.

Main climatophilous and edaphophilous series in Portugal. Characterization: Woods, thickets, "matos", creeping shrub formations, grass perennials (formation of tall grass and creeping), annual grasses.

Animal species: habitats; indigenous, endemic and exotic species; conservation status; invasive species.

Analysis of the dynamics of vegetation and animal communities as a basis for management and conservation of natural systems.

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### **General Chemistry (QUI1090)**

1. Constitution of matter

2. Periodic table

3. Chemical bonding

4. States of aggregation of matter

5. Solutions

6. Chemical thermodynamics

7. Chemical equilibrium

8. Equilibrium in heterogeneous systems

9. Ionic equilibria in homogeneous systems: acid-base

10. Electrochemistry

11. (Optional Chapter)

Chemistry of life

Chemical corrosion

Chemical kinetics



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### **Ecology (PAO2390)**

Ecology: Definitions, concepts, scope.

Structure and function of ecosystems: circulation of matter and energy; energy to control entropy

Biogeochemical cycles: global and local, impact of human activities

Environmental factors: Leibig and Shelford Laws. Factors of production and decomposition. The landscape interpretation

Production and trophic structure: Energy fluxes between trophic levels and ecological efficiencies. The predominant paths

Population: characteristics and vital rates. Models of growth. Selection strategies r and K. Predator-prey interactions, population cycles. Competition. Population regulation

Species diversity in the evaluation of anthropogenic pressures and environmental quality

Island biogeography Theory - implications for networks of green spaces and classified areas

Community: Structure, stability, environmental quality. Resistance and resilience

Succession: Primary and secondary. Natural and Cultural. Climax theories.

Man-Nature relationship

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### **Climate and Climate Change (FIS11379)**

The climate and the climate system, climate characterization and climate classification systems; The climate of Portugal. The greenhouse effect of the atmosphere and the energy balance on Earth. The general circulation of the atmosphere and the oceans:

Observations and simplified models, Ocean-Atmosphere Interaction phenomena. Brief history of the climate. Radiative forcing and the atmospheric composition: The concept of radiative forcing, the natural and anthropogenic radiative forcing. Feedback mechanisms and climate sensitivity. Recent observed climate changes. Climate change detection and attribution of causes.

Introduction to climate models. Climate projections: methodology, emission scenarios, global and regional climate projections.

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### **Principles Landscape Ecology (PAO11380)**

Landscape and Ecological Theory. Fundamentals of Landscape Ecology. Landscape elements and characteristics. Heterogeneity landscape approach methods and models. Mapping landscape units. Landscape metrics. Approaches to the relation between landscape structure and functions. Human intervention in the territory, cultural landscape and the ecological values of the landscape. Holistic landscape ecology premises approach. Relation with landscape planning and management.

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### **Geographical Information Technologies I (ERU2592)**

1.1) satellites triangulation ; 1.2) measurement of distances; 1.3) to assure exact time; 1.4) satellites position; 1.5) errors correction; 1.6) why do we need differential GPS (DGPS)?; 1.7) how does the differential GPS works?; 1.8) where can we get differential correction?; 1.9) Other forms of working with DGPS; 1.10) GPS positioning types; 1.11) GPS applications; 1.12) practical works with GPS (NAV, DGPS and DGPS RTK).

2.1) structuring spatial data bases, as reality models; 2.2) data models (A-raster and B-vectorial); 2.3) relevant aspects in the different data models; 2.4) Structured query languages; 2.5) Maps algebra.

3) remember the fundamental laws of the electromagnetic radiation. Vegetation Indexes (NDVI); 3.7) digital classification images (principal components analysis, supervised and unsupervised classification)



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### **Introduction to Earth Sciences (GEO11381)**

Geology: The Earth Planet and its origin. The structure and origin of the Universe; The Dynamic of Earth - as a system of interacting components: the climate system, system tectonic and geodynamic system. The Tectonic system - Plate Tectonics; Rocks: The registration of Geological Processes: The Geological Cycle, Rocks: The Igneous, The Sedimentary, The Metamorphic; Weathering and Erosion: Weathering, erosion and geological cycle, physical weathering, chemical weathering, Soil: the residue from weathering; Sedimentary and Continental environments: fluvial and lacustrine, coastal, marine. Pedology: Soil and environmental services. Soils in space and time. Soil profile, horizons and soil materials. Soil composition. Soil physical properties. Soil chemical properties and nutrient cycling. Introduction to soil classifications. Soil maps of Portugal. Hydrology: The Water natural cycle; Watershed; Hydrological processes; The water availability and uses usos da água; Extreme events

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### **Analytical Chemistry (QUI1038)**

Sampling and sample preparation; Solubility and precipitation; Selective precipitation separation; Gravimetric analysis; Introduction to volumetric analysis; Precipitation, acid-base, complexation and oxidation-reduction titrations; Introduction to chromatographic methods; High performance liquid chromatography (HPLC) and gas chromatography (GC).

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### **Space Analysis (PAO0769)**

Geographic representation: Evaluation of the different representation metaphors and an introduction to a systemic approach to representation metaphors.  
Spatial data models: Detailed analysis of vectorial model, raster model and other data models.  
Unique layer spatial operations: Neighbourhood analysis, buffering, masks and filtering.  
Multiple layer spatial operations: Overlay analysis and geoprocessing operations.  
Dimensionality of geographic data: 3-dimensional models and an introduction to time modelling.  
Conceptual design of data models and geographic modelling: Geographic modelling concepts and flowcharts design including map algebra operations.  
Network analysis: Shortest path analysis, service area, cost distance functions  
Future perspectives: New spatial data models, new models for spatial relations and new spatial analysis processes.

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### **Biostatistics with Computer Software (MAT0911)**

Introductory concepts  
Descriptive statistics  
Basic notions of probability — revision  
Discrete and continuous random variables  
Introduction to sampling and sampling distributions  
Point and interval estimation  
Parametric hypothesis testing  
Non-parametric tests  
One-way analysis of variance  
Linear regression analysis

The IT component consists in the use of SPSS software and of a spreadsheet in the resolution of statistical problems.

NOTE: We strongly advise students to install on their personal computers the software SPSS (please contact the Serviços de Informática for a free installation) and Excel (or equivalent) and to bring their PCs to the classes.



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### **Methods, Techniques and Communication in Ecology and Environment (PAO11382)**

Module 1: Science, method and scientific practice. The evolution of knowledge; science has limits and impossibilities? Observation, deduction, intuition; science, ideology, myths, beliefs, superstitions, fantasies; naive science and errors in the definition of cause-effect relations; the creativity process in science, factors and serendipity.

Módulo2: Field methods: maps and its use, space interpretation and orientation; campaign planning; GPS; observation and register of information; sampling principles, transects and definition of aleatorial sampling units; basic equipment of field work; simple techniques for site characterization; good practices in field work.

Módulo 3: Communication in science - presentation of results, graphical representations, powerpoint presentations; production of reports, papers, dissertations, monographies, reviews, state-of-the-art; application for grants, projects, studies.

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### **Characterisation and Assessment of Territory (PAO2378)**

Concept of Landscape

The nature of spatial information

Perception of the nature of the landscape

The importance of scale, structure and function:

Landscape assessment:

- the analytical, synthetic and hierarchical perspectives
- the landscape as a complex object
- the disturbed landscape
- the ecological landscape
- the cultural landscape

The practice of landscape assessment

- Material and circumstantial elements
- Climatology
- Morphology
- Geology
- Soil
- Hydrology
- Ecology

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### **Evolutionary Biology (BIO11383)**

1. Microevolutionary concepts (adaptive evolution; neutral evolution; the genetic impact of selection on populations; the origin and maintenance of genetic variations; the expression of evolution)
2. Design by selection for reproductive success (the evolution of sex; genomic conflict)
3. Principles of macroevolution (speciation; phylogeny and systematic; comparative methods)
4. The history of life
5. Integrating micro- and macroevolution (coevolution, human evolution)
6. Nucleotide diversity and phylogenetic analysis of sequences, Neutral theory of molecular variation.
7. Intraspecific analysis with genetic markers



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### **Microbiology (BIO0408)**

Theoretical:

1. Historical context and Ubiquity
2. Diversity of the Microbial World
3. Microbial Growth and Death
4. Metabolism
5. Basics of Molecular Microbiology: Microbial genetics, Virology, Immunology
6. Microbes and disease; Normal flora, Pathology, infection and disease, Mechanisms of pathogenicity, Principles of epidemiology
7. Food microbiology: Hygiene and concept of indicator. Processing and storage of food.

Foodborne diseases

8. Ecology and environmental microbiology: Soil and water, Biogeochemical cycles, Agricultural applications, Wastewater treatment, Biotechnology applications

Lab Practice:

Aseptic practice

Observation of bacteria, fungi and protists.

Demonstration of Ubiquity

Preparation and sterilization of culture media.

Isolation of pure culture.

Colonial and cellular morphology. Gram Staining

Microbial counts

Environmental conditions for growth (pH, temp., O<sub>2</sub>)

Anaerobic Culture

Antibiograms

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### **Fundamentals of Biochemistry (QUI7211)**

Introduction to Biochemistry and its correlation with the other sciences. The importance of water and inorganic ions in biosystems. Biological buffer systems. Methods and techniques used in biochemistry. Nomenclature, structure and properties of biomolecules: carbohydrates, lipids, amino acids, peptides, proteins and nucleic acids. Lipoproteins. Biomembranes. Enzymes and enzyme kinetics. Bioenergetics and bioelectrochemistry. The importance of ATP in metabolism. Anabolism and catabolism. The main metabolic pathways. Introduction to the metabolism of carbohydrate, fat and protein. Integration and metabolic regulation.

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### **Ecological Modelling (PAO2064)**

Types of models. Issues of scale while building models. The components, the steps and the tools of the ecological modeling process. Population dynamics models. The analysis of Model Behavior - types of stability. Models for primary producers. Individual growth models in animals.

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### **Air and Noise Pollution (PAO11384)**

Air pollution. Main pollutants. Effects. Outdoor and indoor air pollution. Emission control of the major atmospheric pollutants. Particulates emission control. Gases and particulate control devices.

Basic concepts of sound and noise. Sound-pressure level (SPL). Decibel. Frequency. Infra-sound and ultrasound.

Characteristics sources of noise. Noise monitoring. Legislation.





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### **Terrestrial and Aquatic Ecosystems (PAO2081)**

Aquatic vs. Terrestrial Ecosystems. Strategies and types of producers. Limiting factors of production.

Terrestrial Ecosystems: The humanization of space - historical analysis of the large human impacts. Species adaptation to the terrestrial Mediterranean environment and peculiarities of the Iberian species. Energy flow and matter recycling in the terrestrial ecosystems. Diversity assessment in the Iberian communities regarding the soil, vegetation and animal subsystems. World distribution of the main ecosystem types.

Aquatic Ecosystems: Lentic systems: factors of primary production; eutrophication; thermal stratification. Lotic systems: the three linkages - longitudinal, lateral, vertical; zonation and distribution of species; floods and riparian corridors; persistent and temporary rivers. Estuaries: types; hydrology and communities; flocculation, nutrient trap, nurseries; coastal lagoons. Ocean: zonation; productivity, upwelling; dynamics of the coastal sediment processes.

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### **Human Ecology (PAO0043)**

Valuing Nature: the idea of value and criteria for setting value to the natural elements (individuals, populations, communities, ecosystems, landscapes): tangible and intangible values, instrumental and non-instrumental, economic and non-economic values. Ecological services. The Ecological Economics. Environmental valuation methods.

Looking at and attitudes towards Nature - paradigms. Evolution of development paradigms in relation to the environment: unrestricted development, deep ecology, environmental protection, resources management, sustainable development. Arguments of Nature conservation. The experience of Nature in its multiple levels. The reappraisal of Nature and Arcadia revisited.

Ethics, environmental ethics, ethics of life, liberationism, biocentrism, ecocentrism, specism. Aldo Leopold and the Land Ethic, Arne Naess and the Deep Ecology. Environmentalism and radicalism. Religion and environmental ethics: despotism and custodian. Ethics, relativisms, pragmatism.

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### **Ecotourism (PAO11392)**

Definitions and principles of ecotourism. Heritage values. Natural heritage - endemic, rare and threaten species; natural and semi natural habitats. Criteria for identifying wetlands of international, national, regional and local importance; criteria for identifying sites of international, national, regional and local importance in Iberian continental ecosystems. Man-made heritage - sociological meaning of archaeological and architectural heritage; monumental and vernacular heritage; environment and manmade heritage. Genetic patrimony - Portuguese autochthonous breeds and their distribution. Immaterial heritage, its conservation and its safeguarding. Elements of territory attractiveness in outdoor activities related with tourism. Environmental impacts related to tourism activities in rural areas. The concept and determination of carrying capacity. Socio-economic characterization of ecotourism in the world and in Portugal. The Cultural Park as model of territory management.

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### **Environment and Development in Tropical Regions (PAO11393)**

The tropical regions. Concepts and generalities. Location, soil, climate and natural vegetation. Biological and cultural diversity. Economic structure. Agriculture and its importance in the economy. Social and environmental impacts. Industry.

Social and demographic characteristics. Population growth rate and food production. Age structure. Pressure on natural resources, land and forest degradation.

Identification of key environmental issues tropical. Deforestation. Smallholding / landowners. Application of non-sustainable agricultural systems. Degradation of natural resources. Loss of biodiversity. Poverty and degradation of rural communities. Suburbs and other phenomena associated with urban sprawl.

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### **Multivariate Data Analysis (MAT2557)**

Elementary concepts of the theory of matrices. The Multivariate Normal Distribution. Univariate analysis of variance. Multivariate Analysis of Variance. Non-Parametric Tests (Multivariate). Principal Component Analysis. Factorial Analysis. Cluster Analysis.



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### **Fundamentals of Environmental Assessment and Impact (PAO11385)**

1. The concepts of environmental assessment and sustainability - the concepts of disturbance, naturalness and artificiality. The evaluation system of reference - Mankind health and well being.
2. The evaluation concept - reference systems, scales, operation, values, reproducibility. The socio-cultural paradigms and evaluation and decision making. Outrage.
3. Environmental evaluation legal framework.
4. EIA phases.
5. The practical process of SEA
6. Main types of environmental impacts.
7. Impact evaluation and prediction methodologies, Universes of impact, Impact aggregation.
8. Impacts on flora, fauna, vegetation and habitats.
9. Reference situation characterization methodologies EIA methodologies and mitigation methodologies.
10. Impacts on the natural and cultural heritage. Evaluation methodologies.

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### **Environmental Monitoring (PAO11386)**

Sampling theory and techniques.  
Environment bioindicators for evaluate the state of the ecosystem.  
Environmental analysis. Sensors and biosensors. In situ methods.  
Monitoring: air, water, soil and noise.  
Monitoring plan e management. Study cases.

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### **Regional Planning (PAO11050)**

1. Spatial planning process:
  - 1.1. Introduction to theories and their evolution;
  - 1.2. Basic concepts;
  - 1.3. Planning System in Portugal - tools for land use planning and management;
  - 1.4. Public participation in Spatial planning.
2. Evaluation and public decision: notions of Evaluation. Multicriteira decision aid methodology.
3. Potentialities and constraints for the future of spatial planning in Portugal.

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### **Water and Soil Pollution (PAO11387)**

Module 1: Water pollution: surface and underground. Main pollutants. Legislation.  
Module 2: Characterization of domestic and industrial wastewater. Quality objectives and treatment requirements. Operations and processes of physical, chemical and biological treatment. Preliminar treatment. Primary treatment. Secondary treatment. Terciary treatment. Treatment processes concerning the reuse of wastewater. Aplications of wastewater reuse. Monitoring. Legal framework  
Module 3: Soil pollution. Main pollutants. Recovery of polluted and degraded soils. Restoration of soil fertility and sustainable management. Legislation.  
Module 4: Solid residues. Production and treatment. Recycling and reuse. Monitoring. Legislation.

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### **Waste Management (PAO11388)**

Introduction to the problem of waste. Definition of waste and type of waste. Solid and liquid waste. Waste management: Survey, characterization, collection (select and storage), transport, treatment (incineration, pyrolysis-gasification, and others) and disposal of waste;  
Recycling and recovery. Technologies of storage and waste processing.Relevant legislation.



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### **Ecology of Agricultural Systems (PAO11394)**

1. Natural systems (ecosystems) as paradigms of any productive process: matter, energy and information as production factors; energy dissipation, products and residues in ecosystems.
2. The second great human impact on biosphere: the invention of agriculture. Characterizing different agricultural productive process, namely in what concerns: energy flow, matter cycling and biodiversity across hierarchical levels of organization - within species, alpha, beta and gamma.
3. Ecosystems attributes versus agricultural systems attributes: complexity/simplicity; diversity/monotony; homeostasis and resilience/regulation by man. Negative externalities and environmental impacts of different agricultural productive processes: greenhouse warming, degradation of habitats and deserts spreading. The implications of agricultural systems on biotopes naturalness and sensitivity.
4. A false dilemma - to produce or to conserve: ways of overcome this apparent problem; examples.

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### **Estuaries and Coastal Systems (PAO11395)**

Estuaries.

Interaction between marine and inland waters.

Factors of primary productivity.

Flocculation and "nutrient trap".

Nurseries and oceanic productivity.

Coastal Lagoons.

Types of coastal lagoons according to the connection regime with the sea.

Coastal lagoons as retaining environments.

Accumulation of detrital organic matter and risks of dystrophy - summer mortality

Haline stratification and oxygen depletion in the hypolimnion

The Ocean.

Zonation. Marine productivity, upwelling.

Coastal processes, coastal drift, erosion and deposition.

Management of coastal areas.

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### **Phytogeography (PAO11396)**

Integrating Concepts in Ecology. Environmental factors that influence the distribution and adaptation of plants (climatic, physiographic, geologic, edaphic, biotic, and others). Distribution area Concept, origin center, natural areas modification and Iberian peninsula Biogeography (province, subprovince, Sectors and Subsectors). Botanical families main dDistribution , genera and indigenous species. Portuguese endemic flora of onthe global context: chorological and major threats to its conservation. Plant communities. Vegetable bases for coexistence. Flora and vegetation Concept . phytosociological syntaxonomy notions.



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### **Health and Safety at Work (GEO11397)**

Module 1 - Industrial Hygiene

I - Chemical hazards (solids, liquids, gases and vapors);

II - Physical hazards (noise, heat / ventilation, vibration);

Module 2 - Industrial Safety

I - Electrical hazards;

II- Fire;

III ? Ergonomics / loads and movement;

IV- Protection machinery;

V- Protection tools and utensils at work;

VI- Prevention in cargo handling operations;

VII- Individual protection of industrial accidents. Protection equipments.

Module 3 - Risk analysis and safety and health plans.

Module 4 - Technical audits of safety.

Module 5 - Legislation.

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### **Habitat Microclimatology (GEO2387)**

1. Micrometeorology and Microclimatology

2. The climate system: components, properties and processes.

3. The Energy in the climate System

4. The water in the climate system

5. Physical Principles of Microclimatology

6. Transport of momentum, energy and mass in the boundary layer

7. Soil Temperature and soil moisture

8. Natural atmospheric environments

9. The climate of modified environments

10. Planning in the scope of climate change.

11. Microclimatological instrumentation.

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### **Final Paper (PAO11389)**

The final work, to be presented in its own model, is a research project / application on a topic which may be either theoretical or supported by empirical evidence, resulting from practical work experience on an agency, public or private institution, or company (internships) or from a research action (project). The contents of the final paper must be related to one or more of the subject areas of the study program. Students may decide to write the final paper in Portuguese or in English.



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### **Fundamentals of Conservation and Management of Ecological Systems (PAO11390)**

#### **1.ECOLOGICAL SYSTEMS - BASIC CONCEPTS**

a.Spatiality, functionality, patterns and processes, ecological paradigms, structural and functional elements (matrix, patch, corridor).

#### **2.ECOLOGICAL BASED MANAGEMENT AND PLANING PROCESSES**

#### **3.CONSERVATION OF ECOLOGICAL SYSTEMS**

#### **4.MANAGEMENT OF ECOLOGICAL SENSITIVE AREAS**

a.Management concept in areas of ecological interest;

b.Sustainable development concept;

c.National system of protected areas. Natura 2000 network.

#### **5.MANAGEMENT CONCEPTS OF ECOLOGICAL SYSTEMS**

a.Environmental management plans and forestry management plans;

b.Evaluation criteria in protected areas and buffer areas;

c.Management trough fire or grazing;

d.Ecological activation structures (ecological corridors);

Definition of conservation and use areas, Values, Resilience, gradients of equilibrium, risks.

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### **Introduction to Environmental Restoration (PAO11391)**

Introduction to the concept of environmental and ecological restoration - targets, criteria, referential for the restoration. Presentation of instruments and systems for the ecological restoration of degraded ecosystems. Preparation of restoration projects and monitoring programs. Follow up of restoration projects in course or concluded. Theoretical foundations of ecological and environmental restoration. Restoration in different environments and ecosystem types. Soil restoration, restoration of mining areas and quarries. restoration of aquatic ecosystems. Recovery of contaminated groundwater.