

Bachelor in Forest Science and Natural Resources | Courses syllabus

1st curricular year

Análise Matemática / Mathematical analysis (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

1. Masters the basic concepts of differential and integral calculus and its applications; 2. Identifies and solves 1st order differential equations; 3. Knows the concepts of both matrix and determinant and their applications for solving linear systems

Syllabus:

1.1. derivatives; 1.2. antiderivative; 1.3. definite integrals; 1.4. areas and volumes by applying definite integrals; 1.5. improper integrals; 2.1. differential equations of separable variables; 2.2. linear differential equations; 2.3. Bernoulli differential equations.

Bybliography:

Foulis, D.; Munem, M.- O Cálculo. Guanabara Dois, S.A.:Volume I, Cop. 1978.
Leithold - O Cálculo Com Geometria Analítica. Dinalivro, 1994.
Ross, S. - Differential Equations. McGraw-Hill, 1984.
Saraiva, M.A; Silva, M. - Primitivação. Edições ASA, 1995.
Swokowsski, E. W.; - Cálculo com Geometria Analítica. McGraw-Hill, 1983.

Química e Bioquímica I / Chemistry and Biochemistry I (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

To know: the properties of the solutions; laws of the Chemical Equilibrium considering the different types of equilibrium: acid base, oxidation-reduction, poorly soluble salts and complexation; structure of the main classes of organic compounds; the nomenclature of the main classes of organic compounds; the physical properties of the organic compounds; the main functional groups of the organic biomolecules

Syllabus:

Interaction forces between molecules and sites of action. Properties of the solutions. Chemical Equilibrium: acid-base, oxidation-reduction, poorly soluble salts and complexation. Structure, nomenclature and physical properties of the organic compounds. Functional groups of the organic biomolecules

Bybliography:

Atkins, P. W; Beran, J.A. - General Chemistry, Sci. Am. Books, 1992
Allinger, N.L.; Stevens, C.L. - Organic Chemistry, Worth Publishers, Inc. 1998
Stryer, L. - Biochemistry, The Molecular Basis of Cell Structure and Function, Worth Publishers, 1979
Vidal, M.M.; Filipe O.; Costa, M.C. - Química no laboratório, 100Luz, 2ª Edição, 2010

Ecologia / Ecology (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

1- Domination of ecosystem concept and their compounds particularly energy flow; 2 - Identification of ecological factors and establishment of their influence in life processes; 3- Obtain the knowledge about population dynamic interactions and evaluate their impact in ecosystems; 4 - Acquires the concept of community and understands their development.

Syllabus:

1 - Ecosystems organization and development: 1.1 Ecosystems generalities, 1.2 Characteristics of natural systems, 1.3 Energy flow, 1.4 Energy and material transfer, 1.5 Ecosystems evolution; 2. Ecosystems dynamic: 2.1 Life and Climate, 2.2 Life and Soil, 2.3 Biogeochemical cycles; 3. Relationships in ecosystems: 3.1 Interactions established, 3.2 Populations dynamic and consequences, 3.3 Man role in ecosystems.

Bibliography:

BEGON, M., TOWNSEND, C.R. & HARPER, J.L. - Ecology: from individuals to ecosystems. Cambridge: Blackwell Publishing Limited, 2005.
FAURIE, C., FERRA, C., MÉDORI, P., DEVAUX, J. & HEMPTINNE, J. - Ecologie. Approche scientifique et pratique. Lavoisier, 2002.
RICKLEFS, R. & MILLER, G. - Ecology. W.H.Freeman and Company, 2000.

Biometria / Biometrics (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

1 - Knowledge of the principles and techniques used to quantify the variables associated with forest resources; 2 - Knowledge of the procedures for stock and yield evaluation.

Syllabus:

Variables to be collected, measurements to be performed, data collection and information processing; Methods of sampling, sample plots installation and data collection.

Bibliography:

- Almeida, V. V., Páscoa, F. e Silva R. (1983) Área Ótima das Parcelas de Amostragem. Notas Técnico-Científicas nº 4/83, EFN, Lisboa.
- Autoridade Florestal Nacional (2009) Instruções para o Trabalho de Campo do Inventário Florestal Nacional - IFN 2005/2006. AFN, Lisboa.
- FAO (1981) Manuel d'Inventaire Forestier. Roma
- Forestry Commission (1988) Forest Mensuration Handbook. London.
- Forestry Commission (2006) Forest Mensuration: A Handbook for Practitioners, FC-HMSO, London.
- Hamilton, G. (1975) Forest Mensuration Handbook. Forestry Commission Booklet N° 39, London.
- Laar, A., Akça, A. (2007) Forest Mensuration, Springer, Dordrecht.
- Oliveira, A. (1982) Teoria da Produção Florestal. CEF/INIC E/84-2, Lisboa.
- Páscoa, F., Silva, R e Tavares, M. (1981) Tabelas de Produção. Metodologia para a Instalação de Parcelas, Recolha e Tratamento dos Dados. Notas Técnico-Científicas nº3/81, EFN, Lisboa.
- Philip, M. (1994) Measuring Trees and Forests. CAB International.

Geografia e Levantamentos / Geography and Surveying (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

(1) Understand the geological and climatic phenomena with expression on the environment; (2) Recognize the soil and climate characteristics and social systems that determine the main land use in Portugal; (3) Understand the concepts and the methods of carrying out surveys and dominate the various techniques of data collection and production of information; (4) Know the different forms to represent, generate and analyze the cartography.

Syllabus:

Understanding the geological and climatic phenomena and their relationship with the environment and land use; Use of techniques and tools in surveys production of cartography.

Bibliography:

- Avery, T., Berlin, G. L. (1992) Fundamentals of Remote Sensing and Airphoto Interpretation. Macmillan Publishing Company, New York.
- Barry, R.G. e Chorley, R.J. (1992) Atmosphere Weather and Climate, Routledge, 6ª edição.
- Carvalho, A.M.G. (1996) Geologia, Morfogénese e sedimentogénese, UNIVERSIDADE ABERTA, 93, LISBOA 189P.
- Casaca, J., Matos, J., Baio, M. (2000) Topografia Geral, Lidel, Lisboa
- Instituto Geográfico do Exército (2002) Manual de Leitura de Cartas (5ª Edição). Instituto Geográfico do Exército, Lisboa.
- Peixoto, J.P. (1987) O Homem, o clima e o ambiente – II. As variações do clima e o ambiente. Coleção o ambiente e o Homem, Secretaria de Estado do Ambiente e Recursos Naturais.
- Portugal, J. M. (1992) Introdução às Tecnologias de Levantamento da Informação Geográfica Física, Lisboa.
- Wyllie, P.J. (1979) A Terra, Nova Geologia Global. FUNDAÇÃO CALOUSTE GULBENKIAN, Lisboa, 384P.

Introdução à Profissão / Introduction to the Profession (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

1 - Know the forests in Portugal and the World; 2 - Know the socio-economic of the Forestry activity in Portugal and its relations with the Natural Resources.

Syllabus:

The situation of forests in Portugal and Worldwide. Basic concepts of forestry; Actors and administrative framework of forestry. Influence of forest ownership in the typology of Portuguese forests. Multifunctionality of forest systems, context of National forestry and its relations with the National Natural Resources. Objectives of management and use of forests in Portugal.

Bibliography:

- Alves, A.A.M., 1982. Técnicas de Produção Florestal. Instituto Nacional de Investigação Científica, Lisboa.
- Baptista, F., 2001. Agriculturas e Territórios. Celta Editora, Oeiras.
- FAO, 2011. State of the World's Forests. Roma, FAO.
- Mathews, J.D., 1989. Silvicultural Systems. Oxford University Press, Oxford.

- Molles, M., 2010. Ecology. Concepts and Applications. New York, McGraw-Hill
- Radich, M.C. and Alves, A.A.M., 2000. Dois Séculos da Floresta em Portugal. CELPA- Associação da Indústria Papeleira, Lisboa.
- Sharma, N.P. (ed.), 1992. Managing the World's Forests. Looking for Balance between Conservation and Development. Kendall/Hunt Publishing Company, Dubuque – Iowa.

Botânica e Dendrologia / Botany and Dendrology (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

- a) To identify the structure and internal organization of vegetal bodies relating them with the function of different organs; b) To know how to identify plant species (full plants or small parts), based on morphological characteristics, using different resources such as dichotomous keys, Floras, e-Floras, Field guides, herbarium material, etc. c) To recognize/know native plant species with more interest in Portugal, including mainly trees and shrubs but also some herbaceous species; d) To recognize/know exotic plant species with more interest in forest and natural environments (including both cultivated and invasive species); e) To develop curiosity for plant world.

Syllabus:

Module 1. a) Plant histology and anatomy: plant tissues and its characterization; primary and secondary growth; anatomy of roots, stems and leaves, and its relationship with physiology, on main taxonomical group; b) Morphology of root, stem (including bark), leaf, flower and fruit; c) Classification- taxonomy principles; characterization of major taxonomical groups; Module 2. d) Characterization (taxonomy; morphology; comparisons/ contrasts to other species with which the plant may be easily confused; distribution; variance; interest and utilization) of plant species with more interest in forestry and natural areas in Portugal, including species of: Adoxaceae, Altingiaceae, Anacardiaceae, Aquifoliaceae, Betulaceae, Cistaceae, Cupressaceae, Ericaceae, Fabaceae, Fagaceae, Ginkgoaceae, Juglandaceae, Lauraceae, Magnoliaceae, Malvaceae, Moraceae, Myrtaceae, Oleaceae, Pinaceae, Pittosporaceae, Platanaceae, Salicaceae, Taxaceae e Ulmaceae, amongst others.

Bibliography:

- Bingre P, Aguiar C, Espírito-Santo D, Arsénio P & Monteiro-Henriques T [Coord.s Cient.] (2007): Guia de Campo – As árvores e os arbustos de Portugal continental. 462 pp. In vol. IX Sande Silva J [Coord. Ed.] (2007): Coleção Árvores e Florestas de Portugal. Jornal Público/ F
- Fernandes, R.B. Vocabulário de termos botânicos. Separata do Anuário da Sociedade Broteriana. 1972.
- Franco, J.A. & Afonso, M.L.R. Nova Flora de Portugal (Continente e Açores). Escolar Editora. Lisboa. Portugal. 1971-2003.
- Humphries, C.J.; Press, J.R. & Sutton, D.A. 1996. Árvores de Portugal e Europa. Guia Fapas. ISBN: 972-95951-2-7
- Izco, J.; et al. 1998. Botânica. 2ªEd. Mc.GRAW-HILL Interamericana de España, S.AU.
- Lidon, F.J, Gomes H. & Abrantes A.C. 2001. Anatomia e morfologia externa das plantas superiores. Lidel. Lisboa.
- Polunin, O. 1999. Árboles Y Arbustos De Europa. OMEGA. ISBN: 9788428207393
- Raven, P.H., Evert, R.F. & Eichhorn, S.E. 1999. Biology of Plants. 6ª ed. W. H. Freeman and Company. NY.

Solos Florestais / Forest Soils (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

Increase and improve forest production without degrading the environment. This course addresses the issues of formation, characterization, conservation and soil fertility, erosion and effect of forest fires. It is structured to provide students with the fundamentals and methods appropriate to the acquisition of skills for the proper use of Soil, in particular within forest ecosystems. This course aims to enable the student with knowledge about: 1) The constituents and properties of soils and their effects on soil quality. 2) The dynamics of mineral elements in the soil-plant-atmosphere and the importance of fertility physical, chemical and biological soil. 3) The general factors and processes responsible for the formation and differentiation of soils. 4) The soil degradative processes and practices that contribute to the conservation and improvement of soil quality.

Syllabus:

Functions of soils in terrestrial ecosystems. Mineral and organic soil constituents; Mineralogy soil; organic matter and the carbon cycle. Soil properties and its relation with the composition. Soil water: content, retention and movement in unsaturated and saturated soil, water availability for plants. Effects of the composition and properties of soil on plant growth. The plant growth. Biogeochemical cycle and balance of plant nutrients in a forest ecosystem. Factors and processes of soil formation; Horizons Diagnostics; Main soil types. Types of erosion: wind and water; factors and processes, soil conservation practices; universal equation of soil loss. Effects of forest fire on soil structure, water infiltration, concentration of runoff and soil losses by erosion.

Bibliography:

- AGASSI, M. - Soil Erosion, Conservation and Rehabilitation. Marcel Dekker, Inc. N. York, 1996.
- BRADY, N.C.; WEIL, R.R. - The Nature and Properties of Soils. 13ªEd. Mac Millan Pearson Education Inc. New Jersey, 2002.
- CARDOSO, J. C., BESSA, M. T., MARADO M. B. - Carta de Solos de Portugal (1 : 1 000 000). Agronomia Lusitana 33 : 481 – 602, 1973.

COSTA, J. B. - Caracterização e Constituição do Solo. 7ªEd., F.C.G., Lisboa, 2004.
FISHER, R. F.; BINKLEY, D.- Ecology and Management of Forest Soils. 3ªEd. John Wiley and Sons, 2000.
FOTH, H. D. - Fundamentals of Soil Science. John Wiley and Sons, 1978.
PRITCHETT, W.; FISHER, R.F. - Properties and Management of Forest Soils – 2ª Ed. John Wiley and Sons. NYork, 1987.
RICARDO, R. P. - Génese e Evolução dos Solos. ISA, Lisboa, 1969.
TAM, K. H.- Environmental Soil Science. Marcel Dekker, Inc. New York, 1994.
WIGLEY, T.M.L., SCHIMMEL, D. S. - The Carbon Cycle. Cambridge University Press. Cambridge, 2000.

Estatística / Statistics (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

1) Understands the language and notation statistics; 2) Covers the key concepts and the necessary methods for summarization and the interpretation of data; 3) Develops and implements statistical tests and interprets the results; 4) Applies statistical techniques to support decision making.

Syllabus:

1. Descriptive statistics in one dimension. 2. Probability distributions. 3. Discrete and continuous random variables. Common discrete and continuous distributions. 4. Confidence interval for a parameter of a population. 5. Hypothesis testing for a parameter of a population. 6. Nonparametric tests. Conditions of applicability. 7. Simple linear regression. Multiple linear regression.

Bibliography:

R. Guimarães e J. Sarsfield Cabral, "Estatística", McGraw-Hill, Lisboa (2007), 2ª ed.

Química e Bioquímica II / Chemistry and Biochemistry II (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

The student knows the reactivity of the main functional groups of the organic compounds; Knows the structure of the main classes of natural compounds; - Understands the metabolism of carbohydrates, lipids and proteins; Understands the mechanism of the catalytic activity of the enzymes

Syllabus:

Reactions of the main classes of organic compounds. Structure and properties of the main classes of natural compounds. Biological functions of carbohydrates, lipids and proteins. Metabolism of carbohydrates, lipids and proteins. General structure of enzymes and their action mechanism.

Bibliography:

Lehninger - Principles of Biochemistry, Worth Publishers inc, 1987
Morison, R.; Boyd, R. - Química Orgânica, Fundação Calouste Gulbenkian, 1998
Metzler, D. E. - Biochemistry: The Chemical Reactions of Living Cells, Academic Press, 1977

Língua Inglesa e Comunicação / English Language and Communication (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

1 - Use specific terminologies in English; - Characterize, classify and define proficiently. 2 - Use advanced audiovisual communication techniques in scientific and technical tasks both in Portuguese and In English; - Write scientific and technical reports using quotes; - Give and discuss guided presentations.

Syllabus:

1 - English vocabulary expansion of specific terminologies of the field area; - Discourse features and linguistic patterns present in sample texts: descriptions, definitions, classifications, comparisons, instructions, etc.; - Academic vocabulary revision. 2 - Oral and written production in the specific context of Forestry Science and Natural Resources both in Portuguese and in English; - Advanced communication techniques in different tasks.

Bibliography:

Answers.com – Online Dictionary, Encyclopedia and much more. <http://www.answers.com> .
MURPHY, Raymond – English Grammar in Use. Cambridge: Cambridge University Press, 2004.
SINCLAIR, J. M. – Collins English Dictionary. Millennium Edition. Glasgow: Harper Collins, 1998.
NP 405-1.1994, Informação e documentação - Referências bibliográficas: documentos impressos. Instituto Português da Qualidade (IPQ).
NP 405-3.2000, Informação e documentação – Referências bibliográficas: documentos não publicados. IPQ.
NP405.4.2002, Informação e documentação – Referências bibliográficas: documentos electrónicos. Instituto Português da Qualidade (IPQ)

Inventário dos Recursos Naturais / Natural Resources Inventory (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

(1) Know the most important sampling methods for forest and floristic inventories; (2) Know the most important sampling approaches for wildlife surveys; (3) Know the most common biodiversity indicators; (4) Is able to plan , execute, analyze and present results, for a concrete situation.

Syllabus:

Introduction to multi-resources inventories. How to plan for multi-resources inventories. Sampling methods for forest inventory. Floristic inventories. Sampling methods for wildlife species. Assessment of Biodiversity indicators. Data analysis. Presenting results of a multi-resources inventory.

Bibliography:

- Daubenmire R.F. 1968. Plant communities: A textbook of plant synecology. Harper & Row, New York, 300 p.
Ferris-Kaan, R. and Patterson, G.S. 1992. Monitoring vegetation changes in conservation management of forests. Forestry Commission Bulletin, 108. HMSO, London.
Gotelli, N. and Ellison, A. 2004. A primer of ecological statistics. 2nd Edition. Sinauer, Sunderland MA, USA.
Krebs, Ch. 1989. Ecological methodology. 2nd Edition. Harper & Row, New York.
Mueller-Dombois D. & Ellenberg H. 1974. Aims and methods of vegetation ecology. John Wiley & Sons.USA. 547 p.
Reed D.D. and G.D. Mroz. 1997. Ressource Assessment in Forest Landscapes. New York. John Wiley & Sons. 386 p.
Rondeux J. 1993. La mesure des arbres et de peuplements forestiers. Les Presse Agronomiques de Gembloux, Belgique. 511 p.
Shiver B.D. and B.E. Borders. 1996. Sampling techniques for forest resource inventory. New York. John Wiley & Sons.

2nd curricular year

SIG e Deteção Remota / GIS and Remote Sensing (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

1 - Master the concepts and principles of Geographic Information Systems (GIS) and recognizes its role as a tool to support decision making in land management; 2 - Master the Remote Sensing (RS) methods of information analysis and processing; 3 - Use the available tools and techniques (GIS and RS) in practical work and in a project development.

Syllabus:

1 - Data collection, information analysis and cartographic production; 2 - Using GIS tools and digital image processing of remote sensing images to support the decision making process.

Bibliography:

- Bossler, John D. (2001) Manual of Geospatial Science and Technology. Taylor & Francis, New York.
Burrough, P., McDonnell, R. (1998) Principles of Geographical Information Systems - Spatial Information Systems and Geostatistics. Oxford University Press, Oxford.
Cosme, António (2012) Projecto em Sistemas de Informação Geográfica. Lidel, Lisboa.
DeMers, Michael N. (2005) Fundamentals of Geographic Information Systems (3rd Edition). John Wiley & Sons, Inc., New York.
Longley, P., Maguire, D., Goodchild, M., Rhind, D. (1999) Geographical Information Systems, Vol I – Principles and Technical Issues & Vol II – Management Issues and Applications, John Wiley & Sons, Inc., New York.
Matos, João. (2007) Fundamentos de Informação Geográfica - 5ª Edição Actualizada e aumentada, Lidel, Lisboa
Tso, B., Mather, P. (2001) Classification Methods for Remotely Sensed Data, Taylor & Francis, New York.

Hidráulica e Hidrologia / Hydraulics and Hydrology (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

1. Know basics of hydrology and hydrological processes of precipitation, interception, infiltration, evaporation and evapotranspiration; 2. Know the basic principles of hydrodynamics and fluid flow under pressure; 3. Know the principles of hydraulic surface and porous media flow; 4. Know the principles of hydrological processes of runoff and underground flow.

Syllabus:

1. Generalities about the importance of Hydraulics and Hydrology in various application areas. 2. Elements of cartography and topography, for application in hydraulics and hydrology. 3. General laws of hydraulics: Properties of

liquids. Hydrostatic. Hydro cinematics. Hydrodynamics. 4. General study of fluid flow. Laws of uniform flow resistance. 5. Permanent flows under pressure and free surface in porous media. 6. Fundamental concepts of hydrology: Hydrological cycle and water balance. Watershed. Time of concentration. Return time and probability laws. 7. Study of hydrological processes: Precipitation. Interception and surface retention. Evaporation and evapotranspiration. Infiltration. Surface runoff. Groundwater flow. 8. Uses and water management: The role of water in society. Political-legal framework for water management.

Bibliography:

Lencastre, A.; Franco, F. - Lições de hidrologia. Fundação Armando Lencastre, Lisboa, 2003.
Quintela, A. de C. - Hidráulica. Fundação Calouste Gulbenkian, Lisboa (9ª edição), 539 p., 2005.
Hamill, L. - Understanding Hydraulics. Macmillan Press, London, 366 p., 1995.
Lencastre, A. - Hidráulica Geral. Edição do autor, Lisboa, 1991.
Linsley, R.; Kohler, M.; Paulhus, J. - Hydrology for engineers. International Student Ed. Mc Graw Hill, Singapore, 3ª edição, 1982.
Novais-Barbosa, J. (1986) Mecânica dos Fluidos e Hidráulica Geral. Porto Editora, Porto.
Pinto, N. L. de S.; Holtz, A. C. T.; Martins, J. A.; Gomide, F. L. S. - Hidrologia básica. Editora Edgard Blücher, São Paulo, 1976.
Viessman, W., Jr.; Lewis, G. L. - Introduction to hydrology. HarperCollins College Publishers, 4ª edição, 1996

Economia dos Recursos Naturais / Natural Resources Economics (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

1. To know the concepts and methodologies used by the economic science. 2. To understand the mechanisms of price formation in market economy and the relationship between economic factors and technical production levels; 3 To understand the relationships between the economy and the natural resources; 4. To discuss options for the management of renewable natural resources.

Syllabus:

1. Introduction: 1.1. Fundamental problems facing the economy; 1.2. Main methodologies used in economic science; 1.3. The concepts of opportunity cost, willingness to pay and willingness to accept; 1.4. Production possibilities frontier. 2. Market and economic agents: 2.1. Economic circuits and relations between agents. 2.2. The supply and demand for food. 2.3. Market imperfections. 2.4. Inputs markets. 2.5. Profit maximization using production and costs functions; 3. Natural resources management: 3.1. Natural resources typology. 3.2. Property rights, public goods and externalities. 3.3. The issue of common property and open access. 3.4 Environmental goods evaluation. 3.5. General model of exploitation of a renewable resource. 3.6. The extinction of renewable resources and the loss of biodiversity.

Bibliography:

FRANK, R. e BERNANKE, B. – Princípios de Economia. Lisboa: Mc Graw Hill, 2003.
GREGORY, G. – Resource Economics for foresters. New York: John Wiley & Sons, 1987.
KLEMPERER, W. – Forest resource economics and finance. New York: McGraw-Hill, 1996.
PERMAN, R. [et al.]. Natural resource and environmental economics. 3rd edition. Pearson: Harlow, 2003.
RANDALL, A. Resource economics: an economic approach to natural resource and environmental policy. 2nd ed. John Wiley & Son: New York, 1987.
SAMUELSON, P. e NORDHAUS, W. – Economia. 16ª ed. Lisboa: Mc Graw Hill, 1999

Fisiologia e Reprodução de Plantas Florestais / Forest Plant Physiology and Reproduction (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

1. The knowledge about the connection between plant physiology and morphology regarding tree growth and forest practices; 2. The knowledge about the reproductive system of forest plants, fruit harvesting requirements, how to process and storage forest seeds, and the influence of the provenances and stock type selection on stand establishment. The knowledge about: (1) the effect of external and internal factors on seedling development; (2) the regeneration methods (seed management and vegetative propagation); (3) the nursery culturing (container seedlings, bare root seedling culture and the assessment of seedling quality) and (4) the certification measures.

Syllabus:

Module 1 - The physiological and morphological bases of tree growth and their relationships with the forestry practices: (1) the forest tree growth: in height, diameter and root system; (2) the effect of internal factors and environmental response on the photo assimilates distribution and (3) the effect of cultural practices on yield, quality and sustainability
Module 2 - Forest plants propagation: (1) the management of seed-producing areas / base material; (2) the methods and techniques for harvesting, processing, testing and seed storage; (3) the methods and techniques for forestry plants production / forest reproductive material; (4) the rules and best practices for storage and application of phytochemicals products; (5) quality assessment and plant certification; (6) the conditions for handling and plant transport and (7) evaluation on planting

Bibliography:

- Argillier, C., Falconnet, G., Greuz, J., 1991. Production de plants forestiers. Guide technique du forestier méditerranéen français. CEMAGREF, Aix-en-Provence.
- Duryea, M.L., Landis, T.D., 1984. Forest nursery manual - production of barerootseedlings. Martinus Nijhoff/Dr W. Junk Pub.
- Hartman, H.T., Kester, D.E., Davies, J.F.T., Geneve, R.L., 1997. Plant propagation: principles and practices, 6th ed. Prentice-Hall, Inc., New Jersey.
- Kozłowski, T. T.; Pallardy, S. G., 1996. Physiology of Woody Plants. (2nd Edition). San Diego: Academic Press
- Pereira, J.S., 1983. A dominância ecológica das árvores. In *Naturália*, 5: 5-11.
- Ribeiro, D., Baião, M., Teixeira, A., 1999. Sementes e Plantas Florestais, importância da sua qualidade. DGF, Lisboa.
- Ribeiro, D., Ribeiro, H., Louro, V., 2001. Produção em viveiros florestais. DGDRural/DDTI, Lisboa.
- Santos, M.L.C.R. 1994. Sementes e Plantas Florestais. Coimbra/Lisboa: ESAC & EFN.

Silvicultura /Silviculture (1^o semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

(1) To describe and characterize the forests and stands according with its origin, function, structure and composition; its dynamics and evolution as well as its multifunctionality; (2) Understand de relationship of ecology and physiology with stand development as the basis for forest interventions; (3) Capacity to identify and resolve problems in forests and stand development; (4) Prescribe silvicultural interventions to achieve management options for production, protection or conservation of forests and forest stands.

Syllabus:

Characterization of forest stands. Ecology of main forest species in Portugal. Principles and patterns of growth in trees and in forest stands. Space and thinning operations. Pruning. Rotation length. Silvicultural systems. Silviculture for special purposes

Bibliography:

- Assmann E. The principles of forest yield study. Pergamon Press. 506 p. 1970.
- Evans, J. Silviculture of broadleaved woodland. Forestry Commission. Bulletin 62, HMSO Pub.232 p. 1984.
- Hibberd B.G. Forestry practice. Forestry Commission. Handbook 6. HMSO Pub. 1991.
- Lanier L., Badre M, Delabrazé J. et Flammarion P. Précis de Sylviculture. 2e édition. Engref-Nancy, France. 477 p. 1994.
- Matthews JD. Silvicultural systems. Oxford University Press. 284 p. 1991.
- Monteiro A.A. Técnicas de produção florestal. INIC, Lisboa. 331 p. 1982.
- Oliveira C.A. Teoria da produção florestal. Centro de estudos Florestais. 519 p. 1984.
- Savill PS, Evans J., Auclair D. & Falck J. Plantation silviculture in Europe. Oxford University Press. 297 p. 1997.
- Schütz J.P. Sylviculture 1. Presses Polytechniques et Universitaires Romandes. Suisse. 243 p. 1990.

Operações Florestais / Forest Operations (2^o semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

To enable students with criteria for making and implementing decisions in terms of forestry operations inherent to different phases: for forest stands regeneration (natural or artificial), cultural practices (cleaning, scrolling in hardwoods, and phytosanitary treatments); for other cultural practices (pruning, thinning), harvesting and logging.

Syllabus:

1) analysis of the environmental constraints; (2) identification of forest operations to perform, depending on the objectives and characteristics of the physical environment, (3) identification of the effect of climatic factors on the time spent by forest operation, yield and costs, (4) median operative time and costs associated, (5) establishment of operative and financial timeline, (6) best practices for storage and application of phytochemicals products in forest.

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Ordenamento Biofísico / Land Planning (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

To provide an introduction to the theoretical principles, methods and tools for land evaluation and forest suitability assessments as well as other bio-physical planning studies. At the end of the course the students should be able to: (1) Assess the value and limitations of biophysical resources for forest resources use; (2) Know the regulations concerning to land use planning and management. (3) Elaborate suitability assessments and spatial plans ensuring sustainability and the ecological equilibrium of ecosystems.

Syllabus:

Principles of land evaluation for forest uses; Environmental analysis: Bio-physical variables and its spatial modeling; Land use, land use classifications; Morphology of rural areas and principles of ecological planning; Ecosystems functions and services; Methods for suitability assessment in forest areas; Spatial planning regulation

Bibliography:

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Ministerio De Medio Ambiente (1998). Guia para la elaboración de estudios del medio físico – contenido y metodología. Ministerio de Medio Ambiente, Madrid.

Sistemas Agroflorestais / Agro-Forestry (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

Master the concepts and techniques related with the management and use of trees and pastures in the montado system. Integrate the aspects related with tree management with those related with grazing management according to a perspective of sustainability. Know the aspects related with management natural rangelands, integrating the concepts associated with fire management.

Syllabus:

1. The reality and the potentialities of Agro-forestry systems (AFS). 2. The design and the assessment of AFS in Mediterranean regions. 3. The design and the assessment of AFS in tropical and sub-tropical regions. 4. Characterization and use of fodder used by grazers and browsers in AFS. 5. Digestive systems of the domestic ungulates and the type of food resources they use. 6. Physiologic mechanisms and agronomic characteristics sustaining the adaptability of rangeland species to different climatic conditions. 7. Management programs for animal use in the montado systems.

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Desenvolvimento Local / Local Development (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

To know and to discuss the techniques and methods for the implementation of plans and projects to promote active and creative local development; To know the techniques and methods to promote public participation in the implementation of plans and projects of local development.

Syllabus:

1. Concepts, myths, philosophies and approaches to development; 2. Development indicators; 3. Differences in development; 4. Participatory survey techniques of local development; 5. Construction of participatory and gender-sensitive local development projects.

Bibliography principal:

- Geilfus, F. 80 herramientas para el desarrollo participativo: planificación, monitoreo, evaluación. Proyecto Regional IICA /Holanda/Laderas, San Salvador, 2002
- Guijt, Irene. Monitoramento participativo: Conceitos e Ferramentas Práticas para a Agricultura Sustentável. International Institute for Environment and Development; Assesoria e Serviços a Projectos em Agricultura Alternativa, 1999
- Schiefer, U.; Bal-Dobel, Lucinia; Baptista, António, Dobel, Reinald; Nogueira, João e Teixeira, Paulo. Manual de Planeamento e Avaliação de Projectos. Principia Editora, Estoril, 2006
- Schiefer, Ulrich; Teixeira, Paulo Jorge e Monteiro, Susana. MAPA - Manual de Facilitação para a Gestão de Eventos e Processos Participativos (Método aplicado de Planeamento e Avaliação). Principia Editora, Estoril, 2006
- Wicki, Wilde e Vainio-Mattila, Arja. Gender Analysis and Forestry. Forests, Trees and People Programme, Food and Agriculture Organization, Roma, 1995.

Sanidade Florestal / Forest Protection (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

1- Dominates the functioning of forest ecosystems and population dynamics of phytophagous; 2 - Identifies biotic agents able to cause damage to forest trees, 3 - Establishes the influence of biotic agents in the growth and development of plants; 4 - Knows the effect of abiotic factors (fire, high temperature, natural disasters) in the dynamics of causal agents and assesses the impact caused; 5 - Establishes management measures aimed at a sustainable forest development

Syllabus:

1. Interactions between organisms, phytophagous population dynamics and consequences in the plants; 2. Biotic agents able to cause damage to Portuguese forest trees; 3. Management of forests against forest pests and diseases; 4. Control measures.

Bibliography:

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- FERREIRA, M.C. 1998. Manual dos insectos nocivos às plantações florestais. Plátano Edições Técnicas.Lisboa.
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- JUAN, J. 1993. Patologia Forestal . Ediciones Mundi-Presa, Madrid.
- VASCONCELOS, T.; FRANCO, JC; BRANCO, M., 2008. Os inimigos naturais e a regulação das populações de fitófagos. Pragas e doenças em Pinhal e Eucaliptal: Desafios para uma gestão integrada. ISA press
- VASCONCELOS, T., MACHADO, H., BONOFÁCIO, L., BRAGANÇA, H., INÁCIO, L., BRANCO, M., 2007. Doenças e pragas das florestas portuguesas. Árvores e Florestas de Portugal, 8, 129-152. Edição conjunta da Fundação Luso Americana, Jornal Público e Liga para a Protecção da Natureza

3rd curricular year

Gestão dos Recursos Faunísticos / Wildlife Management (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

Know the bio-ecology of the different groups of vertebrates relevant to forest ecosystems in Portugal and the role they play as part of the ecosystem; Know the concepts associated with hunting and fishing, and also the techniques more suitable for a sustainable management; Know the interactions between the management of forests and animal biodiversity, as the techniques to use to attain the pretended management objectives; Be able to integrate the previous competences in order to produce a game management plan.

Syllabus:

Knowing wildlife: the evolution of vertebrates, species and most important groups of species; their geographical distribution and distribution by habitats; biology (anatomy, physiology, external morphology, ethology and animal health) and ecology of the different taxa with special emphasis to species with management importance from a hunting and fishing perspective; endangered species and protection measures. Hunting and fishing. Historical introduction, processes and means for hunting, Evaluation of trophies of big game, concepts and legislation on fishing in inland waters, Fishing management, Aspects of food health associated to hunting and fishing. Planning and management. Management plans in hunting and fishing zones, management of populations, predator control, repopulation techniques, monitoring techniques, Habitat suitability indices.

Bibliography:

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- Bookhout, A. (ed.), 1994. Research and management techniques for wildlife and habitats. The Wildlife Society. Bethesda.
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Oliveira, M. E., Crespo, E. G., 1989. *Atlas da distribuição dos anfíbios e répteis de Portugal Continental*. Serviço Nacional de Parques Reservas e Conservação da Natureza. Lisboa

Pereira, C.A. 1994. *Espécies Aquícolas de Portugal Continental*. DGF, Lisboa.

Defesa da Floresta Contra Incêndios / Forest Protection against Fire (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

To know the problem of forest fires in Portugal both regarding the ignition problem as the propagation and respective effects; To know and to apply fire prevention techniques, in a way to decrease the number of fire starts, to decrease the propagation potential, to increase resilience and to mitigate fire effects; To know the different aspects associated with firefighting including those related with pre-suppression, initial attack, general firefighting, suppression fire and mop up operations.

Syllabus:

General aspects about wildfires: combustion and fuel characteristics; propagation and fire behavior; models of fire behavior; fire ecology; fire effects; mitigation of fire effects and reclamation of burned areas; common causes of fire starts in Portugal; evolution and present situation of forest fires in Portugal and in Europe. Prevention of forest fires: public awareness, fuel management, including prescribed fire; preventive silviculture; network of fuel breaks; spatial fire risk. Firefighting: pre-suppression, fire danger rating systems, initial attack, general firefighting, use of chemical products, direct and indirect attack techniques, mop-up operations, investigation of fire causes

Bibliography:

Biot, Y. (ed.). 2009. *Living with wildfires: what science can tell us*. Päivinen, R. (ed.). European Forest Institute, Joensuu. 86 p.

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Gestão Empresarial e Empreendedorismo / Enterprise Management and Entrepreneurship (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

Meet the firm goals; distinguishes the different forms of legal and economic enterprises; Mastering the business concepts and principles for its management; Knowing marketing techniques to advertise and promote their products and their activity, acquire the technical skills and analytical skills for identifying and creating new business visibility and growth potential; Mastering the theoretical tools and analytical methodology that allows to investigate the issue of entrepreneurship in its multiple facets

Syllabus:

1. Companies. Organizational Structures. Organizational Behavior. 2. Management of Material Resources: basic variables of management and stock control - the ABC system and economic quantity. 3. Production Management: choice of production process, production planning and philosophy "just-in-time". 4. Management of Financial Resources: finance function and financial analysis, document-based financial analysis, methods and techniques of analysis - the method of ratios, analysis of financial stability and profitability. 5. Commercial Management: Strategic Marketing, Marketing Mix and the importance of market research. 6. Entrepreneurship: ideas and business opportunities, funding sources, procedures for business creation, business plan and criteria for evaluating investments. 7. Ethics and Ethics in Company.

Bibliography:

SOUSA, A. – *Introdução à Gestão*. Lisboa: Editora Verbo, 1990.

CHIAVENATO, I. – *Introdução à Teoria Geral da Empresa*. Editora McGraw Hill, 3ª ed., 1993.

COURTOIS, A., PILET, M., MARTIN, C. – *Gestão da Produção*. LIDEL, 4ª ed., 1997.

ABECASSIS, FERNANDO, CABRAL – *Análise Económica e Financeira de Projectos*. Lisboa: Fundação Calouste Gulbenkian, 3ª ed., 1991.

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KOTLER, R. – Marketing Management: Analysis, Planning and Control. Prentice Hall International Editions, 1980.
BERNARDI, L. – Manual de Empreendedorismo e Gestão: Fundamentos, Estratégias e Dinâmica. Editora Atlas, 2003

Gestão de Recursos Florestais / Forest Management (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

(1) Understand the key issues faced by today's forest managers, in particular the balance between economic production and provision of socially valuable goods and services; (2) Development of information needed to support stand-level and forest-level management planning processes; (3) To know the basic methodologies to develop a natural resource management plan; (4) To be able to build and write a forest management plan.

Syllabus:

Basic concepts in management of forests and other Natural Resources; Development of information to support temporal and spatial decisions in forest management and planning; Estimation and projection of stand and forest conditions. Classical models for forest management; Linear Programming in natural resources management; Forest and natural resource sustainability and multifunctionality; Different forest management strategies.

Bibliography:

Bettinger, P., Boston; K. Siry, J.P., Grebner, D.L. 2009. Forest management and planning. Elsevier Academic Press. USA. 331pp
Davis LS, Johnson KN, Bettinger PS, Howard TE. 2001. Forest Management. New York: McGraw-Hill. 804 pp.
Kangas, A., Kangas, J., Kurttila, M. 2008. Decision Support for Forest Management. Springer. 222 p..

Gestão de áreas naturais / Management of natural areas (1º semestre / Fall semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

- The concepts and specifications regarding natural area and protected area; - The types of natural areas, its ecology, its planning and the management of their resources; - Principles related to the sustainable management of resources, the limitations imposed by the fact that the areas to be managed are classified as natural or protected, and their economic implications.

Syllabus:

- The specificity of the natural areas and their management. - Natural ecosystems in Portugal: wetlands, Coastal Dunes, Mountain Ecosystems, Forest ecosystems and other natural habitats in Portugal. - The specificity and constraints of forestry in protected areas and other natural areas. - Protected areas of Portugal, the Natura 2000, priority habitats and species, and relations with hunting activity in Portugal.

Bibliography:

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Política e Certificação Florestal / Policy and Forest Certification (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

1. ability to assess the political and administrative environment that determines the formation of policies formulation process, taking into account the uncertainty and complexity associated; 2. understand the Institutions, organizations and individual agents actively engaged in the political process, including the factors that influence their involvement; 3. ability to critically examine policy responses to events related to natural resources usage; 4. ability to implement strategic analyzes and understand the resources needed for its implementation.

Syllabus:

1. Elementary notions about sustainable development, economy and development. Obstacles to sustainable development. The major threats to the rural world: the human and physical desertification. Professional ethics and sustainable development. 2. Institutions, organizations and agents involved in the political processes related to forestry and natural resources, conflict management. 3. Global policies, national, regional and sectoral for forest utilization and

conservation and associated natural resources. 4. Criteria and indicators for sustainable forest and associated natural spaces 5. Forest Certification. Certification processes. Social and environmental certification effects. Benefits and costs. Specifics of forest certification implementation in the Portuguese context. 6. Forest management and forest products certification.

Bibliography:

- Bergh, J., 1996. Ecological economics and sustainable development. Theory, methods and applications. Edward Elgar Publications
- Cashore, B., 2007. Creating intelligent markets: lessons from forest certification. University of Michigan Ann Arbor, Michigan
- Cubbage, F., W., O'Laughlin, J. and C. Bullock III, 1993. Forest Resource Policy. John Wiley & Sons, Inc., New York
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- Maser, C., Smith, W., 2001. Forest certification in sustainable development: healing the landscape. Crc press LLC
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- Stine, R.A., Ellefson, P.V., 1997. Organizational effects on policy implementation in a geographical dispersed natural resources organization. *Evaluation Review*, 21(4):419-437.

Exploração florestal / Forest exploitation (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

- Machinery and equipment used in forest harvesting. Forestry operations performed within forest exploitation; -Importance of planning of logging operations (harvesting, processing, extraction and transportation of timber), integration of ecosystem constraints, standards of hygiene and safety at work, and the principles of sustainable forest management.

Syllabus:

- Using the chainsaw and bush cutter; - Moto manual felling with the chainsaw; - Processing of timber, by using the moto manuals methods with the use of chainsaw; - Use of mechanized felling and processing techniques, and the use of equipment of forest exploitation in cultural cuts; - Use of techniques of extraction and transportation; - Identification of machinery and equipment available in the market for forest exploitation; - Achievement of objectives, integrating the constraints of the ecosystem, the rules of hygiene and safety at work, the principles of sustainable forest management and related aspects of forest defense against fires

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- COTF, Conservação e Manutenção da Motosserra. Direcção Geral das Florestas, 1988
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- DGF. Manual de boas práticas florestais. Lisboa, DGF, 2002
- TEIXEIRA, F.; GARDETE, J.J., Trabalho Florestal. Manual de prevenção. IDICT Instituto de Desenvolvimento e Inspeção das Condições de trabalho, 75 pp. 1998

Melhoramento florestal / Forest improvement (2º semestre / Spring semester)

Intended learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students):

• The advantages and constraints of forest improvement; • Factors affecting the genetic population; • The effect of genetic control (heritability), selection methods and the environment in response to selection; • The methods and techniques used in forest improvement; • The introduction of exotic species; • The management and conservation methods of genetic resources of forest species

Syllabus:

The improvement and special feature of forest species: forestry vs. agriculture; Study of variability in forest species - their use on breeding and conservation implications on long-term improvement; Quantitative Genetics: quantitative characteristics and forest improvement; Factors affecting the population genetic and their effect on tree improvement; The definition of strategy on breeding: breeding cycles; mating systems, progeny tests and early tests; Introduction of exotic species: success factors and issues; Global conservation and forest genetic resources management.

3.3.9. Bibliografia principal:

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