Study Plan

School: School of Sciences and Technology
Degree: Bachelor
Course: Physics and Chemistry (cód. 733)

1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS14156L	Basic Notions of Physics	Physics	6	Semester	156
QUI14166L	Basic Notions of Chemistry	Chemistry	6	Semester	156
MAT12877L	Mathematical Analysis I	Mathematics	6	Semester	156
MAT00900L	Linear Algebra and Geometry I	Mathematics	6	Semester	156
INF00878L	Programming	Informatics	6	Semester	156

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS14143L	Mechanics	Physics	6	Semester	156
FIS14165L	Electromagnetism	Physics	6	Semester	156
QUI14162L	Chemical Bonding	Chemistry	6	Semester	156
QUI14651L	Analytical Chemistry	Chemistry	6	Semester	156
MAT12878L	Mathematical Calculus II	Mathematics	6	Semester	156

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS14176L	Electronic and Instrumentation	Physics	6	Semester	156
FIS14144L	Elasticity and Physics of Fluids	Physics	6	Semester	156
QUI14159L	Physical Chemistry	Chemistry	6	Semester	156
QUI14155L	Inorganic Chemistry	Chemistry	6	Semester	156
QUI13564L	Organic Chemistry	Chemistry	6	Semester	156

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS14150L	Undulatory Phenomena	Physics	6	Semester	156
FIS14145L	Statistical Physics and Thermodynamics	Physics	6	Semester	156
FIS14146L	Quantum Mechanics	Physics	6	Semester	156

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI14178L	Chemistry of New Materials	Chemistry	6	Semester	156
QUI14672L	General Biochemistry	Biochemistry	6	Semester	156

3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS14147L	Atomic, Nuclear and Particle Physics	Physics	6	Semester	156
FIS14161L	Astrophysics	Physics	6	Semester	156
QUI14153L	Electrochemistry	Chemistry	6	Semester	156
QUI14180L	Research and Development Perspectives in Chemistry and Physics	Chemistry	6	Semester	156

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
HIS14151L	History and Philosophy of Science	History	6	Semester	156
FIS14164L	Project	Physics	6	Semester	156
QUI14179L	Introduction to the Chemistry of Polymers	Chemistry	6	Semester	156
QUI14163L	Chemistry and Health	Chemistry	6	Semester	156
QUI13532L	Computational Chemistry	Chemistry	6	Semester	156
PED02475L	Information and Communication Technologies in Education	Education Sciences	6	Semester	156
PED14141L	Foundations of Education	Education Sciences	6	Semester	156

3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS14148L	Physics of the Earth	Physics	6	Semester	156
FIS14149L	Condensed Matter Physics	Physics	6	Semester	156
QUI14154L	Instrumental Methods of Chemical Analysis	Chemistry	6	Semester	156
QUI14174L	Environmental Chemistry	Chemistry	6	Semester	156

3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
HIS14151L	History and Philosophy of Science	History	6	Semester	156
FIS14164L	Project	Physics	6	Semester	156
QUI14179L	Introduction to the Chemistry of Polymers	Chemistry	6	Semester	156
QUI14163L	Chemistry and Health	Chemistry	6	Semester	156
QUI13532L	Computational Chemistry	Chemistry	6	Semester	156
PED02475L	Information and Communication Technologies in Education	Education Sciences	6	Semester	156
PED14141L	Foundations of Education	Education Sciences	6	Semester	156

Conditions for obtaining the Degree:

*** TRANSLATE ME: Para obtenção do grau de licenciado em Física e Química é necessário obter aprovação a 168 ECTS em unidades curriculares obrigatórias e 12 ECTS em unidades curriculares optativas, distribuídas da seguinte forma:

1º Ano

1º Semestre

5 UC Obrigatórias num total de 30 ECTS

2º Semestre

5 UC Obrigatórias num total de 30 ECTS

2º Ano

3º Semestre

5 UC Obrigatórias num total de 30 ECTS

4º Semestre

5 UC Obrigatórias num total de 30 ECTS

3º Ano

5º Semestre

4 UC Obrigatórias num total de 24 ECTS

1 UC Optativas num total de 6 ECTS do Grupo de Optativas oferecidas no respetivo ano letivo

6º Semestre

4 UC Obrigatórias num total de 24 ECTS

1 UC Optativas num total de 6 ECTS do Grupo de Optativas oferecidas no respetivo ano letivo ***

Program Contents

Back

Basic Notions of Physics (FIS14156L)

The scientific method. The relation between theory and experiment. Experimental and theoretical uncertainties and their interpretation. Dimensions and units. Dimensional analysis. Estimates and orders of magnitude. Symmetries. A broad overview of the different areas of physics. Brief introduction to the basic concepts of, of oscillations and waves, of geometric optics, and of radioactivity. Current topics: a selection of topics in physics that created particular interest in recent times (form example: black holes, gravitational waves, the Higgs particle, dark matter, etc.).
Examples of laboratory work: Free fall (the time objects fall is measured using photogates), Inclined plane (balls roll down an inclined track, distances and times are measured), Oscillations of a spring, Geometric optics (light sources, prisms and lenses), Law of radioactive decay (counting the activity of a radioactive sample as a function of time with a Geiger counter).

Back

Basic Notions of Chemistry (QUI14166L)

Constitution of matter. Atomic structure. Periodic Table of the Elements. Periodic properties. Nomenclature of inorganic compounds. Chemical bond. Solutions and their properties. Chemical reactions. Stoichiometry. Energy and chemical transformations. Spontaneity of transformations. Entropy. Chemical equilibrium systems. Properties. Homogeneous chemical balance. Heterogeneous chemical equilibrium. Solubility of salts. Solubility balance. Ionic equilibria in homogeneous systems. Acids, bases, and salts. Acid-base equilibrium. Buffer solutions. Acid-base titrations. Oxidation-reduction reactions. Electrochemistry.
In practical laboratory classes, students carry out practical works that illustrate some of the topics covered in theoretical classes, namely: Colligative properties, Calorimetry, Study of systems in chemical equilibrium; Acid-base volumetry; Oxidation-reduction reactions and Electrochemical cells.

Back

Mathematical Analysis I (MAT12877L)

1. Sequences and series.
2. Real functions of one variable.
3. Differential calculus.
4. Sequences and series of functions.
5. Integral calculus and applications.

Back

Linear Algebra and Geometry I (MAT00900L)

Systems of linear equations.
Matrices.
Determinants.
Vector spaces.
Linear applications.
Eigenvalues and eigenvectors.
Geometry of plane and space.
Quadratic forms.

Back

Programming (INF00878L)

- Introduction to programming: algorithms, variables, data types, arithmetic operators, logical values and operators, relational operators.
- Control structures: selection, repetition, decision making.
- Data structures: lists, tuples, dictionaries, sets.
- Working with text: string manipulation, text parsing.
- Functions and modularity.
- Using and creating modules.
- Methods (and classes).
- Looping structures.
- Working with files (I/O).
- Plots.
- Scientific computing libraries.

Note: The order may vary.

Back

Mechanics (FIS14143L)

Component T and TP:

• Fundamentals of Newtonian Mechanics.
• Kinematics
• Particle dynamics
• Dynamics of a System of Particles.
• Conservation Principles
• Oscillatory Movement
• Relativistic kinematics
• Gravitational attraction and movement under the action of a Central Force
• Dynamics in Non-Inertial reference frames

PL component – experimental study of a set of topics such as:

• Movements in nature such as the projectile, exploring the effect of air resistance. The recordings of the positions and times are made with a video camera and/or motion sensors connected to electronic stopwatches;
• Newton's 2nd law study with simple mechanical systems
• Principles of conservation of energy, linear momentum, angular momentum using low friction systems (air track and rotational dynamics device) or ballistic pendulum;
• Study of oscillations (pendulum, springs and forced oscillations).
• Determination of the universal gravitation constant with a Cavendish balance
• Gyroscope precession

Back

Electromagnetism (FIS14165L)

T and TP. Component

• Electrostatic: Electric charge, Coulomb's Law; punctual and continuous distribution; Elec-tric field and Potential; Dipole; Energy, Gauss's Law, Capacity; dielectrics.
• Electricity: current, current density; Conductivity Ohm's Law; conductors; Superconduc-tivity; Dissipated energy; e.m.f.
• DC circuits; Kirchoff's Law; circuit analysis; RC circuits; Electrical Measuring Instru-ments;
• Magnetic Field: Lorentz force; Biot-Savart and Ampere laws; Solenoid; MF in the matter; MF Planetarium.
• Electromagnetic induction: Faraday's Law; Displacement Current; Maxwell relations; Electromagnetic waves; Spectrum.
• AC current: Generators; sinusoidal currents; Admittance; Impedance; Circuits; Power and Energy; RLC circuits; Resonance.
• Magnetic fields in matter

P. Component

• Electric Field Lines, capacitors, experimental Coulomb's law verification
• Ohm's and Kirchhoff's Laws
• Faraday's Law
• RC, RL, RLC circuits, transformers
• Electromagnetic waves/optical fibers

Back

Chemical Bonding (QUI14162L)

1. Atomic structure and atomic molecules – Atomic orbitals
2. Chemical bonding in molecules (Valence Bond and Molecular Orbital Theories. Study of diatomic and poliatomic molecules. Prevision of geometries. Dipolar moment, polarity of molecules).
3. Intermolecular forces – Bulk properties (Covalent crystals, ionic crystals, metals, and semiconductors).
4. Introduction to chemical bonding in coordination compounds.

Back

Analytical Chemistry (QUI14651L)

- Introduction to Analytical Chemistry: types of chemical analysis; quantitative and qualitative analysis; sampling and sample preparation; types of error and statistical analysis of the results.
- Introduction to Volumetric Methods: direct, return and indirect titrations; standards; titration end and equivalence point; classification of volumetric methods.
- Volumetric analysis: precipitation, acid-base, complexation and oxidation-reduction; basic concepts review; titration curves derivation; different types of indicators; application examples.
- Introduction to Chromatographic Methods: theoretical basis of chromatography; classification of chromatographic methods; thin layer chromatography (TLC); column chromatography (CC); high performance liquid chromatography (HPLC); gas chromatography (GC); hyphenated techniques, HPLC and GC coupled to mass spectrometry (MS); new developments like metabolomics and proteomics.

Back

Mathematical Calculus II (MAT12878L)

1. Differential Calculus in Rn

Algebraic and topological structure of Rn. Functions from Rn to Rm: Continuity and the notion of limit. Differentiability. Partial derivatives. Chain rule. Taylor's theorem in Rn and applications to the study of extreme values. Inverse and implicit function theorems. Extreme values of functions with constrained variables

2. Integral Calculus in Rn

Multiple integrals: Fubini's theorem, change of variables theorem, applications to the computation of physical quantities. Line integrals: Integrals of scalar fields and vector fields. Fundamental theorem of calculus for line integrals, conservative fields and scalar potentials. Green's theorem. Surface integrals: surface integrals of a scalar field, flux of a vector field, divergence theorem and Stokes' theorem.

Back

Electronic and Instrumentation (FIS14176L)

1-Semiconductors: Intrinsic/Doped. PN junction. Potential energy barrier. Direct/Inverse Polarization 2-Diodes: ideal/real. Characteristic curve. Approximate/small-signal models. Rectifier. Zener/LED 3-Transistors: BJT, JFET, MOSFET. Polarization. Common e-b-c configurations. Small signal analysis. 4-OpAmp. Inverting/non-inverting configuration, Adder, integrator, differentiator. Instrumentation amplifier. 5-Digital/Analog systems. Binary numbers 6-Boole Algebra. Logic functions. Karnaugh maps. Gate-Level minimization 7-Digital Integrated Circuits. Logic families. Electric levels. Fan-Out; Propagation delays; Noise margin. TTL circuits. Positive negative logic. ICs . 8-Combinational circuits Coders, decoders, multiplexers 9-Sequential Circuits. latches. Flip-Flops. State diagrams. 10-Registers and Counters. 11-Memories. RAM, ROM, EPROM. Memory capacity, Hamming code. 12. Programmable Logic 13 Analog-to-digital converters, Analog devices, Sensors, signal conditioners, sensor networks

Back

Elasticity and Physics of Fluids (FIS14144L)

- Introductory concepts (hypothesis and approximation of continuum medium, non-continuum processes)
- Elasticity: stresses, deformation, linear elasticity, elastic waves.
- Fluids: static (hydrostatic equation, hydrostatic pressure distribution, Archimedes principle, balance and stability of immersed bodies), kinematics (velocity field, Euler and Lagrange description,), dynamics (control volume analysis, Reynolds transport theorem, equations for conservation of mass, momentum and energy (integral form and differential), simple analytic solutions of the Navier-Stokes equations. Failure of the continuum fluid equations: rarefied gas dynamics and hypersonic flows.
- Plasmas (definition, description of plasma as a conductive fluid, simplified magnetohydrodynamic equations).

Back

Physical Chemistry (QUI14159L)

1- Properties of gases: ideal gas, real gases, equations of state.
2- Basic concepts of thermodynamics: first law of thermodynamics, thermochemistry.
3- Spontaneous transformations and entropy. Gibbs energy.
4- Phase equilibrium and phase diagrams of pure substances.
5- The properties of mixtures: ideal and real mixtures, coligative properties, phase diagrams of mixtures.
6- Principles of chemical equilibrium. Relationship between equilibrium composition and thermodynamic functions. Response of equilibrium to external disturbances.
7- Chemical kinetics. Elementary and complex reactions. Steady state approach. Unimolecular reactions. Enzymatic catalysis. Chain reactions.

Back

Inorganic Chemistry (QUI14155L)

T:

Inorganic chemistry: scope and importance. Overview of atomic and molecular structure and chemical bonding. The Periodic Table: properties and periodic relationships, the elements, and their compounds. Structural description of solids: metals, ionic, covalent and molecular solids, the energetics of the ionic bond. Acids and Bases: concepts, reactions and properties of Brønsted and Lewis acids and bases. Oxidation and reduction: reduction potentials and representation, redox stability of water, chemical extraction of the elements. Coordination compounds: nomenclature, geometry, thermodynamics of complex formation, chemical bonding and reactivity. Current applications of inorganic materials.

PL,TP:

Acid-Base and redox properties of chemical species in aqueous solution. Systematic exploration of the Periodic Table. Synthesis, spectroscopic characterization, determination of stability constants and stoichiometry of complexes. Construction and study of structural models of solids.

Back

Organic Chemistry (QUI13564L)

The chemical bond in organic molecules. Classification and nomenclature of organic compounds. Representation of organic molecules. Fischer, perspective and Newman projections. Stereoisomerism and conformations. Electronic structure of molecules. Reactivity of organic molecules. Radical substitution reactions, nucleophilic substitution at saturated and unsaturated carbon, electrophilic aromatic substitution, radical addition, nucleophilic addition, electrophilic addition and elimination. Brief notions about polymerization and transposition reactions. Realization of practical laboratory classes for the application of fundamental techniques of synthesis, extraction, isolation and identification of organic compounds, namely: Synthesis of t-butyl chloride (SN2), Synthesis of cyclohexene by dehydration of an alcohol (E1) and Synthesis of 4-bromoanilline (synthetic strategy). Standard laboratory equipment, Nuclear Magnetic Resonance Spectrometer and Infrared Spectrometer (FTIR).

Back

Undulatory Phenomena (FIS14150L)

Review on complex numbers. Harmonic oscillations and addition of oscillations; beating. Simple, damped and forced harmonic oscillator and their differential equations. Coupled oscillators; infinite chain of coupled oscillators, propagation of a wave. Wave equation. Propagation of waves: amplitude, frequency, wavelength, phase and group velocity. Propagation of energy in a wave. Electromagnetic waves: wave equation, polarization; Poynting vector. Diffraction of light. Geometrical optics: images from mirrors and lenses.

The experiments to be performed in the laboratory lessons should include at least the following: observation of superposition of oscillations and Lissajous figures with an oscilloscope; light diffraction through single and double slits; study of standing waves in a metallic rope; study the Doppler effect with ultrasound; study light interference using the Michelson interferometer.

Back

Statistical Physics and Thermodynamics (FIS14145L)

Concept of probability and probability density. Gaussian distribution and gaussian integrals. Phase-space in classical systems and Hamilton equations. Microstate of a system. Microcanonical distribution ofr isolated systems. Irrelevance of fluctuations for macroscopic systems. Entropy and counting of microstates. Variation of entropy: reverssible and irreversible processes. Canonical distribution and temperature. Applications: classical gas (Maxwell) and spin systems (paramagnetism and magnetic susceptibility). Partition function and calculation of a system's properties (pressure, energy, entropy,....). Equation of state for perfect gas and its energy. Differentials of Gibbs and Helmoltz free energies. Equilibrium of a subsystem. (In)distinguishability and Gibbs paradox. Grand-canonical distribution and its applications. Quantum statistics: bosons and fermions. Blackbody radiation. Bose and Fermi gases.

Back

Quantum Mechanics (FIS14146L)

The origins of Quantum Physics. Corpuscular properties of light and wave properties of matter. The notion of a wave function and its statistical interpretation. Quantum states and the Dirac notation. Observables and operators. The postulates of Quantum Mechanics. The uncertainty principle. The two-level system. Solutions of the Schrödinger equation in one dimension. The general formalism of Quantum Mechanics. The Schrödinger equation in three dimensions. Orbital angular momentum and spin. Identical particles and quantum statistics. Phenomena of entanglement, the EPR paradox, Bell's inequality.

Back

Chemistry of New Materials (QUI14178L)

The key programme contents are
- The early materials (Stone, Copper, Bronze, Iron and Steel Age)
- Structure of Solid Materials
- The Discovery of New Materials
- Composites (natural, synthetic, applications)
- Biomaterials (history, applications, challenges)
- Nanomaterials (development, risks, applications and challenges)
- Intelligent Materials (development and applications in chemistry, health, optical, magnetic, electrical, energy, memory and others domains)
- Polymers (history, synthetics and natural, applications)
- Economic and Environmental Aspects (reuse, recycling, circular economy)
- Analysis and characterization techniques (FTIR, DRX, Microscopy, Porosimetry; Thermal, Rheology, GC, Viscosimetry and others)
- Carrying out laboratory activities related to the characterization, preparation and application of new materials
- Resolution of exercises in the field of materials, their composition and application
- Carrying out research work and its presentation.

Back

General Biochemistry (QUI14672L)

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

Back

Atomic, Nuclear and Particle Physics (FIS14147L)

Brief review of the principles of quantum mechanics. Rutherford scattering and the structure of atoms. The hydrogen atom in quantum mechanics. Orbital angular momentum and spin. The Pauli principle. Multi-electron atoms and the periodic table of the elements. The X-ray spectrum. The laser and its applications.
General properties and models of nuclei. Nuclear reactions. Radioactivity. Applications of Nuclear Physics. Particle detection. Accelerators. Properties and interactions of elementary particles. Symmetries and conservation laws. The Standard Model of Particle Physics.

Back

Astrophysics (FIS14161L)

1. The Earth in Space. The dynamics of the Earth: differential gravitational forces. The dynamics of the earth-Moon system.
2. The solar system. Characteristics of the planets: motion, interiors, surfaces, atmospheres. The small bodies. The origin of the solar system.
3. The stars. The Sun: structure, solar activity. The stars: stellar distances, stelar magnitudes. Binary systems. The Hertzsprung-Russell diagram: stelar atmospheres, stellar spectra.
4. Stellar structure and evolution. Stellar interiors: hydrostatic equilibrium, thermonuclear reactions. Stellar evolution: star birth, main sequence, red giants, quantum degeneracy. Star deaths.
5. Galaxies. The Milky Way. Other galaxies: the hidden mass problem, galactic clusters.
6. The Universe. Expansion of the universe: redshift, Friedmann's equation, the origin and future of the universe.

Back

Electrochemistry (QUI14153L)

Relevance of Electrochemistry in the context of today's Society and of an effectively sustainable development.
Fundamental theoretical and practical aspects of electrochemistry in the bulk of conducting phases and at their interfaces.
Electrochemical characterization techniques of chemical species and new materials, processes and electrochemical devices.
Electrochemical conversion and storage of electrical energy: primary, secondary, fuel and photoelectrochemical cells and supercapacitors.
Electrosynthesis and electrochemical modification: electrolytic production and processing of inorganic and organic substances and new materials.
Electrochemical processes for treatment, recycling, degradation and purification of substances and materials, valuable or hazardous.
Electrometallurgy: metal production, metal finishing and metal processing.
Metallic corrosion: Fundamental concepts, negative impacts of the phenomenon, monitoring techniques, and protective and control measures.

Back

Research and Development Perspectives in Chemistry and Physics (QUI14180L)

Learning concepts, methodologies and applications of Chemistry from a research and development perspective.
The students will attend invited seminars on scientific topics and projects of Chemistry, Biochemistry and Chemical Engineering and develop a small research project, in group, on a recent theme of their choice.

Back

History and Philosophy of Science (HIS14151L)

The plurality of approaches in the history and philosophy of the sciences, and its interest to teaching science. The aristotelian Cosmovision. The portuguese navigations and the preconditions of the Scientific Revolution. The Scientific Revolution - from Copernicus to Newton. Lavoisier and Chemistry. The Laplacian Cosmovision and the essor of Thermodynamics and statistical mechanics. The biological transformism and its implications to the view of mankind. The construction of the periodic table. Quanta and relativity and its philosophical implications. Kant and the theory of knowledge. Whewell on consilience of inductions. Maxwell on scientific analogy. Duhem on underdetermination. Poincaré on geometrical Conventionalism. Popper on demarcation. Kuhn on scientific revolutions. António Sérgio and the educational value of history of science. Darrigol on modular structure of scientific theory. Hermínio Martins on contemporary techno-science. Science and values.

Back

Project (FIS14164L)

Introduction to research methodologies in Physics and Chemistry, involving issues such as: a) The problem to be investigated, c) bibliographic research, c) training of methods and techniques to be used, c) data collection and treatment, d) interpretation of results, e) presentation of results and dissemination.
Development of small research projects on topics of Physics and Chemistry, which involve the application of the questions mentioned above. These projects will be supervised by professors/researchers specialized in the chosen scientific areas that encourage the student to apply diverse and new experimental and numerical means. At the end each project will be presented as a seminar in a workshop organized for this purpose. In projects that require the use of specific equipment not available in the teaching laboratories of the Departments of Physics and Chemistry, those existing from the various research laboratories of the University will be used.

Back

Introduction to the Chemistry of Polymers (QUI14179L)

The key programme contents are
- Introduction, morphology and structure of polymers
- Molecular weight in polymers
- Polymer classification (nature, structure, application)
- Types of polymerisation
- Polymerisation reactions
- Physical and chemical characterization (mechanical, thermal, chemical resistance, conductivity, rheological and other properties)
- Other components such as additives, fillers, dyes and reinforcements in polymerisation processes
- Polymeric composites
- Polymer applications in areas such as environment, health, energy, electronics, transport and communications, optics, pharmaceuticals, chemistry, biology, security
- The circular economy vs, linear economy
- Characterization techniques (FTIR, DRX, Microscopy, Porosimetry; Thermal, Rheology, GC, Viscosimetry and others)
- Carrying out laboratory activities related to the characterization, preparation and application of polymers
- Exercise resolution in the field of polymers
-Research work and its presentation.

Back

Chemistry and Health (QUI14163L)

Health and Illness.
General aspects of the organization and functioning of living beings; general mechanisms of bioenergetic and metabolic regulation of living beings.
Organism homeostasis and individual health. Adaptation and response mechanisms of living beings to chemical agents.
Nutrients, drugs, agrochemicals, biocides and toxics in general. Benefits and dangers related to chemicals.
Chemicals that heal and feed.
Main pollutants of air, water, soil and food.
Behaviour of toxics and their effects on individuals, populations and ecosystems. Transformation of toxics in the environment and in individuals.
Risks to health and to environment due to chemicals and their residues.
A new Chemistry: green, sustainable and safer.
Safety in the production, packaging, transport, storage, dispensing and use of chemicals. Applicable legislation.

Back

Computational Chemistry (QUI13532L)

The use of computers in science.
Conventional computational methods.
Visualization (graphical representation of results, design and visualization of molecules).
Quantum Chemistry (Hückel method, semi-empirical methods, ab initio methods).
Kinetics of complex reactions.
Molecular Mechanics (molecular dynamics methods, Monte Carlo method).
Computer simulation of chemical processes
Unconventional computational methods (models inspired by nature and their applications, introduction to intelligent systems and their applications, introduction to visual programming environments).
In silico experimentation.

Back

Information and Communication Technologies in Education (PED02475L)

1.Rationale for the use of Technology in Education
a. Reasons for using technology in education
b. Learning and Technology
c. Digital literacy: concepts and models
2.Design and planning programs and projects in the field of digital literacy
a. Curricular structure of programs and projects
b. Selection and evaluation of technologies and digital resources
c. Planning tools: teaching guides and lesson plans .
d. Methodologies of educational work: ICT and project work, and methods of collaborative work.
e. Tools, resources and environments to support the assessment of student learning (digital portfolios).
f. Safety, ethics and protection of children and young people in using ICT
g. Social networks and community learning: the new social challenges
3.Evaluation of digital educational resources
a. Types of software and educational resources.
b. Selection and evaluation of digital educational resources, concepts, tools and criteria
4.Special educational needs and ICT

Back

Foundations of Education (PED14141L)

Education as a symbolic construction of the human
2. The Foundations of Education
2.1. Biological foundations
2.2. Psychological foundations
2.3. Anthropological foundations
2.4. Socio-economic foundations
2.5. Philosophical foundations
3. Education and worldviews
4. Education and political agendas; national and international
5. Education as a profession: nature, missions and challenges

Back

Physics of the Earth (FIS14148L)

1) The Earth, planet of the solar system. 2) The shape of the Earth and the gravity field. 3) Introduction to Seismology. 4) Some comments about geophysical prospection. 5) Geomagnetism. 6) Introduction to paleomagnetism. 7) Introduction to the study of the heat flow from the Earth. 8) Composition and structure of the atmosphere and ocean. 9) Atmospheric thermodynamics. 10) Radiation. 11) Atmospheric and ocean circulation. 12) Climate and climate change.

Back

Condensed Matter Physics (FIS14149L)

-The Solid State Physics in the general context of Physics.
-Crystal lattices.
-Cohesion forces in solids.
-Mechanical vibrations and phonons.
-Thermal vibrations: classical and quantic models.
- Bloch theorem and energy bands in crystals.
-Metals: conductivity; specific heat.
-Semiconductors.
-Superconductivity: phenomenology of low and high Tc superconductors, and applications.
-Introduction to liquid crystals

Back

Instrumental Methods of Chemical Analysis (QUI14154L)

Introduction to spectral and electrochemical methods of chemical analysis. Fundamental relationships between electromagnetic radiation and electronic structure of molecular and atomic species and between electrical variables and electrochemical properties of the systems under analysis. Fundamentals, instrumentation, techniques, practical aspects, analytical validation and applications of:

- Molecular absorption spectrometry in UV/Vis;
- Infrared spectroscopy;
- Raman spectroscopy;
- Molecular luminescence spectrometry, with special focus on spectrophotofluorimetry;
- One- and two-dimensional nuclear magnetic resonance (1H, 13C, and other important nuclei);
- Atomic absorption and emission spectrometry in UV/Vis, including LIBS, ICP-AES/OES and MIP-AES/OES;
- Atomic mass spectrometry, mainly ICP-MS;
- Electrochemical methods, namely conductimetric, potentiometric, voltammetric, amperometric and coulometric;
- Chemometric Methods / Intelligent Data Analysis.

Back

Environmental Chemistry (QUI14174L)

1. Introduction to environmental chemistry
2. Chemistry of atmosphere
2.1. Chemical composition, structure and function; introduction to photochemistry reactions;
2.2. Atmospheric pollutants and its effects; air quality and treatment processes.
3. Chemistry of water
3.1.Physical and chemical properties of water;
3.2. Water cycle;
3.3. Water urban cycle,
3.4. Sources of water;
3.5. Water quality control;
3.6. Main pollutants and their impacts on water bodies;
3.7. Wastewater and treatment processes.
4.Chemistry of soil
4.1. Geochemistry of surface; soil composition; plants growth and trace elements;
4.2. Soil pollution and remediation processes.
5. Atmosphere – water – soil interactions
5.1. Introduction to biogeochemical cycles;
5.2. Environmental fate of some pollutants.

Laboratory lessons: Qualitative characterization of a drinking water (pH, turbidity, conductivity, hardness and micropollutants) and a wastewater (COD, TSS)