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

General:

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.

Specific:

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 July 09, 2021.

Qualification requirements and regulations:

The study programme 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:

The IPT Chemical Technology Degree offers solid scientific and technological training in the field of chemical processes at laboratory and industrial levels. The main objectives aim to provide:

- acquisition of skills in the field of laboratory and industrial processes and services in the field of Chemical Technology;
- training in the area of production planning, the management of quality systems, the management of effluent treatment systems and the coordination of hygiene and safety plans in companies in the Chemical Technology area;
- soft skills such as critical thinking and autonomy, which allow, in particular, the continuation of studies in the 2nd training cycle - Master in Chemical Technology.

Key learning outcomes:

With the degree in Chemical Technology (LTQ) it is intended that students will be able to perform technical funtions in companies, mainly industrial, but also in service companies, whether in the area of chemical technology or in another related area and have the ability 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:

- chemical, microbiological, environmental and biotechnological laboratory analysis technician;
- technical direction in the implementation, monitoring and optimization of processes in the chemical industry:
- pulp and paper, petrochemicals, pharmaceuticals, paints, agri-food; agglomerates, etc.;
  technical-commercial of chemical products and equipment;
- 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 study programme 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 code	Course Title	Year	Semester	Credits
81426	General Chemistry	1	S1	5.5
81425	Introduction to Chemical Technology	1	S1	4
81421	Linear Algebra	1	S1	5
81422	Mathematical Analysis I	1	S1	6
81424	Physics	1	S1	5
81423	Technology Applied Computation	1	S1	4.5
81429	Analysis and Treatment of Experimental Data	1	S2	5
814211	Chemical Thermodynamics	1	S2	5
81428	Fluid Mechanics	1	S2	5
814210	Inorganic Chemistry	1	S2	5
81427	Microbiology	1	S2	5
814212	Organic Chemistry	1	S2	5
814213	Biochemistry	2	S1	5
814216	Bioresources	2	S1	5
814215	Heat and Mass Transfer	2	S1	5
814214	Material and Energy Balances	2	S1	5
814217	Physical Chemistry	2	S1	5
814218	Solutions Chemistry	2	S1	5
814223	Chemical Analysis	2	S2	5
814222	Chemical Processes	2	S2	5
814224	Instrumentation and Equipment	2	S2	5
814219	Integrated Management Systems	2	S2	5
814221	Reactors	2	S2	5
814220	Separation Processes I	2	S2	5
814227		3	S1	5
814236	op: Bioenergies (*)	3	S1	5
814228	Industrial Processes and Environment	3	S1	5
814229	Industrial Utilities	3	S1	5.5
814225	Project Assessment Tools	3	S1	4

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

Course structure diagram with credits (cont.)

Course code	Course Title	Year	Semester	Credits
814230	Separation Processes II	3	S1	5.5
814226	Simulation in Technology	3	S1	5
814232		3	S2	5
814240	op: Biotecnology (*)	3	S2	5
814234	Effluent Treatment	3	S2	5.5
814231	Final Project	3	S2	11
814233	Health and Safety	3	S2	3
814235	Process Control	3	S2	5.5

(*) 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

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. (2018). *Chemistry & Chemical Reactivity*. London: Thomson Books - Chang, R.(2013). *Química*. Lisboa: McGraw-Hill
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	- Rousseau, R. e Felder, R. e Bullard, L. (2016). *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 em15 de setembro de 2021 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)	Maria Manuela Morgado Fernandes Oliveira
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)	Eugénio Manuel Carvalho Pina de Almeida
Learning outcomes of the course unit	Provide the learning of general methodologies for observation and analysis of physical processes, and in particular in the interpretation of the main laws of physics associated with the electrical behavior of charged particles, the interaction between them and the interaction with other materials.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1-Physical Quantities, Units and vector representation 2-Observation and measurement 3-Electrostatics I: Properties and action of an electrical charge. Electric field 4-Electrostatics II: Electric Potential 5-Electric Current. Transfer and conversion of energy in an electrical circuit
Recommended or required Reading	- Gonçalves, R.(2015). *Sebenta de Física*. ESTT-IPT: UDMF-ESTT-IPT - Almeida, G.(2002). *Sistema Internacional de Unidades*. Lisboa: Plátano Editora - Halliday, D. e Resnick, R. e Walker, J. (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, E.(2020). *Sebenta de Física* . IPT: UDMF-ESTT-IPT - Ramalho e Costa, M. e Marques de Almeida, M. (2004). *Fundamentos de Física*. Coimbra: Almedina
Planned learning activities and teaching methods	1. Presential M1: Theoretical classes M2: Theoretical-practical classes M3: Laboratory Practices M4: Mentoring Guidance M5: e-learning 2. Autonomous: M6: consultation of resources on the internet M7: Resolution of additional exercises
Assessment Methods and criteria	Rating: 0 to 20 values. Final approval with a minimum of 9.5 values Minimum grade for admission to the 2nd frequency: 7.0 values Evaluation: 1. Continuous assessment: two written tests containing development problems and questions; 1st frequency in the middle of the semester and 2nd frequency at the end of the semester with a weighting of 50% each, for the final grade. 2. Final written test for the student who has not been approved in continuous assessment (or who wants to improve the grade) in the 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 IT project in the chemical technology area, using Excel spreadsheet and Matlab software. Students should be able to develop IT 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 provided exercises.
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 task I has a weight of 10%, task II a weight of 15%, task III a weight of 20%, task IV a weight of 25% 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 Manuela Morgado Fernandes Oliveira
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. Perform 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. Probability theory. 2. Random variables and probability distributions. 3. Estimation. 4. Parametric hypothesis tests. 5. Simple Linear Regression.
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 classes with an expositive and practical component, with the proposal of exercises, promoting the active participation of students in their resolution. Emphasis is given software data analysis and results interpretation.
Assessment Methods and criteria	Continuous assessment: 1st test rated from 0 to 5 values, 2nd test rated from 0 to 10 values and 3rd test rated from 0 to 5 values. The final grade will be the sum of the marks of the three tests, exempting the student from the exam, if it is equal to or higher than 9.5 values. Exam (from 0 to 20): written test, without consultation, on all subjects; the student will pass if it is equal to or higher than 9.5 values.
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	Students should be familiar with the principles of Chemical Thermodynamics and be able to apply them to (solid, liquid or gaseous) systems with interest to Chemical Engineering. They should develop important calculus 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. Thermochemistry; 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. e De Paula, J. e Keeler, J. (2018). *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. Approval is granted with a rating of 9.5 or higher.
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	The students must recognize: the microbial diversity and classification; microbial procaryotic and eucaryotic cell organization, morphology and growth patterns; microbial interactions and role in living systems and biotechnological production.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1- A survey and classification of life at the cellular level. 2- Morphology, ultrastructure and characteristics of bacteria, fungi, and protists. Viruses: structure, morphology and replication. 3- Microbial nutrition, growth, control, metabolism and reproduction. 4- Applied microbiology. Characterization of different microbial environments. Food microbiology. 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. (2016). *Prescott's Microbiology*. New York: McGraw-Hill Education - Case, C. e Funke, B. e Tortora, G. (2016). *Microbiologia*. S. Paulo: Artmed Editora
Planned learning activities and teaching methods	Lectures and laboratory classes.
Assessment Methods and criteria	A - Laboratory ongoing assessment (laboratorial essays -50% and laboratorial written 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	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 bonding in organic molecules, 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 bonding in organic molecules. 2 - Reagents and reactions in organic chemistry. Electronic aspect of reactions and intermediates. 3 - Hydrocarbons: structure, physical properties, nomenclature, reactivity and reactions. 4 - Other groups of organic compounds: structure, nomenclature, properties, reactivity and reactions. 5 - Structural analysis of organic compounds.
Recommended or required Reading	- Schore, N. e Vollhardt, P. (2018). *Organic Chemistry: Structure and Function*. New York: W.H.Freeman - Tomé, A.(2010). *Introdução à nomenclatura dos compostos orgânicos*. Lisboa: Escolar Editora - Smith, J.(2019). *Organic Chemistry*. New York: McGraw-Hill Education
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 works 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 (mandatory laboratorial 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 - Biological Resources. 3 - Water 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 - Clini, C. e Musu, I. e Gullino, M. (2008). *Sustainable Development and Environmental Management - Experiences and Case Studies*. EUA: Springer - Oliveira, J.(2005). *Gestão Ambiental*. Lisboa: Lidel - Edições Técnicas - Fadigas, E. e Reis, L. e Carvalho, C. (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; Laboratory reports; Preparation of an written project with 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. Unsteady-state molecular diffusion. Interphase transport, mass transfer coefficients. Analogies.
Recommended or required Reading	- Mateus, D.(2009). *Fundamentos de Transferência de calor*. Tomar: IPT - Welty, Wicks, Wilson, Rorrer., J. e Foster, . (2021). *Fundamentals of Momentum, Heat and Mass Transfer*. New York: John Wiley & Sons, Inc. - Bird, Stewart, Lightfoot., R.(2007). *Transport Phenomena*. New York: John Wiley & Sons, Inc. - Mateus, D.(0). *Sebentas de Transferência de Massa*.Acedido em15 de setembro de 2021 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.(2016). *Chemical Processes Principles*. London: Springer - Himmelblau, D.(2012). *Basic Principles and Calculations in Chemical Engineering*. New York: Prentice-Hall - Pinho, H.(2020). *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	Solutions 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 - Skoog, D. e West, D. e Holler, F. 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	Continuous evaluation Approval in the practical component (P) depends on the experimental execution of all practical works, delivery of a report of each work. The practical assessment is valid only in the academic year in which it is performed. The theoretical component (T) will be evaluated with two tests with a final value mininum of 9.5v. Final evaluation The final assessment consists of a written test on the theoretical subject (T) with a final mininum 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 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 spectroscopies 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-IR spectrometry 6-NMR spectroscopy 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 the acquired skills.
Assessment Methods and criteria	Continuous evaluation Approval in the practical component (P) depends on the experimental execution of all practical works, delivery of a report of each work. The practical assessment is valid only in the academic year in which it is performed. The theoretical component (T) will be evaluated with a written test and a projet with a final value minimum of 9.5v. Final evaluation The final assessment consists of a written test 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	N.A.
Recommended optional programme componentes	N.A.
Course contentes	1. Termophysical and thermochemical prevision 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. e Bullard, L. (2018). *Elementary Principles of Chemical Processes*. New York: Wiley - Pinho, H.(2020). *Material de Apoio às Aulas de Processos Químicos*. (Vol. 3 Volumes). Tomar: IPT - Himmelblau, D. e Riggs, J. (2012). *Basic Principles and Calculations in Chemical Engineering*. Michigan, USA: Prentice-Hall - Harriot, P. e Smith, J. e McCabe, W. (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 oral 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 equipment and instrumentation in processes in the chemical industry, know the concept of process and its variables, characteristics of sensors and actuators, valves and industrial pumps, as well as the process diagrams and layout of a factory installation.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	I. INTRODUCTION TO THE INDUSTRIAL PROCESS II. INSTRUMENTATION AND EQUIPMENT III. INSTALLATION
Recommended or required Reading	- Jonhson, C.(1990). *Controlo de Processos - Tecnologia da Instrumentação*. Lisboa: Fundação Calouste Gulbenkian - Control Station®, .(2005). *Practical Process Control© "Fundamentals of Instrumentation and Process Control"* . USA: y Control Station, Inc.
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	The Continuous Assessment is carried out by two components: 1st) Two written tests without consultation, during the semester, one on the part of Instrumentation and another on the Equipment part. 2nd) Two bibliographic research works, one on the Instrumentation part and another on the part of Equipment. The final grade of the Continuous Assessment will be given by the formula: (60% of the average of the grades obtained in the written test) + (40% of the average of the marks obtained in the bibliographic work). Exam and Appeal period: written test without consultation. The approval requires 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 - Statistical process control.
Recommended or required Reading	- Pires, A.(2016). *Sistemas de Gestão da Qualidade. Ambiente, Segurança, Responsabilidade Social, Indústria e Serviços*. Lisboa: Edições Sílabo - 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 - Soares, I. e Pinto, A. (2018). *Sistemas de Gestão da QUALIDADE Guia para a sua implementação*. Lisboa: Edições Sílabo
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. Brief 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.(2016). *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 Químicos*. Lisboa: IST Press
Planned learning activities and teaching methods	Lectures, tutorials and some laboratorial works.
Assessment Methods and criteria	The final classification in continuous evaluation is obtained by weighting the classification obtained in 2 written tests (60%), in laboratory and computational tasks and respective reports (30%) and in some tasks that may be of a computational nature (10%). The final classification in period of final evaluation is obtained by written test (70%) and by the classification obtained in laboratory and computational tasks (30%). In all assessment periods, in order to be able to approve, students must obtain a minimum score of 7 out of 20 in any written test.
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 - Coulson, J. e Richardson, R. (1988). *Tecnologia Química*. Lisboa: Fundação Calouste Gulbenkian - Wilson, I.(2000). *Encyclopedia of Separation Science*. London: Academic Press
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: two written individual tests with no possibility of consulting written material. The final grade is the arithmetic mean of the two grades achieved. Approval is granted with a rating of 9.5 or higher. Exams: Written test divided into two parts, corresponding to the two tests of continuous assessment.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Bioenergies (*)
Course unit code	814236
Type of course unit	Optional
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
Name of Lecturer(s)	Marco António Mourão Cartaxo
Learning outcomes of the course unit	Promote the knowledge of bioenergies, the production processes and their applications. Raise the awareness of its uses and its contribution to sustainable development. Know how to evaluate its advantages and disadvantages. Recognize its importance in the development of the country and Europe.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. Introduction to bioenergies. 2. Description of liquid biofuels production processes. 3. Description of gaseous biofuel production processes. 4. The use of biofuels in cogeneration. 5. Other types of bioenergy. 6. Other types of renewable energy. 7. Comparison with fossil energy sources. Resolution of exercises and laboratory works.
Recommended or required Reading	- Mousdale, D.(2008). *Biofuels: Biotechnology, Chemistry, and Sustainable Development*. New York: CRC Press - Klass, D.(2009). *Biomass for Renewable Energy, Fuels, and Chemicals*. New York: Academic Press - Demirbas, A.(2009). *Biohydrogen For Future Engine Fuel Demands*. London: Springer
Planned learning activities and teaching methods	Theoretical lectures, where the fundamental principles and concepts are described. Theoretical-practical classes where application exercises are solved, case studies are analyzed and laboratory works are performed.
Assessment Methods and criteria	1 - Continuous evaluation 1.1 - Practical assessment (AP)= 0.4A + 0.3B + 0.3C • A - Mandatory performance of all laboratory works. • B - Attendance and participation in classes. • C - Presentation of a work related to bioenergies. 1.2 - Theoretical assessment (TA): written test. 2 - Final evaluation: written test (TA). 3 - Final classification (CF) = 0.65AT + 0.35AP
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

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

B - Description of individual course units

Course unit title	Industrial Processes and Environment
Course unit code	814228
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
Name of Lecturer(s)	Manuel Alberto Nogueira Henriques Rosa
Learning outcomes of the course unit	Students should be able to evaluate the environmental impacts of industrial processes.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	NA
Recommended optional programme componentes	Not applicable.
Course contentes	1-Introduction to Pollution 2-Environmental legislation 3-Water pollution 4-Air pollution 5-Soil pollution 6-Industrial solid waste
Recommended or required Reading	- Davis, M. e Cornwell, D. (2012). *Introduction to Environmental Engineering*. New York: McGraw-Hill - Peavy, H. e Tchobanoglous, G. e Rowe, D. (2013). *Environmental Engineering*. New York: McGraw-Hill
Planned learning activities and teaching methods	Theoretical and theoretical-practical classes that address the programmatic contents. Practical classes with discussion of real cases.
Assessment Methods and criteria	Continuous assessment consists of five assessment moments, each of which is valued at 4 points for a final assessment totalizing 20 points. Approval is obtained when the the sum of all moments of evaluation is equal to or greater than 10 values. The assessment during the exam period consists in a written test valued at 20 points.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Industrial Utilities
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 Paula Alexandra Geraldes Portugal
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 (frequency, exam or appeal periods) with a minimum pass mark of 9.5/20.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Project Assessment Tools
Course unit code	814225
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	4
Name of Lecturer(s)	Henrique Joaquim de Oliveira Pinho
Learning outcomes of the course unit	Develop skills in students to: use project management tools; define project organization activities and tasks; estimate investment costs and project operation costs; assess the feasibility of investment projects from a financial and economic perspective.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	Introduction to Project development in the Chemical Technology field. Market assessement techniques. Project design, planning and control principles. Technical, financial and economical evaluation of projects.
Recommended or required Reading	- Peters, M. e Timmerhaus, K. e West, R. (2003). *Plant Design and Economics for Chemical Engineers*. .: McGraw-Hill - Barros, C.(2000). *Decisões de Investimento e Financiamento de Projectos*. Lisboa: Edições Sílabo - Marques, A.(2014). *Conceção e Análise de Projetos de Investimento*. Lisboa: Edições Sílabo - Pinho, H.(2020). *Apontamentos da UC de TAP*. Tomar: IPT
Planned learning activities and teaching methods	Theoretical-practical classes: course content presentation followed by open discussion on proposed case studies; problem solving.
Assessment Methods and criteria	Group work (30%) and written test (70%), in frequency or in exam periods, with a minimum grade of 9 in both components. Students will be excluded from examination if they do not perform the group work during the frequency time.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Separation Processes II
Course unit code	814230
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)	Paula Alexandra Geraldes Portugal
Learning outcomes of the course unit	The student should be able to calculate the basic design parameters for equipment used in milling/grinding/emulsification and particle/fluid droplet separations and to interpret the fluid flow hydrodynamics through particle beds.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable
Recommended optional programme componentes	Not applicable
Course contentes	Grinding / Crushing and Emulsification: - Types of Mills - Grinding energy - Area/volume relation and shape factor Study of the particle motion behaviour within fluids - drag coefficient and Stokes law. Equipment design for: -Gravitational classification; -Sedimentation; -Centrifugation; -Fixed and fluidized particle beds; -Filtration.
Recommended or required Reading	- Perry, J.(2019). *Chemical Engineer's Handbook*. USA: McGraw-Hill Book Company - Wilson, I.(2000). *Encyclopedia of Separation Science*. London: Academic Press - McCabe, W. e Smith, J. e Harriott, P. (2005). *Unit Operations of Chemical Engineering*. Singapore: McGraw-Hill Book Company
Planned learning activities and teaching methods	Mechanical description of equipment using image projection. Theoretical-practical concepts and problem-solving. Problems have a strong practical component based on laboratory and/or industrial data.
Assessment Methods and criteria	Continuous assessment is carried out through a written test and involves the answer to theoretical questions and practical questions about equipment design. The students that obtain a mark equal to or higher than 9.5/20 in the test will be exempted from taking the exam and pass the course. Students eligible for the exam will pass if they reach a mimimum mark of 9.5/20.
Language of Instruction	Portuguese
Work placement(s)	Not applicable

B - Description of individual course units

Course unit title	Simulation in Technology
Course unit code	814226
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
Name of Lecturer(s)	José Manuel Quelhas Antunes
Learning outcomes of the course unit	To acquire the skills needed to develop models of chemical processes and their simulation using the appropriate numerical methods and programming. At the end, students should be able to simulate any process of the area, modeling these processes and solving models.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable
Recommended optional programme componentes	Not applicable
Course contentes	1 - Models and modeling. 2 - Numerical methods applied to chemical technology. 3 - Simulation of chemical technology processes using programming.
Recommended or required Reading	- Luyben, W.(1990). *Process Modeling, Simulation and Control for Chemical Engineers*. New York: Mc Graw-Hill - Hangos, K. e Cameron, I. (2001). *Process Modelling and Model Analysis, 4th vol. of Process Systems Engineering*. San Diego: Academic Press - Chapra, S. e Canale, R. (2015). *Numerical Methods for Engineers*. New York: Mc Graw-Hill - Yang, W. e Chung, T. e Morris, J. (2005). *Applied Numerical Methods Using MATLAB*. New Jersey: John Wiley
Planned learning activities and teaching methods	During the lectures the main concepts are explained, demonstrating the application of these whenever possible. In TP classes is proposed the resolution of some typical exercises and PL classes some case studies are simulated using software.
Assessment Methods and criteria	In continuous evaluation, the classification is obtained through a set of theoretical / practical and computational tasks (60%) and a modeling and simulation work (40%). Students who do not attend 2/3 of the set of TP and PL classes are excluded from the final evaluation, except for the cases provided for in the current Academic Regulation, and students who do not perform the modeling and simulation work will be also excluded from final evaluation. In the final evaluation, the classification is obtained through a modeling and simulation work (40%) and a theoretical / practical and computational test (60%).
Language of Instruction	Portuguese
Work placement(s)	Not applicable

B - Description of individual course units

Course unit title	Biotecnology (*)
Course unit code	814240
Type of course unit	Optional
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second 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 research or obtain laboratory scale data on the overall kinetics of microbial processes in order to be able to: select the fermenter type and operating mode; design the reaction vessel and its mixing, aeration and cooling systems.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable
Recommended optional programme componentes	Not applicable
Course contentes	Stoichiometry and kinetics of microbial processes. Geometries, operation modes and modelling of biological reactors: stirred tank with and without biomass recirculation, fixed bed, fluidized bed, bubble column, aerated recirculation reactor, bioreactor association. oxygen-limited fermentations. Heat transfer and sterilization. Scale-up. Case studies.
Recommended or required Reading	- Mota, M. e Lima, N. (2003). *Biotecnologia - Fundamentos e Aplicações*. (Vol. 1). Lisboa: Lidel-Edições Técnicas - , .(2012). *Bioprocess Engineering Principles*. (Vol. 1). London: Pearson Education - Teixeira, J. e Fonseca, M. (2007). *Reactores Biológicos - Fundamentos e Aplicações*. (Vol. 1). Lisboa: Lidel-Edições Técnicas (). *Sebenta teórica, Protocolos laboratoriais, Enunciados dos exercícios propostos* .Acedido em8 de fevereiro de 2021 em https://doctrino.ipt.pt/
Planned learning activities and teaching methods	Lectures focusing on the fundamental principles. Practical/laboratory classes including laboratory works and the resolution of practical cases.
Assessment Methods and criteria	Final written exam (70%) and laboratory works reports (30%). Minimum mark of 10/20 in each component. This methodology applies to continuous assessment and examination.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable

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

B - Description of individual course units

Course unit title	Effluent Treatment
Course unit code	814234
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5.5
Name of Lecturer(s)	Dina Maria Ribeiro Mateus Manuel Alberto Nogueira Henriques Rosa
Learning outcomes of the course unit	Know the different effluent treatment processes and know how to apply the concepts in the operation of effluent treatment systems.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	I-Introduction to treatment units; II-Physical treatment of liquid effluents; III-Chemical processes for wastewater treatment; IV-Biological wastewater treatment processes; V-Treatment and final destination of sludge.
Recommended or required Reading	- Hendricks, D.(2006). *Water Treatment Unit Processes: Physical and Chemical*. Boca Raton: Taylor & Francis - Curran Inc, W.(2006). *Industrial Waste Treatment Handbook*. Burlington: Butterworth_Heinemann - Elsevier - Kirkwood, R. e Longley, A. (1995). *Clean Technology and the Environment*. Glasgow: Blackie Academic & Professional - Tchobanoglous, G.(2013). *Wastewater Engineering: Treatment and Resource Recovery*. New York: McGraw-Hill
Planned learning activities and teaching methods	In theoretical classes, students learn about the different types of effluent treatment, putting into practice the fundamental knowledge through the resolution of exercises and equipment design.
Assessment Methods and criteria	Continuous assessment: Theoretical tests. The evaluation of chapters I, II and half of chapter III will be carried out through two written tests with a total quotation of 10 values. The evaluation of the remaining half of chapter III and chapters IV and V, will be carried out through a written test with a total quotation of 10 values. Students are exempted from examination if the sum of the two quotations exceeds or equals 10 values and has a minimum of 5 values in each of them. Exam assessment: During exam or appeal periods, students will be able to take only one written test that weighs the same as the continuous assessment.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Final Project
Course unit code	814231
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	11
Name of Lecturer(s)	José Manuel Quelhas Antunes
Learning outcomes of the course unit	On completion of course students should: - be able to prepare and interpret industrial process projects. - adapt to the industrial environment in case of internship. - be able to develop engineering projects and reports as part of lab research or traineeships.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable
Recommended optional programme componentes	Not applicable
Course contentes	1 - Literature review 2 - Report organization. 3 - Chemical Technology project 3.1 Market analysis. 3.2 Production process and its representations. 3.3 Material and energy balances. 3.4 Equipment design. 3.5 Economic analysis.
Recommended or required Reading	- Green, D. e Perry, R. (2019). *Chemical Engineers Handbook*. New York: McGraw-Hill Book Co. - Coulson, J. e Richardson, J. (1989). *Tecnologia Química-Introdução ao Projecto em Engª Química*. (Vol. 6). Lisboa: Fundação Calouste Gulbenkian - Towler, G. e Sinnott, R. (2013). *Chemical Engineering Design – Principles, Practice and Economics of Plant and Process Design*. Oxford: Butterworth-Heinemann - Duncan, T. e Reimer, J. (2019). *Chemical Engineering Design and Analysis - An Introduction*. Cambridge: Cambridge University Press - Riggs, J. e Himmelblan, D. (2014). *Engenharia Química - Princípios e Cálculos*. Rio de Janeiro: Nova Guanabara
Planned learning activities and teaching methods	Lectures and project/traineeship supervision.
Assessment Methods and criteria	Final written report and public presentation of the project.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Possible traineeship if it is student's intention and if there is a company/organization/institution to provide this.

B - Description of individual course units

Course unit title	Health and Safety
Course unit code	814233
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	3
Name of Lecturer(s)	Isabel Maria Duarte Pinheiro Nogueira
Learning outcomes of the course unit	Develop fundamental skills in the area of Health and Safety in the chemical process industry.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. INTRODUCTION 2. MAIN RISKS IN THE CHEMICAL INDUSTRY 3. ORGANIZATION OF HEALTH AND SAFETY AT WORK SERVICES (OSH) 4. WORK-RELATED ACCIDENTS 5. FACILITIES 6. HEALTH AND SAFETY AT WORK - RISK ANALYSIS AND MANAGEMENT 7. SAFETY SIGNAGE 8. PERSONAL PROTECTIVE EQUIPMENT 9. ERGONOMICS 10. OCCUPATIONAL SAFETY AND HEALTH MANAGEMENT
Recommended or required Reading	- Miguel, A.(2012). *Manual de Higiene e Segurança do Trabalho*. Porto: Porto Editora - AEP, .(2011). *Manual de Boas Práticas da Indústria dos Produtos Químicos*. Lisboa: AEP – Associação Empresarial de Portugal
Planned learning activities and teaching methods	Classes are theoretical-practical and focus on course content presentation, resolution of real-life problems and literature review.
Assessment Methods and criteria	Continuous assessment includes two components: the first includes completion of three practical literature review assignments presented in class throughout the semester (90% of the total mark); the second component includes individual practical exercises to be developed in class and attendance (10%). Exam and Appeal Period: Realization of a written test, without consultation. The approval requires a minimum score of 9.5 out of 20.
Language of Instruction	Portuguese | **Mentoring in** French
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Process Control
Course unit code	814235
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5.5
Name of Lecturer(s)	José Manuel Quelhas Antunes
Learning outcomes of the course unit	To develop the skills required to define, design and performance analysis of process control systems. To define control strategies for chemical processes, to design these strategies and to analyze the performance of controllers, including the simulation of the behavior of these controllers.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable
Recommended optional programme componentes	Not applicable
Course contentes	1. Functions, objectives and main control strategies. 2. Typical elements of control cycles. 3. Process control. 4. Case studies of control systems in chemical processes. 5. Simulation of process control.
Recommended or required Reading	- Seborg, D. e Mellichamp, D. e Edgar, T. (2004). *Process Dynamics and Control*. New York: Wiley - Setphanopoulos, G.(1984). *Chemical Process Control- an Introduction to Theory and Pratice*. New Jersey: Prentice Hall International - Luyben, W.(1990). *Process Modeling, Simulation and Control for Chemical Engineers*. New York: Mc Graw-Hill - Bequette, B.(2003). *Process Control: Modeling, Design and Simulation*. New Jersey: Prentice Hall International
Planned learning activities and teaching methods	During the lectures the main concepts are explained, demonstrating the application of these whenever possible. In practical classes are proposed the resolution by the students of exercises provided and some case studies are simulated using software.
Assessment Methods and criteria	Assessment in continuous evaluation is made through of a project computational task of design and simulation of a control system of chemical processes (40%), and a set of theoretical-pratical and computational tasks (60%). In final evaluation periods, the assessment consists in a computational pratical test (60%) and in a project computational task (40%).
Language of Instruction	Portuguese
Work placement(s)	Not applicable