ECTS Information Package: Degree Programme

Bachelor's degree in

CHEMICAL TECHNOLOGY

www.gri.ipt.pt

A - General Description

Programme Title - Tecnologia Química

Qualification awarded - Bachelor's degree in Chemical Technology

Level of qualification - First-Cycle degree, ISCED Level 5, EQF Level 6

Specific admission requirements

General
Specific

In order to be eligible to this bachelor's degree, students must hold the high-school diploma or legally equivalent qualification. Application can also be made through the following special entry routes:

- Students coming from the Portuguese education system through re-admission, degree change and transfer schemes;
- Holders of a Technological Specialization Course Diploma (CET) or a Higher Professional Technical Course (TESP);
- Adults aged more than 23 who have passed tailor-made examinations intended to assess their ability to pursue higher education studies;
- Holders of Intermediary or Graduate degree diplomas;
- Students coming from foreign higher education.

To be accepted for entry in the Bachelor's degree in Chemical Technology students must have passed the following access examinations: (02) Biology and Geology or (07) Physics and Chemistry or (16) Mathematics with a minimum grade of 95 out of 200.

Without prejudice to the general admission requirements and based on IPT's internal regulations, the following applicants may be admitted to the Chemical Technology programme subject to admission quotas:

- the applicants coming from the following regions: Aveiro, Braga, Castelo Branco, Coimbra, Évora, Guarda, Leiria, Lisboa, Portalegre, Porto, Santarém, Setúbal, Viana do Castelo and Viseu (50%);

Specific arrangements for recognition of prior learning (formal, non-formal and informal)

General

Specific
The accreditation of prior learning follows the IPT Regulation of Training and Professional Experience of April 23, 2019, which can be consulted at:http://portal2.ipt.pt/media/manager.php?src=servico&cmd=file&target=m1_MTE2NzQ

Qualification requirements and regulations:
The course structure is presented in the course curriculum published by Order No.15239/2016, dated 19 December. 180 ECTS credits distributed across 6 curricular semesters (3 years).

Profile of the program:
Offer training that, following the potential of knowledge built in IPT in the area of ??Chemical Technology and integrating a training axis CTeSP - Degree - Master, allows the acquisition of skills in the field of industrial processes and services in the area of ??Chemical Technology.Provide a vocational training that enables production planning, quality system management, effluent treatment system management and the coordination of hygiene and safety plans in Chemical Technology companies.Address the shortage of technicians in the field already manifested by several employers, training professionals capable of technical functions and technical direction, in the implementation, monitoring and optimization of industrial processes and services.Prepare professionals capable of effective interaction and value creation in multidisciplinary teams.Develop a sense of responsibility, a critical spirit and the ability to continue learning autonomously, particularly in pursuing studies in the 2nd cycle of training - Master in Chemical Technology.

Key learning outcomes:
The degree in Chemical Technology (TQ) is intended for students to be able to perform technical functions in companies, especially industrial companies, but also in service companies in the field of chemical technology and other related areas and be able to effective interaction within multidisciplinary teams.

Occupational profiles of graduates with examples:
Graduates of the degree in Chemical Technology acquire skills to perform duties in:
- technical and technical direction, in the implementation, monitoring and optimization of processes in the chemical industry: pulp and paper, petrochemical, pharmaceutical, paints, agrifood; agglomerates, etc .;
- technician for chemical and microbiological, environmental, biotechnology laboratory analysis;
- commercial technician and sales of chemicals;
- production planning, management of integrated Quality, Environment and Safety systems, management of effluent treatment systems and coordination of hygiene and safety plans.

Access to further studies:

Graduates from the Chemical Technology program can continue their studies at the Polytechnic of Tomar accessing the Master's degree in Chemical Technology offered by ESTT.

This degree in Chemical Technology allows access to other postgraduate and master's programs according to applicable admission regulations.

Course structure diagram with credits

Course Title	Year	Semester	Credits
General Chemistry	1	S1	5.5
Introduction to Chemical Technology	1	S1	4
Linear Algebra	1	S1	5
Mathematical Analysis I	1	S1	6
Physics	1	S1	5
Technology Applied Computation	1	S1	4.5
Analysis and Treatment of Experimental Data	1	S2	5
Chemical Thermodynamics	1	S2	5
Fluid Mechanics	1	S2	5
Inorganic Chemistry	1	S2	5
Microbiology	1	S2	5
Organic Chemistry	1	S2	5
Biochemistry	2	S1	5
Bioresources	2	S1	5
Heat and Mass transfer	2	S1	5
Material and Energy Balances	2	S1	5
Physical Chemistry	2	S1	5
Solution Chemistry	2	S1	5
Chemical Analysis	2	S2	5
Chemical Processes	2	S2	5
Instrumentation and Equipment	2	S2	5
Integrated Management Systems	2	S2	5
Reactors	2	S2	5
Separation Processes I	2	S2	5
	3	S1	5
	3	S1	5.5
	3	S2	5

(*) This course may not be available in certain academic years. Please confirm availability with the Erasmus coordinator.

Examination regulations, assessment and grading

General
Specific

General assessment rules are in line with the Portuguese law and described in the Academic Regulations of ESTT-IPT.

The bachelor degree is awarded a final grade between 10 and 20 within a 0/20 scale as well as its equivalent in the European grading scale.

Graduation requirements:
Completion of the cycle of study requires approval in all component courses, in order to total 180 compulsory ECTS credits, according to the general rules of assessment.

Mode of study:

Full- or part-time.

Program director or equivalente

Director: Cecília de Melo Correia Baptista
Erasmus coordinator: Marco António Mourão Cartaxo
ECTS coordinator: Marco António Mourão Cartaxo

B - Description of individual course units

Course unit title	General Chemistry
Course unit code	81426
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	5.5
Name of Lecturer(s)	Valentim Maria Brunheta Nunes Marco António Mourão Cartaxo
Learning outcomes of the course unit	Learn basic and in-depth chemistry concepts that are relevant to other courses. Stimulate the study of chemistry and raise awareness to its significance in industry and society. Students should be able to solve basic chemistry problems and perform simple laboratory tasks.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1.Chemistry tools. Atoms, molecules and ions. Chemical reactions and stoichiometry. General principles of chemical reactivity; 2.The structure of atoms and molecules. Electron configuration and periodic relationships among the elements. Chemical bonding; 3. Physical states of matter. Gases.Intermolecular forces, liquids and solids. Physical properties of solutions; 4.Chemical equilibrium.
Recommended or required Reading	- Kotz, J. e Treichel, P. (2003). *Chemistry & Chemical Reactivity*. London: Thomson Books - Chang, R.(2013). *Química*. Lisboa: McGraw-Hill - Atkins, P.(1997). *Chemistry: Molecules, Matter and Change*. NY: Freeman&Co
Planned learning activities and teaching methods	Lectures and lab classes involving exercise solving.
Assessment Methods and criteria	Final written test or exam (75%) and laboratory reports (25%).
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Introduction to Chemical Technology
Course unit code	81425
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	4
Name of Lecturer(s)	Dina Maria Ribeiro Mateus
Learning outcomes of the course unit	Give an integrated and strategic view of process technology and its integration with today's society; provide an introduction to calculations in technology; present the main variables that characterize a process; exemplify their measurement techniques and calculation methods.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. Introduction: The industry of chemical and biological processes; Notions of hygiene and industrial safety. 2. Introduction to engineering calculations. 3. Chemical processes and bioprocesses. 4. Process interconnection: manufacturing diagram and block diagram; case studies.
Recommended or required Reading	- Felder, R. e Rousseau, R. (2005). *Elementary Principles of Chemical Processes*. US: John Wiley & Sons - Himmelblau, D. e Riggs, J. (2012). *Basic Principles and calculations in Chemical Engineering* . US: Prentice Hall - Lima, N. e Mota, M. (2003). *Biotecnologia - Fundamentos e Aplicações*. Lisboa: Lidel-Edições Técnicas - Mateus, D.(0). *Apontamentos das aulas teóricas, Enunciados dos exercícios propostos e Tabelas de apoio* .Acedido em2 de setembro de 2019 em www.e-learning.ipt.pt
Planned learning activities and teaching methods	Lectures and pratical sessions focused on solving practical exercises. Field trips.
Assessment Methods and criteria	Preparation and presentation of a practical assignment (20%) and a final written test (80%). Minimum requirement: 10 marks in each assessment component.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Linear Algebra
Course unit code	81421
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Carlos Filipe Perquilhas Baptista
Learning outcomes of the course unit	1. Acquisition of knowledge in Linear Algebra and Analytic Geometry mathematical areas. 2. Provide students with several algebraic tools that are necessary for modeling and solving problems related to engineering. 3. Development of logical, analytical and critical reasoning thinking skills.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	I. Complex numbers; II. Matrices and Systems of Linear Equations; III. Determinants; IV. Vetor Spaces; V. Eigenvalues and Eigenvectors; VI. Analytic Geometry.
Recommended or required Reading	- Smith, P. e Giraldes, E. e Fernandes, V. (1997). *Curso de Álgebra Linear e Geometria Analítica*. (pp. 1-376). Lisboa: McGraw-Hill - Leon, S.(2010). *Linear Algebra with Applications*. (pp. 1-552). USA: Pearson - Ferreira, M. e Amaral, I. (2009). *Álgebra Linear: Matrizes e Determinantes (Vol 1º)*. (pp. 1-240). Portugal: Edições Sílabo - Amaral, I. e Ferreira, M. (2009). *Álgebra Linear: Espaços Vetoriais e Geometria Analítica*. (Vol. 2). (pp. 1-160). Portugal: Edições Sílabo
Planned learning activities and teaching methods	Lectures and theoretical-practical classes involving presentation and illustration of the subject matter.
Assessment Methods and criteria	Continuous assessment: two written closed-book tests, each worthing 10 marks, and a minimum of 3 marks in each test. Exam assessment: one written closed-book test worthing 20 marks including all taught topics.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Mathematical Analysis I
Course unit code	81422
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Luís Miguel Merca Fernandes
Learning outcomes of the course unit	a)- Provide the mathematical foundations required in other modules of the programme. b)- Provide skills to work with differential and integral calculus of functions of one real variable.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1- Preliminaries. 2- Real functions of a real variable. 3- Limits and continuity. 4- Differential calculus. 5- Integral calculus.
Recommended or required Reading	- Stewart, J.(2013). *Cálculo*. (Vol. 1). São Paulo: Thomson Pioneira - Howard, A.(2007). *Cálculo um novo horizonte*. (Vol. 1). São Paulo: Bookman - Swokowsi, E.(1995). *Cálculo com Geometria Analítica*. (Vol. 1). São Paulo: Makron Books - Silva, J.(1999). *Princípios de Análise Matemática Aplicada*. (Vol. 1). Lisboa: McGraw-Hill
Planned learning activities and teaching methods	Theoretical lectures, with presentation and illustration of the proposed subjects. Theoretical-practical lectures in which exercises are proposed and solved.
Assessment Methods and criteria	Continuous assessment: two written tests. Exam assessment: one written test.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Physics
Course unit code	81424
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Rui Manuel Domingos Gonçalves
Learning outcomes of the course unit	Develop skills for the analysis and resolution of problems related with kinematics, dynamics and electrostatic.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1-Units System. 2-Observations and measures. Data registration. 3-Kinematics of material point. 4-Dynamics of material point. 5-Work and Energy. 6-Electrostatic.
Recommended or required Reading	- Gonçalves, R.(2015). *Sebenta de Física*. ESTT-IPT: UDMF-ESTT-IPT - Walker, J. e Resnick, R. e Halliday, D. (2016). *Fundamentos de Física*. (Vol. 1 e 3). S. Paulo: Livros Técnicos e Científicos - Alonso, M. e Finn, E. (2012). *Física*. Portugal: Escolar Editora - Almeida, G.(2002). *Sistema Internacional de Unidades*. Lisboa: Plátano Editora
Planned learning activities and teaching methods	Lectures about the concepts, principles and applications of physical laws of mechanics and electrostatics. Theoretical and practical classes where exercises and problems are solved. Conducting experiments in class on the subject taught.
Assessment Methods and criteria	Continuous assessment: two tests written containing problems and essay questions, during the semester, with a weighting of 50% each for the final score. Final written exam for the student who has not passed continuous assessment (or grade improvement) in Exam and / or Appeal Exam, with a weighting of 100% for the final grade.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Technology Applied Computation
Course unit code	81423
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	4.5
Name of Lecturer(s)	José Manuel Quelhas Antunes
Learning outcomes of the course unit	To develop the necessary skills for the production of an 1T project in the chemical technology area, using Excel spreadsheet and Matlab software. Students should be able to develop 1T projects required for the numerical solution of common problems in the field of chemical technology.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable
Recommended optional programme componentes	Not applicable
Course contentes	1. lntroduction to digital systems: concepts and definitions. Strategy and Planning (algorithms). 2. lntroduction and use of MS Excel in technology issues. 3. MATLAB - Introduction and application. 4. Applications in chemical technology.
Recommended or required Reading	- Sousa, M.(2011). *Fundamental do Excel 2010*. Lisboa: FCA -Editora de Informática - Walkenbach, J.(2010). *Microsoft Office Exce/ 2010 Bible*. Indianapolis: Wiley Publishing - Chapman, S.(2008). *MATLAB Programming for Engineers*. Toronto: Thomson Learning - Hanselman, D. e Littlefield, B. (2001). *Mastering Matlab 6 -A Comprehensive Tutorial and Reference*. New Jersey: Prentice-Hall
Planned learning activities and teaching methods	In lectures the main concepts are explained, demonstrating the application of these whenever possible. ln practical classes are proposed, in coordination with the evolution of the lectures, the resolution by the students of exercises provided.
Assessment Methods and criteria	The continuous evaluation is carried out through a set of 5 computational practical tasks performed throughout the semester. The final classification in continuous evaluation is obtained by weighting the classifications of the practical tasks and the tasks I and II have a weight of 15% each, tasks III and IV a weight of 20% each and task V a weight of 30%. In the different official periods of final evaluation, computational practical tests with the weight of 100% will be carried out.
Language of Instruction	Portuguese
Work placement(s)	Not applicable

B - Description of individual course units

Course unit title	Analysis and Treatment of Experimental Data
Course unit code	81429
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Maria João da Costa Antunes Inácio
Learning outcomes of the course unit	1. Understand and be able to use the main concepts of: 1.1. Descriptive statistics. 1.2. Probability theory. 1.3. Random variables and probability distributions. 1.4. Estimation and hypothesis testing. 2. Proceed to data analysis, interpret the results and carry out a decision.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. Descriptive statistics. 2. Probability theory. 3. Random variables and probability distributions. 4. Estimation. 5. Parametric hypothesis tests.
Recommended or required Reading	- Gama, S. e Pedrosa, A. (2016). *Introdução Computacional à Probabilidade e Estatística, com Excel*. Lisboa: Porto Editora - Robalo, A.(1998). *Estatística - Exercícios, Vol I (Probabilidades. Variáveis aleatórias)*. Lisboa: Edições Sílabo - Robalo, A.(2004). *Estatística - Exercícios, Vol II (Distribuições. Inferência Estatística)* . Lisboa: Edições Sílabo - Siegel, A.(1996). *Statistics and Data Analysis: An Introduction*. New York: John Wiley & Sons
Planned learning activities and teaching methods	Theoretical-practical lectures where beyond the theoretical exposition of the syllabus, practical applications of the topics presented are developed. Particular emphasis is placed on the analysis of economic data and management problems.
Assessment Methods and criteria	Continuous evaluation: 3 mandatory tests, 1st (0-5 values), 2nd (0-10 values) and 3rd (0-5 values). Final grade is the sum of the 3 tests. Final written test (classification from 0 to 20) of all syllabus contents. Approval in both evaluation periods: grade equal or superior to 10.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Chemical Thermodynamics
Course unit code	814211
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Valentim Maria Brunheta Nunes
Learning outcomes of the course unit	Study of the principles of Chemical Thermodynamics. Students should apply these principles to systems, whether solid, liquid or gaseous, with an interest in Chemical Technology. They should develop important calculation techniques in engineering.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1.Ideal and real gases; 2.Internal energy and the first law of thermodynamics. Thermochemisty; 3. Entropy and the second law of thermodynamics. Third law of thermodynamics; 4.The Helmoltz and Gibbs functions. Combining the first and second laws; 5.Chemical equilibrium; 6. Physical transformations in pure substances. 7. Ideal solutions. Raoult's and Henry´s Law. Phase diagrams.
Recommended or required Reading	- Atkins, P.(2001). *Physical Chemistry*. Oxford: Oxford University Press - Azevedo, E.(2018). *Termodinâmica Aplicada*. Lisboa: Escolar Editora
Planned learning activities and teaching methods	Lectures and tutorials involving problem-solving.
Assessment Methods and criteria	Final written exam (100%)
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Fluid Mechanics
Course unit code	81428
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Paula Alexandra Geraldes Portugal
Learning outcomes of the course unit	Students should be able to perform calculations involving Newton's law, hydrostatics basics law, continuity law, Bernoulli's equation, continuous energy loss, and pump and turbine's power.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable
Recommended optional programme componentes	Not applicable
Course contentes	Physical properties of fluids. Hydrostatics basics law. Interpretation and application of the flow continuity law. General flow equations, Euler and Navier-Stokes equations. Bernoulli's equation and applications. Energy and flow power concepts. Energy loss. Pumps and Turbines.
Recommended or required Reading	- White, F.(2011). *Mecânica dos Fluidos*. São Paulo: AMGH Editora, Lda (McGraw-Hill) - Darby, R. e Chhabra, . (2017). *Chemical Engineering Fluid Mechanics*. Boca Raton (Florida - USA): CRC Press - McDonald, A. e Pritchard, P. e Fox, R. (2010). *Introduction to Fluid Mechanics*. Asia: John Wiley and Sons - Quintela, A.(2000). *Hidráulica*. Lisboa: Fundação Calouste Gulbenkian
Planned learning activities and teaching methods	Theoretical classes where the concepts and laws of fluid mechanics are presented, and theoretical-practical classes where exercises are proposed to be solved by students under the guidance of the teacher.
Assessment Methods and criteria	Continuous assessment: 3 written individual tests with no possibility of consulting written material. The final grade is the arithmetic mean of the 3 grades achieved. Approval is granted with a rating of 9.5 or higher. Exams: Written test divided into 3 parts, corresponding to the three tests of continuous assessment.
Language of Instruction	Portuguese
Work placement(s)	Not applicable

B - Description of individual course units

Course unit title	Inorganic Chemistry
Course unit code	814210
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Valentim Maria Brunheta Nunes Marco António Mourão Cartaxo
Learning outcomes of the course unit	Basic and in-depth chemistry concepts that are relevant to other courses. Foster the study of chemistry and raise awareness to its significance in industry and society. Students should be able to solve basic problems of inorganic chemistry and perform laboratory tasks.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. Theories of chemical bonding. Valence Bond Theory and Molecular Orbital Theory; Chemical bond in metals and semiconductors. 2.Electrochemistry. Redox reactions. Corrosion and electrolysis; 3.Metallurgy and the chemistry of metals. Non-metallic elements. Transition metal chemistry and coordination compounds. Crystal field theory; 4.Nuclear chemistry. Nuclear stability and radioactivity.
Recommended or required Reading	- Kotz, J. e Treichel, P. (2003). *Chemistry & Chemical Reactivity*. London: Thomson Books - Atkins, P.(1997). *Chemistry: Molecules, Matter and Change*. NY: Freeman&Co - Goldsby, K. e Chang, R. (2013). *Química*. Porto Alegre: McGraw-Hill
Planned learning activities and teaching methods	Lectures, tutorials and lab classes involving the performance of several laboratory tasks.
Assessment Methods and criteria	Final written test or exam (75%) and laboratory reports (25%).
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Microbiology
Course unit code	81427
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Cecília de Melo Correia Baptista
Learning outcomes of the course unit	Students should learn about microbial diversity and its classification; organization, morphology, metabolism and reproduction of microorganisms; microbial interactions in natural systems; role of these beings in living systems and biotechnological production.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	N.A.
Recommended optional programme componentes	N.A.
Course contentes	1- Microbial taxonomy. 2- Morphology, ultrastructure and characteristics of bacteria, fungi, algae and protozoa. Viruses - structure, morphology and replication. 3- Nutrition, growth, metabolism, control and reproduction of microorganisms. 4- Applied Microbiology - Characterization of different microbiological systems; Industrial microbiology.
Recommended or required Reading	- Lima, N. e Sousa, J. e Ferreira, W. (2010). *Microbiologia*. Lisboa: Lidel - Edições Técnicas - Woolverton, C. e Sherwood, L. e Willey, J. (2008). *Prescott, Harley and Klein's Microbiology*. New York: McGraw-Hill - Case, C. e Funke, B. e Tortora, G. (2008). *Microbiologia*. S. Paulo: Artmed Editora
Planned learning activities and teaching methods	Lectures and practical laboratory classes.
Assessment Methods and criteria	A - Continuous practical assessment (compulsory practical works - 50% and practical test - 50%). B - Final theoretical test. Final evaluation - 0.4*A + 0.6*B
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	N.A.

B - Description of individual course units

Course unit title	Organic Chemistry
Course unit code	814212
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Cecília de Melo Correia Baptista Marco António Mourão Cartaxo
Learning outcomes of the course unit	Acquire and use the fundamental concepts of structure and binding in organic molecules and the reaction mechanisms and their representation. Learn the properties and typical reactions of different families of monofunctional organic compounds.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	N.A.
Recommended optional programme componentes	N.A.
Course contentes	1 - Structure and binding in organic molecules. 2 - Reagents and reactions in organic chemistry. Electronic aspect of reactions and intermediates. 3 - Structural analysis of organic compounds. 4 - Hydrocarbons: structure, physical properties, nomenclature, reactivity and reactions. 5 - Other groups of organic compounds: structure, nomenclature, properties, reactivity and reactions.
Recommended or required Reading	- Schore, N. e Vollhardt, P. (2005). *Organic Chemistry: Structure and Function*. New York: W.H.Freeman & Co Ltd - Tomé, A.(2010). *Introdução à nomenclatura dos compostos orgânicos*. Lisboa: Escolar Editora - Carey, F.(2007). *Organic Chemistry*. New York: McGraw-Hill International
Planned learning activities and teaching methods	Theoretical lectures. Theoretical-practical classes of exercise resolution. Laboratory classes for synthesis, purification and analysis of organic compounds.
Assessment Methods and criteria	A - two partial theoretical tests (sum = 20 val.); B - completion of all laboratory work and a written practical test; C - final theoretical exam. Final continuous evaluation - 0.6*A + 0.4*B Final exam evaluation - 0.6*C + 0.4*B The practical evaluation (B) is valid for 3 consecutive years.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	N.A.

B - Description of individual course units

Course unit title	Biochemistry
Course unit code	814213
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Cecília de Melo Correia Baptista
Learning outcomes of the course unit	An overview of the structure, properties and metabolism of the biological molecules and its functions in living cells. The metabolism of these molecules: carbohydrates, proteins and lipids. Nucleic acids and informational nature of genetic processes.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1 - Biological molecules: structure, properties, isolation and characterization. Carbohydrates, lipids, proteins and nucleic acids. 2 - Enzymes. Thermodynamics of biological systems. Energy, ATP cycle and biosynthesis. 3 - Metabolism of the main biological molecules. Connections between the main metabolic pathways.
Recommended or required Reading	- Nelson, D. e Cox, M. (2008). *Lehninger Principles of Biochemistry*. New York: W.H. Freeman & Co - Voet, J. e Voet, D. (2011). *Biochemistry*. New York: John Wiley & Sons - Halpern, M. e Freire, A. e Quintas, A. (2008). *Bioquímica - Organização Molecular da Vida*. Lisboa: Lidel, Edições Técnicas
Planned learning activities and teaching methods	Lectures of biomolecules'structure, function and metabolic processes. Laboratory classes depicting extraction, purification and characterization of molecules provided by natural products.
Assessment Methods and criteria	A - Laboratory continuous assessment (laboratory essays -50% and written laboratory test - 50%). B - Final theoretical test. Final classification - 0.4*A + 0.6*B
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Bioresources
Course unit code	814216
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Cecília de Melo Correia Baptista Natércia Maria Ferreira dos Santos
Learning outcomes of the course unit	Acquisition of knowledge in the area of sustainable development. Study of the main natural resources, its intrinsic value, industrial and energetic applications. Sustainable management of bioresources.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1 - Introduction - Biodiversity; value and rating of natural resources. 2 - Water Resources. 3 - Biological Resources. 4 - Mineral Resources. 5 - Energy resources. 6 - Sustainable management of natural resources. Sustainability policies. Biorefinery.
Recommended or required Reading	- Miller Jr., G.(2007). *Ciência Ambiental*. S. Paulo: Cengage Learning - Gullino, M. e Musu, I. e Clini, C. (2008). *Sustainable Development and Environmental Management - Experiences and Case Studies*. EUA: Springer - Oliveira, J.(2005). *Gestão Ambiental*. Lisboa: Lidel - Edições Técnicas - Carvalho, C. e Reis, L. e Fadigas, E. (2019). *Energia, Recursos Naturais e a Prática do Desenvolvimento Sustentável*. Brasil: Manole
Planned learning activities and teaching methods	Lectures and laboratory practice.
Assessment Methods and criteria	Continuous evaluation - Two mini-tests; two worksheets. Preparation of an essay followed by an oral presentation. Final examination.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Heat and Mass transfer
Course unit code	814215
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Dina Maria Ribeiro Mateus
Learning outcomes of the course unit	Students should be able to: interpret the behaviour of thermal systems and solve practical problems; calculate insulation thickness; design heat transfer equipments; understand fundamental mass transfer concepts, namely those necessary for the design of mass transfer equipments.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	Fourier's law. Steady-state heat conduction. Thermal insulation, fins. Unsteady-state heat conduction. Interphase transport, heat transfer coefficients. Radiation heat transfer. Heat exchangers. Mechanisms of mass transport. Fick?s law, diffusivity. Steady-state molecular diffusion. Unsteady state diffusion molecular diffusion. Interphase mass transport, coefficients. Analogies.
Recommended or required Reading	- Mateus, D.(2009). *Fundamentos de Transferência de calor*. Tomar: IPT - Welty, Wicks, Wilson, Rorrer., J.(2008). *Fundamentals of Momentum, Heat and Mass Transfer*. New York: John Wiley & Sons, Inc. - Bird, Stewart, Lightfoot., R.(2002). *Transport Phenomena*. New York: John Wiley & Sons, Inc. - Mateus, D.(0). *Sebentas de Transferência de Massa*.Acedido em2 de setembro de 2019 em www.e-learning.ipt.pt
Planned learning activities and teaching methods	During the theoretical lectures the main concepts are explained and exemplified. In coordination with the evolution of the lectures, the resolution and discussion of exercises and case studies by the students is proposed in the practical classes.
Assessment Methods and criteria	Preparation of a practical assignment (20%) and a final written test (80 %), with minimum mark of 10 out of 20 in each component.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Material and Energy Balances
Course unit code	814214
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Henrique Joaquim de Oliveira Pinho
Learning outcomes of the course unit	Develop the skills needed to solve mass and energy balances. Know how to create and interpret process diagrams, identify process variables and process relationships. Solve mass and energy balances in processes with and without reaction. Decide and define strategies for solving the balances.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. Mass balances; Principles; Process variables; Mass balances without chemical reaction. 2. Mass balances with chemical reaction. 3. Energy balances; Fundamentals, Energy balances without chemical reaction. 4. Energy balances with chemical reaction. 5. Special cases of mass and energy balances.
Recommended or required Reading	- Felder, J.(2000). *Chemical Processes Principles*. London: Springer - Himmelblau, D.(2004). *Basic Principles and Calculations in Chemical Engineering*. New York: Prentice-Hall - Pinho, H.(2018). *Documentos de apoio de BME*. Tomar: IPT (www.e-learning.ipt.pt)
Planned learning activities and teaching methods	Lectures and tutorials.
Assessment Methods and criteria	Written open-book test.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Physical Chemistry
Course unit code	814217
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Valentim Maria Brunheta Nunes Marco António Mourão Cartaxo
Learning outcomes of the course unit	At the end of the course students should be able to solve problems with some fundamental concepts of Physical Chemistry, on a microscopic perspective, namely Quantum Mechanics, Chemical Kinetics and Electrochemistry, that will be useful in more advanced courses.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. Quantum Mechanics. 2. Chemical Kinetics. 3. Electrochemistry.
Recommended or required Reading	- Atkins, P. e De Paula, J. e Keeler, J. (2017). *Physical Chemistry*. Oxford: Oxford University Press - Formosinho, S.(1983). *Fundamentos de Cinética Química*. Lisboa: Fundação Calouste Gulbenkian - Levine, I.(2008). *Physical Chemistry*. New York: McGraw-Hill
Planned learning activities and teaching methods	Lectures where the fundamental principles are described. Theoretical and practical classes where the resolution of application exercises is done and laboratory works dealing with chemical kinetics and electrochemistry is performed.
Assessment Methods and criteria	The theoretical evaluation is made through written tests, with consultation, at the different official evaluation periods (80%), and the practical evaluation (PE) by the practical assignments and respective reports (20%), with a minimum grade of 10 points. The theoretical evaluation (TE) is obtained by weighting the hours taught in each chapter: Test 1 - Quantum Mechanics. Test 2 - Chemical Kinetics. Test 3 - Electrochemistry. The final grade (FG) is obtained by applying the following formula: FG=(0.8xTE)+(0.2xPE)
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Solution Chemistry
Course unit code	814218
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Maria Teresa da Luz Silveira
Learning outcomes of the course unit	Provide skills on matters related with conductometry and strengthen acquired knowledge of redox reactions,precipitation reactions and complexation reactions.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1-Conductometry 2-Redox reactions 3-Precipitation reactions 4-Complexometry and complex reactions
Recommended or required Reading	- Christian, D.(2013). *Analytical Chemistry*. New York: John Wiley & Sons - Harris, D.(2010). *Quantitative Chemical Analysis*. New York: W. H. Freeman and Company - Gonçalves, M.(2001). *Métodos Instrumentais para Análise de Soluções. Análise Quantitativa*. Lisboa: Fundação Caloute Gulbenkian - Holler, F. e West, D. e Skoog, D. e Rouch, S. (2013). *Fundamentals of Analytical Chemistry*. New York: Thomson Brooks/Cole
Planned learning activities and teaching methods	Lectures, tutorials and laboratory classes.
Assessment Methods and criteria	Written tests and laboratory reports.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Chemical Analysis
Course unit code	814223
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Maria Teresa da Luz Silveira
Learning outcomes of the course unit	Students should be able to identify the instrumental methods involving absorption, dispersion and emission of energy, as well as use them in quantitative analysis. They should be able to apply IV and NMR sprectroscopies and chromatography techniques.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1-Vis and UV spectrophotometry 2-Turbidimetry and nephelometry 3-Emission flame photometry 4-Atomic absorption spectrometry 5-IV spectrometry 6-RMN espectroscopy 7-Chromatography
Recommended or required Reading	- Rouessac, A. e Rouessac, F. (2007). *Chemical Analysis: Modern Instrumentation Methods and Techniques*. New York: Wiley - Grouch, S. e Holler, F. e Skoog, A. (2006). *Principles of Instrumentation Analysis*. New York: Brooks/Cole - Gonçalves, M.(2001). *Métodos Instrumentais para Análise de Soluções. Análise Quantitativa.*. Lisboa: Fundação Caloute Gulbenkian
Planned learning activities and teaching methods	Lectures exploring subject matter, theoretical-practical classes and laboratory sessions to apply skills acquired.
Assessment Methods and criteria	Continuous evaluation Approval in the practical component (P) depends on the experimental execution of all practical work, attendance (A, 15%), delivery of a mini report showing the experimental results and calculations of each work. (B, 15%) and three written mini-tests (C, 70%) about laboratory work (C1-10v, C2-5v, C3-5v). C=C1 + C2 + C3 . The classification of the practical component will be: P = A + B + C The practical assessment is valid only in the academic year in which it is performed. Students with the unit in arrears may be exempted from the laboratory execution but they must do the three written tests related to practical work. In this case, it is the classification obtained in these mini-tests that corresponds to the practical component (P) of the final classification. The theoretical component (T) has a minimum of 9.5v and will be evaluated with three written mini-tests (D1-6v, D2-6v, D3-8v) .T = D1 + D2 + D3 Final evaluation The final assessment consists of a written test, at any time, on the theoretical subject (T) with a minimum of 9.5v. The final classification of both the continuous evaluation and the final evaluation will be the weighted average of the two components: CF=0.2P + 0.8T
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Chemical Processes
Course unit code	814222
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Henrique Joaquim de Oliveira Pinho
Learning outcomes of the course unit	Students should be able to perform advanced material and energy balances in complex processes, solve mass balances in multiphasic and staged operations, and use adequate methods to measure and analyse thermophysical and thermochemical properties, use computer tools to calculate mass-energy balances.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Não aplicável.
Recommended optional programme componentes	Not applicable.
Course contentes	1. Termophysical and thermochemical previsiom methods; 2. Mass balances in multiphasic operations; Solid-liquid extraction: solids washing and leaching; Liquid-liquid extraction: imiscible and partially miscible systems. 3. Energy balances in processes with mixture and solution. 4. Simultaneous solving of energy and material balances; Computer design and calculation of energy and mass balances.
Recommended or required Reading	- Felder, R. e Rousseau, R. (2000). *Elementary Principles of Chemical Processes*. New York: Wiley - Pinho, H.(2016). *Material de apoio (Teaching material).*. Tomar: IPT (www.e-learning.ipt.pt) - Himmelblau, D.(1996). *Basic Principles and Calculations in Chemical Engineering*. London: Prentice-Hall - McCabe, W. e Smith, J. e Harriot, P. (2005). *Unit Operations of Chemical Engineering*. .: McGraw-Hill
Planned learning activities and teaching methods	Lectures involving theory presentation. Practical classes involving exercise solving and discussion.
Assessment Methods and criteria	Written open-book examination (75%). A practical assignment including public presentation (25%), requiring a minimum mark of 9/20 in each assessment component.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Instrumentation and Equipment
Course unit code	814224
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Isabel Maria Duarte Pinheiro Nogueira
Learning outcomes of the course unit	Understand the automatic control of the variables of a chemical engineering process, know the concept of the control ring of the variable, the sensors and actuators, the various types of controllers in particular the PID, as well as the process diagrams and layout of a manufacturing facility.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	I. PROCESS CONTROL; II. MEASUREMENT INSTRUMENTATION.
Recommended or required Reading	- Jonhson, C.(1990). *Controlo de Processos - Tecnologia da Instrumentação*. Lisboa: Fundação Calouste Gulbenkian
Planned learning activities and teaching methods	Theoretical classes introduce the themes and present their theoretical foundations. Theoretical-practical classes develop the theoretical concepts in a more practical sense, with the support of real case examples, exercises and study visits.
Assessment Methods and criteria	Written test without consultation, by frequency or exam, obtaining approval with a minimum grade of 9.5 values.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Integrated Management Systems
Course unit code	814219
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Natércia Maria Ferreira dos Santos
Learning outcomes of the course unit	Students should acquire skills to develop and implement quality control and assurance systems, to analyze quality costs and implement statistical control systems.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1 - Introduction - The historical context of Quality. 2 - Quality management systems. Standards of quality assurance. 3 - Certification. Standard ISO 9000. Accreditation of entities. ISO 17025. 4 - Audits. Standard ISO 19011. 5 - Quality Cost Analysis. 6 - Implementation and analysis of statistical process control.
Recommended or required Reading	- Pires, A.(2007). *QUALIDADE ? Sistemas de Gestão da Qualidade*. Lisboa: Edições Sílabo - Hoyle, D.(2005). *ISO 9000 QUALITY SYSTEMS HANDBOOK*. Oxford: Butterworth-Heinemann - António, N. e Teixeira, A. e Rosa, A. (2016). *Gestão da Qualidade - De Deming ao modelo de excelência da EFQM*. Lisboa: Edições Sílabo - Santos, G.(2013). *Sistemas Integrados de Gestão - Qualidade, Ambiente e Segurança*. Porto: Publindústria
Planned learning activities and teaching methods	Explanatory lectures. Theoretical-practical classes: case studies and problem solving.
Assessment Methods and criteria	Theoretical component: written test. Theoretical-practical component: literature review report. Final mark is the average of the two components. A minimum score of 10 (out of 20) in each component is required to pass.
Language of Instruction	Portuguese | **Mentoring in** French
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Reactors
Course unit code	814221
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	José Manuel Quelhas Antunes
Learning outcomes of the course unit	Develop skills in studies of chemical kinetics and in the analysis and design of ideal chemical reactors through mass and energy balances. Real reactors analysis using RTD.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	Introduction: classification, characterization and selection of ideal chemical reactors. Chemical reaction evolution parameters.Chemical Kinetics. Methods of experimental determination of the kinetics of chemical reactions. Ideal Chemical Reactors design: Batch Reactors. Continuous Stirred Reactors. Tubular reactors. Sequential continuous reactors. Residence Time Distribuition.
Recommended or required Reading	- Fogler, H.(1986). *Elements of Chemical Reaction Engineering*. New Jersey: Prentice-Hall - Levenspiel, O.(1999). *Chemical Reaction Engineering*. New York: John Wiley - Bischoff, K. e Froment, G. (2010). *Chemical Reactor Analysis and Design*. New York: John Wiley & Sons - Ribeiro, F. e Lopes, J. e Lemos, F. (2002). *Reactores QuÃmicos*. Lisboa: IST Press
Planned learning activities and teaching methods	Lectures, tutorials and some laboratorial work.
Assessment Methods and criteria	A written test during the regular examination period (60%), reports of laboratorial work (30%) and some homeworks (10%).
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Separation Processes I
Course unit code	814220
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Paula Alexandra Geraldes Portugal
Learning outcomes of the course unit	Students must be able to interpret and use thermodynamics and operation data to perform mass and enthalpic balances, and use analytical, numerical and graphical methods to design equipment for simple, flash and fractional distillation.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable
Recommended optional programme componentes	Not applicable.
Course contentes	1 - Distillation principles - liquid-vapour equilibrium. 2 - Calculations in batch distillation - Rayleigh's equation. 3 - Calculations in flash distillation. 4 - Fractional distillation columns and other equipment. Design calculations, reflux ratio, number of stages, operating lines - side streams and multiple feeds.
Recommended or required Reading	- Seader, J. e Henley, E. (2016). *Separation Process Principles*. USA: John Wiley and Sons - Perry, J.(2019). *Chemical Engineer's Handbook*. USA: McGraw-Hill Book Company - Richardson, R. e Coulson, J. (1988). *Tecnologia Química*. Lisboa: Fundação Calouste Gulbenkian - Academic Press, .(2000). *Encyclopedia of Separation Science*. London:
Planned learning activities and teaching methods	Theoretical sessions involving discussion on chemical-physical principles and the design methods and theoretical-practical sessions involving exercise solving with the lecturer's guidance.
Assessment Methods and criteria	Continuous assessment: 3 written individual tests with no possibility of consulting written material. The final grade is the arithmetic mean of the 3 grades achieved. Approval is granted with a rating of 9.5 or higher. Exams: Written test divided into 3 parts, corresponding to the three tests of continuous assessment.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	
Course unit code	814229
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	5.5
Name of Lecturer(s)	Isabel Maria Duarte Pinheiro Nogueira
Learning outcomes of the course unit	Students should be able to understand and meet the demands of the heavy industry regarding essential industrial utilities: electric power, thermal energy,pneumatics and refrigeration.
Mode of delivery	b-learning
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. The electric power (AC) 2. Thermal Energy 3. Energy Pneumatic 4. Refrigeration and Cooling Systems 5. Ventilation
Recommended or required Reading	- Ganapathy, V.(2003). *Industrial Boilers and Heat Recovery Steam Generators - Design, Applications and Calculations*. New-York and Basel: Marcel Dekker, Inc. - Novais, J.(2008). *Ar comprimido industrial*. Lisboa: Fundação Calouste Gulbenkian - McQuiston, F. e Parker, J. e Spitler, J. (2005). *Heating, Ventilating and Air Conditioning - Analysis and Design*. USA: John Wiley and Sons
Planned learning activities and teaching methods	Lectures are designed to introduce the study topics and present theoretical fundamentals. Theoretical-practical sessions are intended to develop the theoretical concepts with the support of real-world cases and exercise-solving.
Assessment Methods and criteria	Written examination (first attempt or re-sit) with a minimum pass mark of 9.5/20.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.