A - General description

Course Title – Environmental and Biological Engineering

Qualification awarded – BSc degree (180 ECTS credits)

Admission requirements – General admission and re-enter system and special admission schemes for people older than 23. The general admission system requires one of the following exams: Biology and Geology; Physics and Chemistry; Mathematics. Regional preferences are applied as 40 % of total admissions.

Educational and Professional goals – The Environmental and Biological Engineering degree is a BSc degree (adapted according to the Bologna Declaration) designed to provide high level training in Engineering on matters related to environmental and biological technologies. This degree aims at facilitating access of graduates to the labour market both at national and international level. Special emphasis is placed on emergent areas of knowledge in chemical, biochemical and biotechnology fields. In view to this, the degree delivers technical professionals for top positions in the industry, services and public administration, trainers and instructors, technicians qualified for the development and auditing of industrial projects, researchers, process controllers and monitors focussed on environmental friendly practices and clean technologies.

Access to further studies – Any graduate can apply to Master Programs (second cycle) in the fields of Environmental Engineering, Chemical, Biochemical and Biotechnology and to any Master program requiring a BSc in engineering.

Course structure diagram with credits (60 per year) – Three-year course (six semesters, 30 ECTS credits each):

Course Title	Year	Semester	Number of credits
Linear Algebra	1	1	5
Mathematical Analysis I	1	1	6
Applied Computing	1	1	4.5
General Physics	1	1	5
Introduction to Environmental and Biological Engineering	1	1	4
General Chemistry	1	1	5.5
Mathematical Analysis II	1	2	6

Ecology and Biological Sciences	1	2	4.5
Fluid Mechanics	1	2	4
Probability and Statistics	1	2	4.5
Organic Chemistry	1	2	5.5
Geographical information Systems	1	2	5
Material and Energy Balances	2	1	5
Applied Numerical Methods	2	1	4.5
Chemistry of Solutions	2	1	5.5
Hydraulics I	2	1	5
Hydrology	2	1	5
Chemical Thermodynamics	2	1	5
Chemical Analysis	2	2	4.5
Biochemistry	2	2	5.5
Transport Phenomena	2	2	5
Microbiology	2	2	5.5
Reactors	2	2	4.5
Hydraulics II	2	2	5
Economy and Environmental Policies	3	1	5
Solid Wastes	3	1	4.5
Ecomanagement Systems	3	1	4
Water Treatment Technology	3	1	5.5
Enzyme Engineering (optional)	3	1	5.5
Genetic Engineering (optional)	3	1	5.5
Atmospheric Pollution (optional)	3	1	5.5
Noise Pollution (optional)	3	1	5.5
Ecotoxicology (optional)	3	1	5.5
Quality Management	3	2	4

Project of Environmental and Biological Engineering	3	2	10
Waste Gases Treatment Systems	3	2	5
Soils Contamination and Decontamination (optional)	3	2	5.5
Separation Processes on Biotechnology (optional)	3	2	5.5
Biological Reactors (optional)	3	2	5.5
Advanced Water Treatment Technologies (optional)	3	2	5.5

Final examination, if any – not applicable

Examination and assessment regulations – final examination not required; examination and assessment defined for each individual course unit

ECTS departmental co-ordinator – Prof. Henrique J.O. Pinho (hpinho@ipt.pt)

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B - Description of individual course units

Course title	Linear Algebra
Course code	91002
Type of course	One-Semester course
Level of Course	NA
Year of study	First
Semester/trimester	First
Number of credits	5
Name of lecturer	Carlos Perquilhas; Pedro Carrasqueira
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Students will be provided with knowledge of Matrix Algebra as applied to discussion and resolution (exact and approximate) of linear equation systems and with concepts of vector spaces, determinants and eigen vectors and values as they are fundamental common subject matters for most branches of engineering.
Prerequisites	NA
Course contents	1 - Matrices and linear equation systems 2 - Vector spaces 3 - Determinants 4 - Eigen vectors and values.
Recommended reading	Support texts and other material provided to students through IPT's *e-learning* platform. F. Dias Agudo, Introdução à Álgebra Linear e Geometria Analítica, Escolar Editora, Lisboa, 1978. E. Giraldes, P. Smith, Curso de Álgebra Linear e Geometria Analítica, Mcgraw-Hill, Lisboa, 1995. L. T. Magalhães, Álgebra Linear como Introdução à Matemática Aplicada, Texto Editora, 1989. W. Nicholson, Linear Algebra with Applications, PWS Publishing Company, Boston, 1995. M. Heath, Scientific Computing: an Introductory Survey, McGraw-Hill, 2007. R. Burden e J. Faires, Numerical Analysis, John Wiley & Sons, 1993.
Teaching methods	Lectures and tutorials with practice of course content.
Assessment methods	Continuous assessment: two written tests Final assessment: one written exam covering all subject matters taught.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Mathematical Analysis I
Course code	91001
Type of course	One-Semester course
Level of Course	I
Year of study	First
Semester/trimester	First
Number of credits	6
Name of lecturer	Cristina Costa, Luís Merca, Manuela Fernandes
Objectives of the course (preferably expressed in terms of learning outcomes competences)	1 - Provide the basic concepts and mathematical methods usually used in this engineering degree. 2 - Provide the students with skills to work with differential and integral calculus in one real-variable functions.
Prerequisites	NA
Course contents	1 - Preliminaries. 2 - Real functions of a real variable. 3 - Limits and continuity. 4 - Differential calculus 5 - Integral calculus.
Recommended reading	Texts and support material available in the course web page. Jaime Carvalho e Silva; "Princípios de Análise Matemática Aplicada". McGraw-Hill. Swokowski, E. W.; "Cálculo com Geometria Analítica". McGraw-Hill. Piskounov, N.; "Cálculo Diferencial e Integral". Ed. Lopes da Silva. Simmons, G. F.; "Cálculo com Geometria Analítica". McGraw-Hill. Anton, Howard; "Cálculo um novo horizonte. Volume I". Bookman. Stewart, James; "Cálculo. Volume I". Pioneira. Larson, Ron; "Cálculo. Volume I". 8ª Edição. McGraw-Hill.
Teaching methods	Theoretical lectures, with presentation and illustration of the proposed subjects. Theoretical-practical lectures to propose and solve exercises.
Assessment methods	Continuous assessment: two written tests. Exam assessment: one written test.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Applied Computing
Course code	91006
Type of course	One-Semester course
Level of Course	NA
Year of study	First
Semester/trimester	First
Number of credits	4.5
Name of lecturer	Nuno Madeira
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Know basic IT concepts; understand the computer and inside transactions. Know how to develop an IT Project Develop, use and apply Fortran 77 code Develop, use and apply Octave environment to perform numerical computations.
Prerequisites	NA
Course contents	Basic IT concepts Algorithms: How to develop a project? 1. Thinking/understanding the problem 2. Strategy and Planning 3. Development (Fortran or Octave) 4. Running and use 5. Maintenance and continuous improvement Develop Fortran 77 Code Use Octave environment to perform numerical computations Link Fortran and Octave
Recommended reading	Chapman, S. J., *Introduction to Fortran 90/95*, McGraw-Hill, New York (1998) Nyhoff, L. R., Leestma, S. C., *Fortran 90 for Engineers & Scientists*, Prentice-Hall, New Jersey (1997) Kerrigan, J. F., *Migrating to Fortran 90*, O' Reilly & Associates, Sebastopol (1994) Documentation prepared by the lecturer
Teaching methods	Lectures and group work
Assessment methods	Examinations, presentations and project work
Language of instruction	Portuguese

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B - Description of individual course units

Course title	General Physics
Course code	91004
Type of course	One-Semester course
Level of Course	NA
Year of study	First
Semester/trimester	First
Number of credits	5
Name of lecturer	Rosa Brígida Almeida de Quadros Fernandes
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Fundamentals of material point and oscillatory and wave mechanics. The students should become familiar with the subject matter and capable of handling the principles and concepts, applying them to concrete situations and solving problems in different areas. Some computer programs like Maple, Excel and Modellus, in addition to flash and java simulations, help the student study a particular physical problem using various methods and processes.
Prerequisites	Elementary trigonometry, elementary algebra and function analysis.
Course contents	Introduction: branches of classical physics; measures and units; international system of units; scientific notation; dimensional analysis. Revision of trigonometry and of vectorial analysis. Interactions and forces: fundamental Interactions in nature; effect various forces applied simultaneously; principle of overlap. Introduction to scalar kinematics. Dynamic laws. Work and energy. Oscillations: simple harmonic motion; damped and forced oscillations; resonances. Waves: light and sound.
Recommended reading	Texts and other materials on the web site: http://www.e-learning.ipt.pt, on the AIF courses: "Física Computacional 1". Course appointments of Rosa Brígida Fernandes. Alonso & Finn, "*Física um curso universitário*", vol I e II, Addison Wesley (1972). M. Margarida Costa e Maria José Almeida, "*Fundamentos de Física*", Almedina Coimbra (1ª Ed 1992 ou 2ª Ed 2004). Paul G. Hewitt, *Física Conceitual*, Bookman, 9ª Ed. (2002).
Teaching methods	Theoretical classes in which the concepts and the laws are given and exemplified and theoretical-practical classes where the concepts and laws are applied to a variety of problems. Practical experiments are implemented in some classes in order to clarify some of the concepts and laws.

Assessment methods	Continuous assessment consisting of seven or eight conceptual mini-tests, with formulary, and two experimental group works, all during classes. In case of failure, students can submit to a written exam. Exam consists of two parts with formulary: a conceptual part, including 40 multiple-choice questions, and a description part with 3 to 5 working questions.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Introduction to Environmental and Biological Engineering
Course code	91005
Type of course	One-Semester course
Level of Course	NA
Year of study	First
Semester/trimester	First
Number of credits	4
Name of lecturer	Maria Teresa da Luz Silveira
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide competences on matters related to basic engineering calculations particularly unit conversions, dimensional analysis and linear correlation of magnitudes. Provide awareness of the impact of different types of pollution on natural ecosystems; identify the different types of pollutants and familiarise with the solid, liquid and gaseous waste treatment systems.
Prerequisites	Basics of units and magnitudes of the various unit systems most commonly used in engineering.
Course contents	Introduction to engineering calculations. Environmental problems and environmental awareness. Industries/environment relationship. Environmental protection technologies. Environmental biotechnology. Solid, liquid and gaseous waste treatment systems.
Recommended reading	Support material prepared by the lecturer. Inginiería Ambiental-Fundamentos, entornos, tecnologías y sistemas de gestión, Gerard Kiely, McGRAW-Hill, 1999. Biotecnologia-Fundamentos e Aplicações, N. Lima e M. Mota, Lidel-Edições Técnicas, 2003. Elementary Principles of Chemical Processes, R. Felder and R. Rousseau, 3rd ed., John Wiley & Sons, 2000. Basic Biotechnology, Colin Ratledge and Bjorn Kristiansen Eds, Cambridge University Press, 1996.
Teaching methods	Lectures addressing subject content proposed, theoretical-practical classes with application of knowledge acquired.
Assessment methods	Written tests and a written assignment.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	General Chemistry
Course code	91003
Type of course	One-Semester course
Level of Course	NA
Year of study	First
Semester/trimester	First
Number of credits	5.5
Name of lecturer	Valentim Maria Brunheta Nunes / Marco António Cartaxo
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Learn and develop basic knowledge of chemistry fundamentals, relevant for the other Courses. Stimulate the study of chemistry as a science and show its importance for industry and the society with a view to a future profession as Chemical or Environmental Engineers.
Prerequisites	NA
Course contents	Chemistry tools. Atoms, molecules and ions. Chemical reactions and stoichiometry. General principles of chemical reactivity. The structure of atoms and molecules. Electron configuration and periodic relationships among the elements. Chemical bonding. Molecular geometry. Physical states of matter. Gases. Intermolecular forces, liquids and solids. Solutions and physical properties of solutions. Chemical equilibrium. Acid-base equilibria. Solubility equilibria.
Recommended reading	Chang, R., Química, 8ª ed., McGraw-Hill, Lisboa, 2005 Atkins & Jones, Chemistry: Molecules, Matter and Change, 4th ed.; Freeman&Co., 1997 Kotz & Treichel, Chemistry & Chemical Reactivity, 5th ed., Thomson Books, 2003
Teaching methods	Theoretical lectures on course subjects. Practical sessions with resolution of applied exercises and practical execution of laboratorial activities.
Assessment methods	Final written exam and reports on laboratorial activities.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Mathematical Analysis II
Course code	91007
Type of course	One-Semester course
Level of Course	II
Year of study	First
Semester/trimester	Second
Number of credits	6
Name of lecturer	Carlos Perquilhas, Luís Merca, Manuela Fernandes, Pedro Carrasqueira.
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide the basic concepts and mathematical methods usually used in this engineering degree. Provide the students with skills to work with differential and integral calculus in functions of several real variables.
Prerequisites	NA
Course contents	1- Numerical and Functions Series 2- Real functions of several real variables 3- Multiple Integrals
Recommended reading	Texts and support material available in the course web page. Jaime Carvalho e Silva; "Princípios de Análise Matemática Aplicada". McGraw-Hill. Swokowski, E. W.; "Cálculo com Geometria Analítica". McGrawHill Piskounov, N.; "Cálculo Diferencial e Integral". Ed. Lopes da Silva. Simmons, G. F.; "Cálculo com Geometria Analítica". McGraw-Hill. Anton, Howard; "Cálculo um novo horizonte. Volume II". Bookman. Stewart, James; "Cálculo. Volume II". Pioneira. Larson, Ron; "Cálculo. Volume II". 8ª Edição. McGraw Hill. Zill D., Cullen M.; "Advanced Engineering Mathematics".PWS Azenha A., Jerónimo M., "Cálculo Diferencial e Integral em R e R^n" McGraw-Hill.
Teaching methods	Theoretical lectures, with presentation and illustration of the proposed subjects. Theoretical-practical classes with exercise solving.
Assessment methods	Continuous assessment: two written tests. Exam assessment: one written test.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Ecology and Biological Sciences
Course code	91009
Type of course	One-Semester course
Level of Course	NA
Year of study	First
Semester/trimester	Second semester
Number of credits	4.5
Name of lecturer	Luís Filipe Neves Carreira dos Santos
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Students should develop the capacity to understand ecological concepts; importance and sensitivity expressed in ecosystem's equilibrium; fluency in calculating diversity and quality indexes using natural data and developing interpretation and decision-making skills.
Prerequisites	Biology and English at high school level and basic statistics.
Course contents	1 Ecological Principles; 2 Communities; 3 Ecosystems; 4 Population Dynamics; 5 Feeding Territory and Biological resources; 6 Island Biogeography; 7 Environmental Problems; 8 Water quality bio-indicators
Recommended reading	Campbell - *Biology 3rd Edition*, 1994 Sacarrão, G.F., 1991; *Ecologia e Biologia do ambiente*, ISBN:9721031135 Cunningham, W., Saigo, B. 1999, Environmental Science Fifth Edition, WCB/McGraw-Hill, ISBN:0-07-115681-X Provini, A., Galassi, S., Marchetti, R. 2003, Ecologia applicata, Società Italiana di Ecologia, Città Studi Edizioni. Odum, E.P. 2004, Fundamentos de Ecologia, Gulbenkian
Teaching methods	Lectures, Tutorials and Practice
Assessment methods	50% written exam and 50% assignments
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Fluid Mechanics
Course code	910011
Type of course	One-Semester course
Level of Course	NA
Year of study	First
Semester/trimester	Second
Number of credits	4
Name of lecturer	Paula Alexandra Geraldes Portugal
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Be fluent in physical principles of fluid mechanics. Develop competences to carry out calculations with Newton's law, basic law of hydrostatics, law of continuity of flows, equation of Bernoulli, continuous loss of energy, and pump and turbine power.
Prerequisites	Basic knowledge of physics, algebra and mathematical analysis
Course contents	1 – Physical properties of the fluids. 2 – Basic law of the hydrostatics and its application to several systems. 3 – Interpretation and application of the law of continuity of flows. 4 – General flow equations, Navier-Stokes equations and Bernoulli equation and its applications. 5 – Concepts of energy and power of flow. Loss of energy. Pumps and Turbines.
Recommended reading	Giles, R.; "Mecânica dos Fluidos e Hidráulica"; McGraw-Hill Quintela, C.; "Hidráulica"; Fundação Calouste Gulbenkian White, F.; "Fluid mechanics" McGraw-Hill Bird, R. et al; "Transport Phenomena", John Wiley&Sons
Teaching methods	Theoretical sessions with provision of concepts and laws on fluid mechanics and theoretical-practical sessions where the students are offered the opportunity to solve exercises under lecturer supervision.
Assessment methods	Written examinations divided in a theoretical section including "true or false" statements (5 points) and a practical section consisting in the resolution of exercises (15 points).
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Probability and Statistics
Course code	910012
Type of course	One-Semester course
Level of Course	NA
Year of study	First
Semester/trimester	Second
Number of credits	4.5
Name of lecturer	Luís Miguel Grilo
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide the students with the foundations of some of the main techniques and methodologies of Statistics, so that they develop capacities for analysis and reasoning that allows them to design and implement solutions to various problems. The aim is, therefore, to provide tools that facilitate decision-making.
Prerequisites	Knowledge of the subject matters of Mathematical Analysis and Linear Algebra.
Course contents	1 - Elements of probability 2 - Random variables. Some probability distributions. 3 - Sampling and sample distributions 4 - Estimation of parameters 5 - Tests of hypotheses 6 - Correlation and simple linear regression
Recommended reading	Support texts and other material available on the course website: Guimarães, Rui C. e Cabral, José A. S. (2007). *Estatística*. 2.ª Edição, McGraw-Hill. Pedrosa, A. C. e Gama, S. M. A. (2004). *Introdução Computacional à Probabilidade e Estatística*. Porto Editora.
Teaching methods	Lectures including description and illustration of the concepts and methods taught. Theoretical-practical sessions including exercise solving. Tutorial classes making use of statistical data processing software.
Assessment methods	Continuous assessment: two written tests; Exam assessment: regular exam period and re-taking
Language of instruction	Portuguese

B - Description of individual course units

Course title	Organic Chemistry
Course code	91008
Type of course	One-Semester course
Level of Course	NA
Year of study	First
Semester/trimester	Second
Number of credits	5.5
Name of lecturer	Cecília Baptista and Marco Cartaxo
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Acquisition of knowledge on the structure, bonding and reactions in organic molecules. Introduction to reaction mechanisms and its representation. Study of the main categories of monofunctional organic compounds.
Prerequisites	Basics on the properties of chemical elements and bonding.
Course contents	1 – Structure and bonding in organic molecules. 2 – Reactants and reactions in organic chemistry. 3 – Electronic approach of the reactions and intermediates. 4 – Hydrocarbons: structure, physical properties, nomenclature reactivity and reactions (alkanes, alkenes, alkines, arenes). 5 – Other organic compounds: structure, physical properties, nomenclature reactivity and reactions (alkyl halides, alcohols, thiols, ethers, phenols, amines, aldehydes, ketones, carboxilic acids and its derivatives).
Recommended reading	Vollhardt, K.P.C.; Schore, N.E. - "Organic Chemistry – Structure and Function", 3ª ed., W.H. Freeman & Co., New York, 1999. Carey, F.A., "Organic Chemistry", 6ª ed., Mc-Graw-Hill International Edition, New York, 2006. Campos, L. S.; Mourato, M. – "Nomenclatura dos compostos orgânicos", Escolar Editora, Lisboa, 1999.
Teaching methods	Theoretical classes about the properties and reactions of this type of organic compounds. Practical classes to practise applied problems. Laboratorial classes to practise the synthesis, purification and analysis of these compounds.
Assessment methods	Three intermediate theoretical and laboratorial written tests and final theoretical examination.
Language of instruction	Portuguese

B - Description of individual course units

Course title	Geographical Information Systems
Course code	910010
Type of course	One-Semester course
Level of Course	NA
Year of study	First
Semester/trimester	Second
Number of credits	5
Name of lecturer	José Luís Carreiras
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide basic theoretical skills on cartography and GIS technologies and functionalities. The students will learn how to use the ArcView software with application to case studies.
Prerequisites	Basic computer skills at user level.
Course contents	1 – Fundamentals. SIG components. Geographic information. GIS types. 2 – Cartography basics. Coordinate systems. Cartographic projections. Scales. Chart reading. 3 – GIS functionalities. Space analysis. 4 – Geographic information gathering techniques 5 – GIS applications in particular to territory planning and the environment. Case study analysis. 6 –Use of ArcView software. Practical application works.
Recommended reading	Aronoff, S. – "*Geographic Information Systems: A management Perspective*". Comas, D. e Ruiz, E. – "*Fundamentos de los Sistemas de Information Geográfica*", Ed. Ariel Geografia. Matos, J. – "*Fundamentos de Informação Geográfica*", Ed. Lidel. "*Using ArcView Gis*", Manual do utilizador, ESRI.
Teaching methods	Lectures and tutorials that will be held in the computer room to enable the use of ArcView.
Assessment methods	Individual assignments executed in the practical sessions, one final group assignment and one theoretical test.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Material and Energy Balances
Course code	910016
Type of course	One-Semester course
Level of Course	NA
Year of study	Second
Semester/trimester	First
Number of credits	5
Name of lecturer	Henrique Pinho
Objectives of the course (preferably expressed in terms of learning outcomes competences)	The students should be able to perform material and energy balances in single or multi unit processes, with or without chemical transformations, required to further design or audit of industrial plants.
Prerequisites	Basic knowledge of units and process variables, chemical thermodynamics and stoichiometry calculations.
Course contents	1 – Introduction: flow sheets and unit operations. 2 – Mass balances fundamentals. 3 – Process variables gathering, prevision and use 4 – Mass balances in processes with chemical reaction 5 – Energy balances fundamentals 6 – Energy balances in processes with chemical reaction 7 – Solution of simultaneous mass and energy balances 8 – Mass and energy balances in stage type processes 9 – Introduction to computer aided mass and energy balances
Recommended reading	Teaching material available at course web page: R. M. Felder and R. W. Rousseau, *Elementary Principles of Chemical Processes*, 3rd ed., Wiley (2000). D. Himmelblau, *Basic Principles and Calculations in Chemical Engineering*, Prentice-Hall, 6th ed. (1996).
Teaching methods	Lectures: description and demonstration of course contents. Tutorials: resolution of proposed calculation exercises.
Assessment methods	Written examination. Students can bring and use all the course and personal study materials.
Language of instruction	Portuguese.

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B - Description of individual course units

Course title	Applied Numerical Methods
Course code	910018
Type of course	One-Semester course
Level of Course	NA
Year of study	Second
Semester/trimester	First
Number of credits	4.5
Name of lecturer	João Patrício
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide insight on the main concepts of Numerical Methods and Numerical Analysis, namely numerical algorithms for linear systems of equations, nonlinear equations and systems of nonlinear equations, polynomial interpolation, numerical integration and ordinary first order differential equations. Sensitivity for algorithm development and implementation is also developed.
Prerequisites	NA
Course contents	1 – Error and stability 2 – Numerical methods for systems of linear equations 3 – Nonlinear equations and systems of nonlinear equations 4 – Polynomial interpolation 5 – Numerical integration 6 – Numerical methods for ordinary differential equations
Recommended reading	Lecture notes available at the IPT *e-learning* platform. Atkinson, K., ”Elementary Numerical Analysis”, 2nd ed., John Wiley & Sons, N. Y. (1993) Burden R., Faires J., ”Numerical Analysis”. PWS Publishing Company (1993) Pina, H., ”Métodos numéricos”, McGraw-Hill, Lisboa (1995)
Teaching methods	Theoretical and theoretical-practical lectures, with presentation and illustration of the proposed subjects, as well as laboratorial sessions for computer implementation and analysis.
Assessment methods	Continuous assessment: two written tests and computational projects Exam assessment: one written test
Language of instruction	Portuguese

B - Description of individual course units

Course title	Chemistry of Solutions
Course code	910014
Type of course	One-Semester course
Level of Course	NA
Year of study	Second
Semester/trimester	First
Number of credits	5.5
Name of lecturer	Maria Teresa da Luz Silveira
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide competences on matters related with conductometry and develop knowledge previously acquired on redox reactions, precipitation reactions and complexes and complexation reactions.
Prerequisites	NA
Course contents	1 - Conductometry 2 - Redox reactions 3 – Precipitation reactions 4 – Complexometry and complex reactions
Recommended reading	Support material prepared by the lecturer: Gonçalves, M.L.S.S., Métodos Instrumentais para Análise de Soluções, Fundação Calouste Gulbenkian, 4ª Ed., Lisboa, 2001. Christian, D.G., “Analytical Chemistry”, 4ª ed., John Wiley & Sons, New York Segal, B.G., “Chemistry Experiment and Theory”, John Wiley & Sons, New York
Teaching methods	Lectures addressing subject content proposed, theoretical-practical classes and laboratorial sessions with application of knowledge acquired.
Assessment methods	Written tests and reports on laboratory work done.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Hydraulics I
Course code	910013
Type of course	One-Semester course
Level of Course	I
Year of study	Second
Semester/trimester	First
Number of credits	5
Name of lecturer	José Luís Carreiras
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide theoretical knowledge on permanent and variable runoff under pressure, hydraulic pumps and measure, safety and control devices. Apply this knowledge to the study, dimensioning and analysis of water supply systems.
Prerequisites	Fundamentals of Fluid Mechanics (acquired in a previous degree subject)
Course contents	1 – Permanent runoff under pressure 2 – Variable runoff under pressure 3 – Hydraulic pumps 4 – Hydraulic measures 5 – Piping. Exploration and safety devices. 6 – Water catchment 7 – Water supply. Layout and dimensioning. 8 – Pumping stations 9 – Water tanks. Dimensioning and construction. 10 – Water distribution systems
Recommended reading	Quintela, A.C. – "*Hidráulica*", ed. Gulbenkian. Lencastre, A. – "*Hidráulica Geral*". Novais Barbosa. J. – "*Mecânica dos Fluidos e Hidráulica Geral*" "*Manual de Saneamento Básico*", Volumes 1 e 2, Ministério do Ambiente e Recursos Naturais, 1991.
Teaching methods	Lectures and theoretical-practical classes
Assessment methods	Written examinations
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Hydrology
Course code	910017
Type of course	One-Semester course
Level of Course	NA
Year of study	Second
Semester/trimester	First
Number of credits	5
Name of lecturer	José Luís Carreiras
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide knowledge on matters related to hydrological processes and the characterization of hydrological variables.
Prerequisites	NA
Course contents	1 – Fundamentals. Water cycle. Water basins. Water balances. 2 – Rainfall. Time and space distribution. Rainfall data analysis. 3 – Evaporation and fly-off 4 – Drainage. Hydrographs. 5 – Rainfall-runoff relationship. Hydrologic models 6 – Erosion and sedimentation
Recommended reading	Lencastre, A. E Franco, F. – "*Lições de Hidrologia*", ed. Universidade Nova de Lisboa, 1984. "*Curso Internacional de Hidrologia Operativa*", Manual, ed. DGRAH, 1984. Linsley, Kolher e Paulhus – "*Hydrology for Engineers*", 1988. Chow, Maidment e Mays – "*Applied Hydrology*", 1988.
Teaching methods	Theoretical and theoretical-practical classes
Assessment methods	One written test and assignments carried out throughout the semester.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Chemical Thermodynamics
Course code	910017
Type of course	One-Semester course
Level of Course	NA
Year of study	Second
Semester/trimester	First
Number of credits	5
Name of lecturer	Valentim Maria Brunheta Nunes
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Study of Chemical Thermodynamics principles. Application to systems (solid, liquid or gaseous) with interest to Chemical Engineering. Introduction of Environmental issues. Development of important calculus techniques in Engineering.
Prerequisites	NA
Course contents	Ideal and real gases. The zeroth law of thermodynamics. Internal energy and the first law of thermodynamics. Thermochemisty. Entropy and the second law of thermodynamics. Third law of thermodynamics. The Helmoltz and Gibbs functions. Combining the first and second laws. Chemical potential. Chemical equilibrium. Physical transformations in pure substances. Phase rule. Ideal solutions. Raoult's law and Henry's law. Colligative properties. Mixtures of volatile liquids.
Recommended reading	Atkins, P., de Paula, J., *Physical Chemistry*, 7th ed, Oxford University Press, Oxford, 2001 Azevedo, E. G., *Termodinâmica Aplicada*, 2ª ed., Escolar Editora, Lisboa, 2000 Smith, Van Ness e Abbott, *Introduction to Chemical Engineering Thermodynamics*, McGraw-Hill, New York, 1995.
Teaching methods	Theoretical lectures to explain the subjects of the course. Practical lectures with resolution of applied exercises
Assessment methods	Final written exam.
Language of instruction	Portuguese.

B - Description of individual course units

Course title	Chemical Analysis
Course code	910019
Type of course	One-Semester course
Level of Course	NA
Year of study	Second
Semester/trimester	Second
Number of credits	4.5
Name of lecturer	Maria Teresa da Luz Silveira
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide competences on matters related to instrumental methods involving energy absorption, emission and dispersion and solvent-extraction separation techniques.
Prerequisites	Basics of electromagnetic spectrum and of the magnitude units used in the study of radiation.
Course contents	1 – Vis and UV spectrophotometry 2 – Turbidimetry and nephelometry 3 – Emission flame photometry 4 – Atomic absorption spectrometry 5 – Solvent extraction
Recommended reading	Gonçalves, M.L.S.S., "Métodos Instrumentais para Análise de Soluções, Análise Quantitativa", 4 ed., Fundação Calouste Gulbenkian, Lisboa, 2001. Skoog, L.,"Principles of Instrumental Analysis", 4 ed.,Internacional edition. Willard, Merritt,Dean, Sette, "Instrumental Methods of Analysis", 7ª Ed. International Edition. Pecsok, Shields, Caims, Mcwilliam, "Modern Methods of Chemical Analysis", John Willey & Sons. Ewing, G.W., "Instrumental Methods of Chemical Analysis", McGraw-Hill Book Company.
Teaching methods	Lectures addressing subject content proposed, theoretical-practical classes and laboratorial sessions with application of knowledge acquired.
Assessment methods	Written tests and reports on laboratory work performed.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Biochemistry
Course code	910024
Type of course	One-Semester course
Level of Course	NA
Year of study	Second
Semester/trimester	Second semester
Number of credits	5.5
Name of lecturer	Cecília Baptista
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Study of the structure, properties and metabolism of the biological molecules and its functions in living cells. Metabolism of these molecules: carbohydrates, proteins and lipids. Nucleic acids and informational nature of genetic processes.
Prerequisites	Basic knowledge of the structure, properties and reactivity of the organic compounds.
Course contents	1 – Molecular origin of life. 2 – Biological molecules: structure, properties, isolation and characterization. 3 – Carbohydrates, proteins and lipids. Enzymes and nucleic acids. 4 – Energy, ATP cycle and biosynthesis. 5 – Metabolism of the main biological molecules. 6 – Connections between the metabolic routes.
Recommended reading	Quintas, A., Freire, A.P. e Halpern, M.J., "Bioquímica – Organização Molecular da Vida", 1ª ed., Lidel, Lisboa, 2008 Halpern, M.J., "Bioquímica", 1ª ed., Lidel, Lisboa, 1997 McKee, T. e McKee, J.R., "Biochemistry - The molecular basis of life", 3ª ed., McGraw-Hill, 2003
Teaching methods	Theoretical classes to describe the properties of the main biological molecules, its functions and metabolism. Laboratorial classes to study this kind of molecules and to perform several isolation and characterization procedures.
Assessment methods	Laboratorial written test and final theoretical examination.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Transport Phenomena
Course code	910022
Type of course	One-Semester course
Level of Course	NA
Year of study	Second
Semester/trimester	Second
Number of credits	5
Name of lecturer	Dina M. R. Mateus
Objectives of the course (preferably expressed in terms of learning outcomes competences)	To master fundamental concepts of heat. To know how to interpret the behaviour of thermal systems and solve practical problems. To be able to calculate the transfer area of heat transfer equipment. To master fundamental mass transfer concepts, namely those necessary for the design of mass transfer operations
Prerequisites	Differential and Integral Calculus
Course contents	Mechanisms of energy transport. Fourier's law of heat conduction, thermal conductivity. Steady-state heat conduction. Thermal insulation, fins. Unsteady-state heat conduction. Convective heat transfer. Interphase transport, heat transfer coefficients. Radiation heat transfer. Heat exchangers. Mechanisms of mass transport. Fick's law, diffusivity. Steady-state molecular diffusion. Unsteady-state molecular diffusion. Convective mass transfer. Interphase mass transport, mass transfer coefficients. Momentum, heat and mass transfer analogies.
Recommended reading	Sebentas de Fenómenos de Transferência I e II , D.M.R. Mateus (2004). Transport Phenomena, R.B. Bird, W.E. Stewart, and E.N. Lightfoot, John Wiley, Inc. (2002). Fundamentals of Momentum, Heat and Mass Transfer, J.R. Welty, R.E. Wilson and C.E.Wicks, John Wiley & Sons (2001).
Teaching methods	Theoretical classes consist of a short introduction to course basic foundations and theoretical/practical classes involve resolution of application exercises. At the end of class work, further exercises are proposed for training. Design of heat equipment.
Assessment methods	A Design of a heat transfer equipment in conjunction with two partial tests during the term or with one final exam.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Microbiology
Course code	910021
Type of course	One-Semester course
Level of Course	NA
Year of study	Second
Semester/trimester	Second
Number of credits	5.5
Name of lecturer	Cecília Baptista
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Study of the microbial diversity and classification, the procaryotic and eucaryotic cell organization, morphology and growth patterns. Microbial interactions and role in living systems and biotechnological production.
Prerequisites	Knowledge of structure and properties of the biological molecules.
Course contents	1 – A survey and classification of life at the cellular level. 2 – Morphology, ultrastructure and characteristics of bacteria. 3 – Morphology, ultrastructure and characteristics of fungi, and protists. 4 – Viruses: structure, morphology and replication. 5 – Microbial nutrition, growth, control, metabolism and reproduction. 6 – Characterization of different microbial environments. 7 – Applied and industrial microbiology.
Recommended reading	Wiley, J.M., Sherwood, L.M. e Woolverton, C.J. – "Prescott, Harley, and Klein's Microbiology", 7ª ed., McGraw-Hill, USA, 2008. Ferreira, W.F.C. e Sousa, J.C.F. – "Microbiologia", 1ª ed., Volumes 1, 2 e 3, Lidel, Lisboa, 1998, 2000 e 2002. Waites, M.J., Higton, G., Morgan, N.L. e Rockey, J.S. – "Industrial Microbiology: An Introduction", Blackwell Pub. L., USA, 2001.
Teaching methods	Theoretical classes about the characteristics and applications of eucariotic and procariotic microorganisms. Laboratorial classes about sterilization, culture media, laboratorial growing and identification techniques.
Assessment methods	Laboratorial written test and final theoretical examination.
Language of instruction	Portuguese

B - Description of individual course units

Course title	Reactors
Course code	910020
Type of course	One-Semester course
Level of Course	NA
Year of study	Second
Semester/trimester	Second
Number of credits	4.5
Name of lecturer	José Manuel Quelhas Antunes
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Development of skills in analysis and project of ideal chemical reactors through the production of mass and energy balances.
Prerequisites	Concepts of chemical kinetics and thermodynamics.
Course contents	1 –Introduction: classification, characterization and selection of ideal chemical reactors. 2 – Methods for experimental determination of chemical reaction kinetics. 3 – Reactors with on-load refuelling and a stirring device 4 - Batch and semi-batch reactors 5 - Tubular reactors 6 – Sequence of on-load refuelling reactors
Recommended reading	Texts and support material available at the course unit website. Fogler, H.S., *Elements of Chemical Reaction Engineering*, Prentice-Hall, New Jersey, 1986. Levenspiel, O., *Chemical Reaction Engineering*, Third Edition, John Wiley, New York, 1999.
Teaching methods	Lectures with theoretical course introduction and theoretical/practical classes involving practical work and application exercises.
Assessment methods	Theoretical component is assessed through a written test (as continuous or exam assessment) and practical component is assessed through laboratorial reports and assignments as follows: 60% for the theoretical part and 40% for the practical part.
Language of instruction	Portuguese

B - Description of individual course units

Course title	Hydraulics II
Course code	910023
Type of course	One-Semester course
Level of Course	NA
Year of study	Second
Semester/trimester	Second
Number of credits	5
Name of lecturer	José Luís Carreiras
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide knowledge of free surface runoff and apply them to the design, analysis and dimensioning of domestic wastewater and storm water drainage systems.
Prerequisites	Concepts of fluid mechanics and general hydraulics (learned in previous course units).
Course contents	1 – Free surface runoffs 2 – Domestic wastewater draining systems. Design, project and dimensioning criteria of drain piping. 3 – Storm water drainage systems. Design, project and dimensioning criteria of drain piping. 4 – Unit drainage systems 5 – Drainage systems and parts thereof 6 – Structural dimensioning of drain piping 7 – Septicity of the drain piping system
Recommended reading	Quintela, A.C. – "*Hidráulica*", ed. Gulbenkian. Manzanares, A. – "*Hidráulica Geral*", vol.2, ed. AEIST. Lencastre, A. – "*Hidráulica Geral*". Novais Barbosa. J. – "*Mecânica dos Fluidos e Hidráulica Geral*" "*Manual de Saneamento Básico*", Volume 2, Ministério do Ambiente e Recursos Naturais, 1991.
Teaching methods	Lectures and theoretical-practical classes.
Assessment methods	Written test and a project on drainage system dimensioning.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Economics and Environmental Policies
Course code	910026
Type of course	One-Semester course
Level of Course	One-Semester course
Year of study	Third
Semester/trimester	First
Number of credits	5
Name of lecturer	Natércia Maria Ferreira Dos Santos
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Familiarization with the great issues of environment and sustainable development in Portugal and in the world. Skills to understand the environmental policies at global level and at national level and the concepts of Economy of the Environment.
Prerequisites	NA
Course contents	1 - Introduction - Population and demography: dynamics of populations worldwide and in Portugal. 2 - Natural resources and sustainable use. Issues of natural resources and their use in Portugal and in the world. 3 - The concept of sustainable development. Forms of environmental degradation. 4 - Environmental policies in the EU - institutions and conventions. 5 - Clean Technologies. Recyclable materials: the new industrial ecology.
Recommended reading	Chiras, D. D., (2001), Environmental Science. Creating a Sustainable Future, 6ª Ed., Jones and Bartlett Publishers, Sudburry. Kirkwood R. C., Longley A. J., (1995), Clean Technology and the Environment, Blackie Academic & Professional, Glasgow.
Teaching methods	Lectures. Theoretical-practical classes: case studies.
Assessment methods	Theoretical evaluation - Written test. Theoretical-practical evaluation - Report of literature search. The final mark is the average mark of two parts. Approval in the course unit involves a score higher or equal to 10 on both parts (theoretical and practical).
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Solid Waste
Course code	910027
Type of course	One-Semester course
Level of Course	NA
Year of study	Third
Semester/trimester	First semester
Number of credits	4.5
Name of lecturer	Stefan Rosendahl
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Development of competences that will enable an analysis and evaluation of solid waste management systems and the capacity for an adequate choice of the treatment method of solid waste.
Prerequisites	Basic knowledge of inorganic chemistry and physics
Course contents	1 – Production and characterization of solid waste 2 – Collection and transport of solid waste 3 – Treatment methods and final destination of solid waste: Sanitary landfills, composting, incineration, pyrolysis. 4 – Legislation 5 – Recycling of solid waste 6 – Industrial waste: Origin, treatment methods 7 – Hazardous waste: Origin, treatment methods 8 – Hospital waste: Origin, treatment methods
Recommended reading	G. Tchobanoglous et al.: Integrate Solid Waste Management. – McGraw-Hill, 1993 P. T. Williams: Waste Disposal and Treatment. – Wiley, 1998. M. D. LaGrega et al.: Hazardous Waste Management. – McGraw-Hill, 1994.
Teaching methods	Lectures: introduction and debate on subject contents. Tutorials: research and experiments by the students on the matters in question.
Assessment methods	Continuous assessment: Written test, draw up and presentation of a practical assignment. Exam: Written test and assignment.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Ecomanagement Systems
Course code	910028
Type of course	One-Semester course
Level of Course	NA
Year of study	Third
Semester/trimester	First
Number of credits	4
Name of lecturer	Joana Valente
Objectives of the course (preferably expressed in terms of learning outcomes competences)	The students will be provided with the concepts that enable them to understand and analyse an environmental management system designed according to appropriate requirements and regulations. Furthermore, they should develop the capacity to perform simple audits tasks and draw up relevant plans and reports.
Prerequisites	Concepts of environmental issues.
Course contents	1 – Introduction to environmental management systems 2 – Environmental management systems and tools 3 – Case studies/on-site visits/assignments
Recommended reading	Santos Oliveira (2003), Gestão Ambiental, Lidel, Lisboa. Pinto, A. (2005) Sistemas de Gestão Ambiental-Guia para a sua implementação. Sílabo. SGS (2003), O caminho para a ISO 14001, Evitar as armadilhas. APCER (200 I), NP ISO 1400 I: 1999. Guia interpretativo. Ruth Hillary (2000), ISO 14001, Case Studies and Pratical Experiences, Ed. Greenleaf Publishing, UK.
Teaching methods	Theoretical lectures, with presentation and illustration of the proposed subjects. Theoretical-practical classes to propose and solve exercises.
Assessment methods	Written “open-book” test (periodic assessment) or exam (final assessment) and group assignment with oral presentation and discussion.
Language of instruction	Portuguese

B - Description of individual course units

Course title	Water Treatment Technology
Course code	910025
Type of course	One-Semester course
Level of Course	NA
Year of study	Third
Semester/trimester	First
Number of credits	5,5
Name of lecturer	João António Clemente Antunes
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide the students will knowledge about water and wastewater treatment technologies.
Prerequisites	Knowledge of physical and chemical unit operations
Course contents	Water Treatment processes. Physical and chemical characteristics of water sources. Water treatment stations. Pre-treatment operations – Screening – Grit chambers – Flow equalization. Sedimentation – Discrete particle settling – Flocculent settling – Hindered settling. Granular medium filtration. Chemical precipitation – Phosphorus removal – Estimation of sludge quantities – Hardness correction. Disinfection – Use of chlorine compounds and oxygen compounds. Wastewater treatment processes. Physical, chemical and biological characteristics of wastewaters. Primary Unit processes – Flow equalization – mixing – flocculation and flotation. Primary sedimentation tanks – Design of facilities – Biological unit processes – Bacterial growth – activated sludge process. Aerobic aerated lagoons – stabilization ponds – Trickling filters – Sludge treatment – Dewatering of sludge.
Recommended reading	Wastewater Engineering: Treatment, Disposal, Reuse; 3rd ed.; Metcalf & Eddy, McGraw-Hill International Editions; Environmental Engineering, Peavy, H. S.; Rowe, D. R.; Tchobanoglous, G; McGraw-Hill International Editions;
Teaching methods	Lectures and tutorials
Assessment methods	Technical report on laboratory sessions and final written examination.
Language of instruction	Portuguese

B - Description of individual course units

Course title	Enzyme Engineering
Course code	910033
Type of course	One-Semester course (optional)
Level of Course	NA
Year of study	Third
Semester/trimester	First
Number of credits	5.5
Name of lecturer	Dina Maria Ribeiro Mateus
Objectives of the course (preferably expressed in terms of learning outcomes competences)	The students must acquire an integrated training in the area of enzyme engineering through the learning of the fundamental concepts of enzymology, protein engineering, biocatalyst immobilisation, mass transfer applied to biological systems, and design and operation of enzyme reactors.
Prerequisites	Organic and Biochemistry
Course contents	Structure and function of enzymes. Classification and nomenclature. Large-scale production. Enzyme kinetics, inhibition, stability and deactivation. Protein engineering. Immobilisation of biocatalysts. Kinetics in immobilised enzyme systems. Design and analysis of ideal, and non-ideal, enzyme immobilised reactors. Bio-catalysis in non-conventional media. Medical and industrial utilization of free and immobilised enzymes. Laboratory sessions on: demonstration and comparison of different methods for biocatalyst immobilisation; kinetic characterization; operation of different types of enzymatic reactors.
Recommended reading	*Applied Biocatalysis* , A.J.J. Straathof e P. Adlercreutz, Harwood Academic Publishers, Chur, Switzerland (2000). *Bioprocess Engineering – Basic Concepts*, M.L. Shuler e F. Kargi. Pearson Educatión (2002).
Teaching methods	Theoretical classes consist of an introduction to course foundations and practical/laboratory classes involve resolution of application exercises and laboratory sessions.
Assessment methods	Weighed average of the information on laboratory performance, written reports of the conducted experiments, and final exam.
Language of instruction	Portuguese

B - Description of individual course units

Course title	Genetic Engineering
Course code	910032
Type of course	One-Semester course (optional)
Level of Course	NA
Year of study	Third
Semester/trimester	First
Number of credits	5.5
Name of lecturer	Dina Maria Ribeiro Mateus
Objectives of the course (preferably expressed in terms of learning outcomes competences)	The students must acquire knowledge in the area of genetic engineering, through the learning of the fundamental concepts of molecular biology, genetics, and the applications of recombinant DNA technology. The students are trained in the use of relevant molecular techniques.
Prerequisites	Biochemistry and cellular biology
Course contents	DNA structure, replication, restriction and repair. Homologous and heterogeneous recombination of genes. Transcription in eukaryotes and prokaryotes. Protein synthesis. Regulation of genetic expression. Recombinant DNA technology. Restriction enzymes and ligases. Cloning vectors and gene cloning. Methodology to introduce recombinant DNA in clone cells. Instability of r-plasmids. PCR, Southern Blot, Foot-printing, Northern Blot, basis and applications. Sequencing of DNA fragments. Genomic banks. Bioinformatics. Laboratory sessions.
Recommended reading	Biotechnology – Genetic Fundamentals and Genetic Engineering, vol 2, H.-J. Rehm, G. Reed, A. Pühler and P. Stadler (Eds) (1993), VCH Publishers INC. Biotechnology – A Laboratory Course, J.M. Becker, G. A. Caldwell and E.A. Zachgo, Academic Press (1996).
Teaching methods	Theoretical classes consisting of an introduction to course foundations and practical/laboratory classes involving resolution of application exercises and laboratory sessions.
Assessment methods	Weighted average of the information on laboratory performance, written reports of the experiments conducted, and final exam.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Atmospheric Pollution
Course code	910029
Type of course	One-Semester course (optional)
Level of Course	NA
Year of study	Third
Semester/trimester	First
Number of credits	5.5
Name of lecturer	Joana Valente
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide knowledge to understand and analyse atmospheric pollution related issues such as the emission of pollutants into the atmosphere, air quality management and pollutant dispersion, processing and deposition.
Prerequisites	Basics of physics and chemistry
Course contents	1 – The atmosphere 2 – The sources of atmospheric pollution and respective emissions 3 – Pollutant dispersion into the atmosphere 4 – Atmospheric pollutant cycles 5 – Processing and deposition 6 – Air quality management
Recommended reading	Borrego, C. (1994) Poluição Atmosférica I. Dept. de Ambiente e Ordenamento, Universidade de Aveiro. Seinfeld J.H. (1986) Atmospheric Chemistry and Physics of Air Pollution. John Wiley & Sons. Stern, A.c. (1986) Air Pollution. Academic Press, New York. Wallace, J.M. (1977) Atmospheric Science. Academic Press, New York. Wash, K. e Warner, C. F. (1984): Air Pollution: its Origin and Contral, IEPA Dun-Donnelley Publisher
Teaching methods	Theoretical lectures, with presentation and illustration of the proposed subjects. Theoretical-practical classes where exercises are proposed and solved.
Assessment methods	Written “open-book” test (periodic assessment) or exam (final assessment) and group assignment with oral presentation and discussion.
Language of instruction	Portuguese

B - Description of individual course units

Course title	Noise Pollution
Course code	910030
Type of course	One-Semester course (optional)
Level of Course	NA
Year of study	Third
Semester/trimester	First
Number of credits	5.5
Name of lecturer	Isabel Nogueira, João Antunes, Rosa Brígida
Objectives of the course (preferably expressed in terms of learning outcomes competences)	To provide the skills in the field of noise pollution that will enable the student to intervene with regard to the management, noise abatement and control in the environmental phenomena.
Prerequisites	Knowledge in Chemistry, Physics and Mathematics.
Course contents	1. The Physics of Sound 2. Noise Measurement Techniques and Instrumentation 3. Man and Noise 4. Impact Assessment 5. Noise Mapping — Planning and Execution of Noise
Recommended reading	Course texts and related materials available through IPT's e-Learning platform. I. Rocha, D. F. Vieira, "Ruído", Porto Editora, 2ª Ed. (2001). "Regulamento Geral sobre o Ruído", Porto Editora (1997). P. Martins da Silva, "Acústica de Edifícios", MHOP Laboratório Nacional de Engenharia Civil, Porto (1978). P. Martins da Silva, "Ruído de Tráfego Rodoviário ", MOP Laboratório Nacional de Engenharia Civil, Porto (1978). S. N. Y. Gerges, *"Ruído, Fundamentos e Controle"*, Ed. autor – 2ª Ed. (2000).
Teaching methods	Theoretical and practical classes.
Assessment methods	Written examination (first or second session) with a minimum passing score of 9.5 (70% of the final grade) Project work during the semester (30% of the final grade).
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Ecotoxicology
Course code	910031
Type of course	One-Semester course (optional)
Level of Course	NA
Year of study	Third
Semester/trimester	First
Number of credits	5.5
Name of lecturer	Manuel Rosa
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Development of abilities to understand the complexity of the possible resultant interactions in the environment caused by the presence of xenobiotics, to recognise the relevant information to evaluate possible environmental risks and the limitations of the currently available information and to learn the most important ecotoxycologic tests as well as the most appropriate statistic analysis.
Prerequisites	NA
Course contents	Toxicology and ecotoxicology; Contaminants; Distribution of pollutants and modelation; The destination of metals and radioactive isotopes in contaminated ecosystems; The destination of the organic pollutants in the individuals and ecosystems; Toxicity tests; Forecast of ecological effects; Monitoring and bioindicators; Risk evaluation of contaminants.
Recommended reading	Calow, P. (1993). Handbook of Ecotoxicology, Vol. I. Blackwell Scientific Publications, Oxford. Dallinger, R. (1993). Ecotoxicology of metals in invertebrates. Lewis Publishers, Boca Raton. Huges, W. W. (1996). Essentials of Environmental Toxicology. Taylor & Francis, London. Shaw, I. C., Chadwick, J. (1998). Principles of Environmental Toxicology. Taylor & Francis, London.
Teaching methods	Theoretical classes consisting of an introduction to course foundations. Ecotoxicolology tests and adequate statistic analysis are executed in practical and laboratory classes.
Assessment methods	Continuous evaluation equal or higher 14 marks exempt students from taking final exam.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Quality Management
Course code	910034
Type of course	One-Semester course
Level of Course	NA
Year of study	Third
Semester/trimester	Second
Number of credits	4
Name of lecturer	Natércia Maria Ferreira Dos Santos
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Skills to develop and implement control or guarantee quality systems. Skills to analyse quality costs. Skills to implement statistical control systems.
Prerequisites	Knowledge of basic statistics.
Course contents	1 - Introduction - The historical context of Quality 2 - Quality management systems. Quality assurance standards. 3 - Certification of companies. ISO 9000. Accreditation of entities. ISO 17025 4 - Audits. 5 –Quality Cost Analysis 6 – Implementation and analysis of statistical process control.
Recommended reading	PIRES, A. R., *QUALIDADE – SISTEMAS DE GESTÃO DA QUALIDADE*, 2ª Ed., Edições Sílabo, 2000, Lisboa. CAPELAS, L. (Coordenadora), *MANUAL PRÁTICO PARA A CERTIFICAÇÃO E GESTÃO DA QUALIDADE COM BASE NAS NORMAS ISO 9000:2000*, Verlag Dashöfer Ed., 2001, Lisboa. JURAN, J. M., *JURAN´S QUALITY CONTROL HANDBOOK*, 4ª Ed., McGraw-Hill, 1988, Singapura. GRANT, E., LEAVENWORTH, R., *STATISTICAL QUALITY CONTROL*, 7ª Ed., Mc Graw Hill, 1996, USA.
Teaching methods	Lectures and theoretical-practical classes: case studies and exercise solving.
Assessment methods	Theoretical evaluation - Written test. Theoretical-practical evaluation - Report of literature search. Final grade is the average of two parts. Approval in the course unit requires a score higher or equal to 10 on both parts.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Project of Biological and Environmental Engineering
Course code	910036
Type of course	One-Semester course
Level of Course	NA
Year of study	Third
Semester/trimester	Second
Number of credits	10
Name of lecturer	João António Antunes
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Ability to execute and read projects in the various environmental dimensions.
Prerequisites	Knowledge of unit operations and master the general aspects of all the environmental dimensions and impacts.
Course contents	1 – Project Design. Flowcharts. 2 – General environmental legislation 3 – Dimensioning of treatment bodies 4 - Equipments 5 – Process management and conduction 6 – Cost evaluation 7 – Project control
Recommended reading	Ingenieria Ambiental, Gerard Kiely, Mc Graw Hill Water and Wastewater Treatment: Calculations for Chemical and Physical Processes; Humenick, M. J.; Marcel Dekker, Inc;
Teaching methods	Theoretical classes and supervised assignments.
Assessment methods	Continuous assessment and final assignment submitted to and presented before a jury.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Waste Gases Treatment Systems
Course code	910035
Type of course	One-Semester course
Level of Course	NA
Year of study	Third
Semester/trimester	Second
Number of credits	5
Name of lecturer	Joana Valente
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Develop competences to define the technology, general dimensions, operation conditions and performance of appropriate equipment for the control and removal of gaseous effluents associated with a given industrial process.
Prerequisites	Basics of thermodynamics
Course contents	Origins of gaseous pollutants. Composition and characterization of a gaseous effluent. Legislation applicable to gaseous effluents. Gaseous effluent treatment techniques: analysis and dimensioning. Dust collectors. Electrostatic precipitators. Dry filtration. Humid washers. Gas-liquid absorption. Gas-solid adsorption. Incineration.
Recommended reading	Gomes, J. (2001). Poluição atmosférica: um manual universitário, Publindústria, Portugal. Buonicore, A.J. and Davis (2000). W.T. Air Pollution Engineering Manual, Air & Waste Management Association, USA Matos, A. e Pereira, A. (2003). Manual para técnicas de tratamento de efluentes gasosos. Departamento de Ambiente e Ordenamento da Universidade de Aveiro.
Teaching methods	Theoretical lectures, with presentation and illustration of the proposed subjects. Theoretical-practical classes where exercises are proposed and solved.
Assessment methods	Written “open-book” test (periodic assessment) or exam (final assessment) (80%) + group assignment with oral presentation and discussion (20%).
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Soil Contamination and Decontamination
Course code	910038
Type of course	One-Semester course (optional)
Level of Course	NA
Year of study	Third
Semester/trimester	Second
Number of credits	5.5
Name of lecturer	Stefan Rosendahl
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Development of competences that will enable analysis and evaluation of a contaminated site as well as help selection of the adequate treatment method. Knowledge of soil profiles, of the main soil types and the processes occurring inside them.
Prerequisites	Basic knowledge of inorganic chemistry and physics
Course contents	1 – Soil components 2 – Origin and classification of soils 3 – Chemical processes inside the soils 4 – Soil organisms 5 – Transport and movement of water, air and solutions 6 – Degradation of soils 7 – Paths and effects of soil contamination 8 – Contaminating substances 9 – Examples of risk assessment 10 – Methods of de-contamination of soils
Recommended reading	T. Castelo-Grande et al.: Técnicas de descontaminação de solos. – Ingenium, II série, 98 (2007). J. Botelho da Costa: Caracterização e constituição do solo (7.ª ed.). – Fundação Calouste Gulbenkian, Lisboa, 2004. A. Wild: Soils and the Environment. Cambridge, 1993.
Teaching methods	Theoretical classes: introduction to the subject matter and discussion with the students. Practical classes: Research and experiments by the students on course content.
Assessment methods	Continuous assessment: Written test, preparation and presentation of a practical assignment. Exam: Written test end practical assignment.
Language of instruction	Portuguese

B - Description of individual course units

Course title	Separation processes in biotechnology
Course code	910039
Type of course	One-Semester course (optional)
Level of Course	NA
Year of study	Third
Semester/trimester	Second
Number of credits	5.5
Name of lecturer	Henrique Pinho
Objectives of the course (preferably expressed in terms of learning outcomes competences)	The students should be able to develop, scale-up and implement unit separation and purification operations to biological products, within the biotechnology industry context.
Prerequisites	Interpretation of process flow sheets and basic knowledge of unit operations
Course contents	1 – Introduction: fundamentals of recovery and purification of biological products. 2 – Recovery of cellular materials: filtration; centrifugation; sedimentation. 3 – Cell disintegration: mechanic methods; non mechanic methods 4 – Recovery of soluble products; extraction; precipitation; membrane processes; electrokinetic processes. 5 – Purification procedures: adsorption and chromatographic processes; crystallization; drying. 6 – Industrial application examples.
Recommended reading	Teaching material available at course web page. Michael L. Shuler, Fikret Kargi, *Bioprocess Engineering, Basic Concepts*, 2nd ed., Prentice Hall PTR (2002). Jean-François Hamel, Subhas K. Sikdar, Jean B. Hunter, Eds, *Downstream Processing and Bioseparation - Recovery and purification of biological products,* Oxford University Press (1989).
Teaching methods	Lectures: description and application examples of biological products recovery and purification methods. Practical classes: resolution of proposed exercises.
Assessment methods	Written exam (70% of final grade), in which students may use all the course and personal study materials. Group assignments and presentations (30% of final grade).
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Biological Reactors
Course code	910040
Type of course	One-Semester course (optional)
Level of Course	NA
Year of study	Third
Semester/trimester	First
Number of credits	5.5
Name of lecturer	Dina Maria Ribeiro Mateus
Objectives of the course (preferably expressed in terms of learning outcomes competences)	To become aware of which information to gather, or obtain at the laboratory scale, on the global kinetics of the microbial process to get data that will enable: to select the type of fermenter or the battery of fermenters to be used; operation mode; to design the vessel and the respective mixing, aeration and cooling devices.
Prerequisites	Microbiology and Biochemistry
Course contents	Stoichiometry and kinetics of microbial growth. Design and analysis of biological reactors: batch reactor, continuous-flow stirred-tank, fed-batch, CSTR with recycle and wall growth, plug-flow reactor with recycle, bubble-column, fluidized-bed, trickle-bed, CSTRs in series, association CSTR-PFR. Oxygen transfer, consumption rates and oxygen-limited fermentations. Heat balance, sterilisation. Scale-up criteria. Industrial bioreactor construction. Case studies and Laboratory sessions.
Recommended reading	Basic Biotechnology. Colin Ratledge and Bjorn Kristiansen Eds, Cambridge University Press (2001). Bioprocess Engineering Principles, P.M. Doran, Academic Press (1995).
Teaching methods	Theoretical classes consist of an introduction to course foundations and practical/laboratory classes involve resolution of application exercises and laboratory sessions.
Assessment methods	Weighted average of the information on laboratory performance, written reports of the conducted experiments and final exam.
Language of instruction	Portuguese

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B - Description of individual course units

Course title	Advanced Water Treatment Technology
Course code	910037
Type of course	One-Semester course (optional)
Level of Course	NA
Year of study	Third
Semester/trimester	Second
Number of credits	5,5
Name of lecturer	João António Clemente Antunes
Objectives of the course (preferably expressed in terms of learning outcomes competences)	Provide the students with knowledge of new technologies for water and wastewater treatment.
Prerequisites	Knowledge of physical and chemical unit operations
Course contents	Water Treatment processes. Chemical precipitation – Hardness correction – Demineralization – Desalinization – Membrane filtration. Disinfection with oxygen compounds, ozone production. Wastewater treatment processes. Nitrate reduction - Phosphorus removal. Sludge treatment – Dewatering of sludge – Volume reduction of sludge – Biogas production - Biogas utilization.
Recommended reading	Wastewater Engineering: Treatment, Disposal, Reuse; 3rd ed.; Metcalf & Eddy, McGraw-Hill International Editions; Environmental Engineering, Peavy, H. S.; Rowe, D. R.; Tchobanoglous, G; McGraw-Hill International Editions; Water and Wastewater Treatment: Calculations for Chemical and Physical Processes; Humenick, M. J.; Marcel Dekker, Inc; Ingenieria Ambiental, Gerard Kiely, Mc Graw Hill
Teaching methods	Theoretical classes and laboratory classes
Assessment methods	Technical report of laboratory classes and final written examination
Language of instruction	Portuguese