# Study Plan

**School:** School of Sciences and Technology
**Degree:** Bachelor
**Course:** Biochemistry (cód. 644)

**1st Year - 1st Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| MAT11959 | Biostatistics with Computer Software | Mathematics | 6 | Semester | 156 |
| QUI11958 | Principles and Methods in Chemistry | Chemistry | 9 | Semester | 234 |
| MAT11960 | Mathematics I | Mathematics | 6 | Semester | 156 |
| QUI11459 | Lab Techniques and Methods I | Chemistry | 3 | Semester | 78 |
| FIS11961 | Physics 1.1 | Physics | 6 | Semester | 156 |

**1st Year - 2nd Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| QUI1084 | Physical Chemistry I | Chemistry | 6 | Semester | 156 |
| QUI11962 | Organic Chemistry I | Chemistry | 6 | Semester | 156 |
| QUI11963 | Principles and Methods in Biochemistry and Bioinorganics | Biochemistry | 9 | Semester | 234 |
| MAT12237 | Mathematics II | Mathematics | 6 | Semester | 156 |
| QUI11464 | Lab Techniques and Methods II | Chemistry | 3 | Semester | 78 |

**2nd Year - 3rd Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| QUI0344 | Biochemical Analysis I | Biochemistry | 6 | Semester | 156 |
| QUI12394 | Physical Biochemistry | Biochemistry | 6 | Semester | 156 |
| BIO0408 | Microbiology | Biological Sciences | 6 | Semester | 156 |
| QUI0348 | Biochemistry | Biochemistry | 6 | Semester | 156 |
| BIO12209 | Cell Biology | Biological Sciences | 6 | Semester | 156 |

**2nd Year - 4th Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| QUI12395 | Biochemical Analysis II | Biochemistry | 6 | Semester | 156 |
| QUI0350 | Microbial Biochemistry | Biochemistry | 6 | Semester | 156 |
| QUI12396 | Enzymology | Biochemistry | 6 | Semester | 156 |
| QUI0347 | Biomembranes | Biochemistry | 6 | Semester | 156 |
| QUI1080 | Chemistry of Natural Products | Chemistry | 3 | Semester | 78 |
| QUI12397 | Organic Chemistry II A | Chemistry | 3 | Semester | 78 |

**3rd Year - 5th Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| QUI12253 | Enzymes Technology | Chemical and Biochemical Engineering | 6 | Semester | 156 |
| BIO12411 | Animal Physiology | Biological Sciences | 6 | Semester | 156 |
| QUI12398 | Biochemistry of Nucleic Acids | Biochemistry | 3 | Semester | 78 |

**3rd Year - 5th Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| QUI12399 | Nucleic Acids Biochemistry Lab | Biochemistry | 6 | Semester | 156 |

**Options I/II**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| QUI12402 | Inorganic Biochemistry | Biochemistry | 3 | Semester | 78 |
| QUI11482 | Cell Biophysics | Biochemistry | 6 | Semester | 156 |
| QUI11483 | Introduction to Clinical Biochemistry | Biochemistry | 3 | Semester | 78 |
| QUI12403 | Pharmacognosy | Biochemistry | 6 | Semester | 156 |
| QUI12243 | Bromatology and Nutrition | Biochemistry | 6 | Semester | 156 |
| QUI12254 | Fermentation Technology | Chemical and Biochemical Engineering | 6 | Semester | 156 |
| QUI12404 | Chemistry of Natural Waters | Chemistry | 6 | Semester | 156 |
| QUI11983 | Forensic Chemistry | Chemistry | 6 | Semester | 156 |
| QUI11980 | Chemistry Applied to Heritage | Chemistry | 6 | Semester | 156 |
| BIO11471 | Immunology | Biological Sciences | 6 | Semester | 156 |
| BIO12405 | Human Genetics | Biological Sciences | 3 | Semester | 78 |
| BIO11480 | Virology | Biological Sciences | 6 | Semester | 156 |
| QUI12242 | Techniques of Animal Tissue Culture | Chemical and Biochemical Engineering | 3 | Semester | 78 |
| GES2310 | Entrepreneurship and Innovation | Management | 6 | Semester | 156 |
| INF11968 | Introduction to Programming | Informatics | 6 | Semester | 156 |
| FIL0637 | Bioethics | Philosophy | 3 | Semester | 78 |
| LLT2285 | Foreign Language - English | Languages and Literature | 3 | Semester | 78 |

Free Option

**3rd Year - 6th Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| QUI12400 | Biochemical Toxicology | Biochemistry | 6 | Semester | 156 |
| QUI0358 | Metabolism and Energetics | Biochemistry | 6 | Semester | 156 |
| QUI12401 | Learning in Work Context | Biochemistry | 15 | Semester | 390 |
| Free Option | | | | | |

**3rd Year - 6th Semester**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|

**Options I/II**

| Component code | Name | Scientific Area Field | ECTS | Duration | Hours |
|---|---|---|---|---|---|
| QUI12402 | Inorganic Biochemistry | Biochemistry | 3 | Semester | 78 |
| QUI11482 | Cell Biophysics | Biochemistry | 6 | Semester | 156 |
| QUI11483 | Introduction to Clinical Biochemistry | Biochemistry | 3 | Semester | 78 |
| QUI12403 | Pharmacognosy | Biochemistry | 6 | Semester | 156 |
| QUI12243 | Bromatology and Nutrition | Biochemistry | 6 | Semester | 156 |
| QUI12254 | Fermentation Technology | Chemical and Biochemical Engineering | 6 | Semester | 156 |
| QUI12404 | Chemistry of Natural Waters | Chemistry | 6 | Semester | 156 |
| QUI11983 | Forensic Chemistry | Chemistry | 6 | Semester | 156 |
| QUI11980 | Chemistry Applied to Heritage | Chemistry | 6 | Semester | 156 |
| BIO11471 | Immunology | Biological Sciences | 6 | Semester | 156 |
| BIO12405 | Human Genetics | Biological Sciences | 3 | Semester | 78 |
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| GES2310 | Entrepreneurship and Innovation | Management | 6 | Semester | 156 |
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| FIL0637 | Bioethics | Philosophy | 3 | Semester | 78 |
| LLT2285 | Foreign Language - English | Languages and Literature | 3 | Semester | 78 |

## Conditions for obtaining the Degree:

*** TRANSLATE ME:

Para obtenção do grau de licenciado em Bioquímica é necessário obter aprovação a 168 ECTS em unidades de 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

6 UC Obrigatórias num total de 30 ECTS

3º Ano

5º Semestre

4 UC Obrigatórias num total de 21 ECTS

UC Optativas plano do curso do Grupo I / II ou optativa livre num total de 9 ECTS

6º Semestre

2 UC Obrigatórias num total de 12 ECTS

Estágio num total de 15 ECTS

UC Optativas plano do curso do Grupo I / II ou optativa livre num total de 3 ECTS

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# Program Contents

Back

**Biostatistics with Computer Software (MAT11959)**

One-dimensional and two-dimensional descriptive statistics.
Probability topics. Random variables. Distribution function.
Discrete and continuous probability distributions.
Sampling. Sampling distributions.
Point estimation and confidence intervals
Tests for the mean, variance, proportion, comparison of means (independent samples and paired samples), comparison of variances and comparison of proportions. Analysis of variance. Nonparametric tests.
Use of programs on the MS Windows. MS Excel. SPSS statistical software.

Back

**Principles and Methods in Chemistry (QUI11958)**

Atomic theory and evolution of the atomic models. Quantum theory and electronic structure of atoms. Periodic relations between the elements. Basic concepts of chemical bonding. Ionic bonding. Covalent bonding (Lewis structures, VSEPR model, VB theory, MO theory). Molecular interactions. States of aggregation. Gas equations. Perfect gas mixtures. Chemical thermodynamics. Phase equilibrium. Properties of solutions. General aspects of chemical equilibrium in ideal systems. Acid-base, solubility, complexation and oxidation-reduction equilibria. Electrochemistry. Chemical kinetics.

Back

**Mathematics I (MAT11960)**

1. Topological concepts in R
2. Differential calculus in R

Derivative at a point and physical interpretation. Rules of derivation. Rolle, Lagrange and Cauchy Theorems. Cauchy and L'Hôpital Rules. Monotonicity, concavity and asymptotes

3. Primitives

Primitives. Primitives by parts and by substitution. Primitives of rational functions

4. Integration

Integral of Darboux and Riemann. Properties of the integral. The mean value theorem, fundamental theorem of calculus and formula Barrow. Integration by parts and substitution.

5. Applications of integral calculus

Areas. Length of a line. Volumes and areas of solids of revolution.

6. Improper integrals

Convergence theorems. Absolute Convergence

7. Numerical series

Geometric series and Mengoli series. Nonnegative real series. Alternating series. Absolute convergence

8. Power series

Definitions. Taylor and Mac-Laurin series

9. ODE

Homogeneous non-homogeneous linear ODE of order n. Applications

Back

**Lab Techniques and Methods I (QUI11459)**

- Solutions.
- Laboratory Regulations and Safety Procedures.
- Experimental Planning and Production of Reports and Scientific Posters.
- Information Sources.
- Laboratory Techniques and Unit Operations.
- Volumetric Analysis.
- Distillation.
- Sampling.
- Samples preparation.
- Introduction to Chromatography.
- Thin Layer Chromatography and column chromatography.
- High performance liquid chromatography.
- Gas chromatography.

Back

**Physics 1.1 (FIS11961)**

Introduction ; Physics and measurements; Vectors

Trajectory; velocity and acceleration.

Force and mass; Newton's dynamic laws; Momentum and momentum conservation; Work; Principle of conservation of energy.

Rotation; Angular displacement, angular velocity, angular acceleration; Torque about an axis. Kinetic energy of rotation; Angular momentum; conservation of angular momentum. Gravity

Temperature and heat; thermal expansion; Heat and internal energy; State changes; The transfer of heat; The ideal gas law and kinetic theory; The first law of thermodynamics; The second law of thermodynamics.

Electromagnetic waves; properties of light; Optical images

Back

**Physical Chemistry I (QUI1084)**

The properties of gases: the perfect gas, real gases, equations of state, the principle of corresponding states.
Key concepts in thermodynamics. First law of thermodynamics. Thermochemistry.
Spontaneous change and entropy. The second law of thermodynamics. Gibbs energy. Maxwell equations. Chemical potential. Fugacity. Phase transitions and phase diagram of pure substances.
The properties of mixtures: ideal and real mixtures, the activity, colligative properties, phase diagrams of mixtures.
Application to chemical equilibria. Relationship between the equilibrium composition and the thermodynamic functions. The response of equilibria to the conditions.
Equilibrium electrochemistry. Ionic activities. Debye-Huckel law. Half-reactions and electrodes. The Nernst equation. Standard potentials. Solubility constants.

Back

**Organic Chemistry I (QUI11962)**

Classification and nomenclature of organic compounds. The chemical bond in organic molecules. Drawing molecules. Constitutional isomers. Stereoisomers and conformational analysis. Electronic structure of organic molecules. Reactivity of organic molecules. Nucleophilic substitution at saturated carbon. Elimination reactions. Electrophilic addition to alkenes. Electrophilic aromatic substitution reactions. Accomplishment of laboratory experiments for the application of fundamental techniques of synthesis, extraction, isolation and identification of organic compounds.

Back

**Principles and Methods in Biochemistry and Bioinorganics (QUI11963)**

Biochemistry: Living Organisms: structure of prokaryotic and eukaryotic cells. Methodology and technical approaches used in Biochemistry. Water: the medium of life. Inorganic ions in biologic systems. Physiologic buffers. Functional characteristics of biomolecules. Carbohydrates, Aminoacids, peptides and proteins Classification of metallic biomolecules. Main biochemical functions of metal ions. Nucleotides and nucleic acids. Lipids,and lipoproteins. Structure and properties of biomembranes. Enzymes and enzymatic kinetic. Bioenergetics and Bioelectrochemistry. The role of ATP in biological processes. Introduction to the metabolism. Anabolic and biosynthesis processes. The major metabolic pathways. Some applications of bioinorganic biochemistry. The role of inorganic elements in the life: essential elements, toxic elements and their use in therapeutic and diagnostic practices. Biodistribuition of inorganic elements and interaction with biomolecules and specific function in the life.

Back

**Mathematics II (MAT12237)**

I – Linear Algebra
1. Vector spaces
2. Linear functions
3. Matrices and Linear Systems of Equations .
4. Determinants – Permutations.
5. Eigenvalues and eigenvectors– Definitions. The caracteristic polynomial. Algebraic and geometric multiplicities. Inverse matrix calculation. Matrix diagonalization.

II – Differential Calculus in ℝn
1. Dot Product – Dot product. Euclidean spaces. Cauchy-Schwarz inequality. Orthogonal bases. Projections. Gram-Schmidt orthogonalization process. Cross and mixed products properties and geometrical applications
2. Topology & Scalar and Vector Fields - Notions of topology. Scalar and vector fields. Domain and range. Graphical representation. Level sets of scalar fields.
3.Limits and Continuity - Limit in scalar and vector fields. Branching limits. Properties of limits. Continuity and continuity prolongation.
4. Differential calculus -Differentiability of scalar and vector fields.

Back

**Lab Techniques and Methods II (QUI11464)**

Experimental error. Introduction to statistics and calibration methods. Fundamentals of spectrometric methods. Molecular spectroscopy: an introduction to ultraviolet/visible molecular absorption spectrometry, molecular luminescence spectrometry, infrared spectrometry. Applications. Equipments. Atomic spectroscopy. An introduction to optical atomic spectrometry, atomic absorption spectrometry and atomic emission spectrometry. Applications and equipment.
Fundamentals of electroanalytical chemistry. Different types of electrodes: reference, indicator, working electrodes. Potentiometry, condutimetry, coulometry, voltammetry. Applications.

Back

**Biochemical Analysis I (QUI0344)**

1. Experimental design and control of quality.
2. Applications of differential spectrometry and fluorescence in qualitative and quantitative analysis of biological molecules.
3.Centrifugation, analytical, preparative and gradient centrifugation. Subcellular separation and enzymatic localization.
4.Electrophoresis, matrix and buffers, electric parameters, PAGE, IEF e 2D. Equipment, sample preparation, application and run. Gel staining and conservation.
5.HPLC, mobile and stationary phases, solute retention mechanisms. Experimental optimization. Chromatograph, columns, detectors, hyphenates techniques.
6. GC, mobile and stationary phases, solute retention mechanisms, columns technology. Chromatograph, temperature, injectors and detectors. Data acquisition. Column and carrier gas supply. Flux programming of carrier gas.

Back

**Physical Biochemistry (QUI12394)**

1. Structure of biomacromolecules.
2. Interactions in aqueous medium and in hydrophobic medium.
3. Notions of symmetry.
4. Fundamentals of Statistical Mechanics and Molecular Thermodynamics.
5. Introduction to Molecular Modeling tools.
6. Thermodynamic aspects of solutions of macromolecules.
7. Fundamentals of non-equilibrium thermodynamics.
8. Characterization of sedimentation phenomena, electrophoresis and transport through membranes.

Back

**Microbiology (BIO0408)**

Theoretical:
1. Historical context and Ubiquity
2. Diversity of the Microbial World
3. Microbial Growth and Death
4. Metabolism
5. Basics of Molecular Microbiology: Microbial genetics, Virology, Immunology
6. Microbes and disease; Normal flora, Pathology, infection and disease, Mechanisms of pathogenicity, Principles of epidemiology
7. Food microbiology: Hygiene and concept of indicator. Processing and storage of food.
Foodborne diseases
8. Ecology and environmental microbiology: Soil and water, Biogeochemical cycles, Agricultural applications, Wastewater treatment, Biotechnology applications

Lab Practice:
Aseptic practice
Observation of bacteria, fungi and protists.
Demonstration of Ubiquity
Preparation and sterilization of culture media.
Isolation of pure culture.
Colonial and cellular morphology. Gram Staining
Microbial counts
Environmental conditions for growth (pH, temp., O2)
Anaerobic Culture
Antibiograms

Back

**Biochemistry (QUI0348)**

Back

**Cell Biology (BIO12209)**

THEORICAL:
Cellular organization. Animal and Plant Cell. Organelles and Cellular Structures. Structure / Function of the Plasma Membrane. Cellular compartmentalization. Membrane transport systems.
Protein Synthesis. Mitochondria and Chloroplast - bioenergetic centers. Mitochondria and aerobic respiration. Glycolysis. Chloroplast and Photosynthesis. Cell Communication. Cellular cycle regulation.
Cell death: necrosis and apoptosis (programmed cell death )

PRACTICAL :
Compound light microscope (components); plant cell and animal cell (observation); organelles of plant cell ; organelles of animal cells (observation); preparation of a wet-mount slide and examination; biometry: cell length and stomatic cell density from different plant species; cell membrane permeability; plasmolysis and turgescence in plant cell (Elodea); cell division: mitosis and meiosis in animal and plant cells (observation and identification).

Back

**Biochemical Analysis II (QUI12395)**

Atomic spectral methods applied to the analysis of metal ions with biological interest, and forensics.
Applications of electrochemical methods for detection and quantification of biomolecules.
Protein crystallography. Crystallization techniques. Applications of crystallography in the determination of metabolic pathways in the design of compounds for the pharmaceutical, food and more.
Simulation in biochemistry.
Immunological methods. General processes of the immune response. Antigen-antibody reaction. Production and purification of monoclonal and polyclonal antibodies. Introduction to radiochemistry. Nuclear stability and radioactive decay. Interaction of radiation with matter. Detection of radiation. Nuclear reactions. Natural and artificial radionuclides. Applications of radionuclides and nuclear processes. Radiation protection. Liquid scintillation. Functional characterization of radiometric reading devices, advantages, interferences and applications.
NMR and its applications to the study of biomolecules.
Cell cultures and their applications. Aseptic technique and manipulation of cells. Culture of primary cells. Continuous cell lines and their use in research: advantages and disadvantages.

Back

**Microbial Biochemistry (QUI0350)**

Back

**Enzymology (QUI12396)**

1. Catalitic activity of proteins and RNA. Terminology. Reaction curves, deviation to linearity, v0, Eact, transition state complex.
2. Continuous and descontinuous assays to v0 determination. Burst and lag phases. Interferences in v0 determination
3. The Henri-Michaelis-Menten equation. Parameters Vmax e Km. Effects of [E], T, pH, [I] [A], [S]. Failure to obey rectangular hyperbola, km and Vmax determination, differents graphics models.
4. Units and specific activity.
5. Mechanisms of enzymatic reaction, reactions of more than one substrate, enzymatic inhibition.
6. Regulation of enzymatic activity. Post-translation modifications. Alostery and cooperativity, mathematics models.
7. Extraction, solubilization and purification of enzymes, homogenization, centrifugation, organics solvents, polymers e chromatographic methods. 8. Physico-chemical characterization of enzymes.

Back

**Biomembranes (QUI0347)**

Structure and function of biomembranes.
Properties of biomembranes.
Transport across biomembranes: Pumps, exchangers and ion channels; Other transport systems: transporters, secondary carrier molecules and group translocation; Mechanisms of transport and its regulation.
Signal transduction across biomembranes.
Receptors for neurotransmitters and hormones.
2nd messengers cascades: G-proteins and Ras proteins; cAMP and cGMP in signal transduction; Phospholipases and phospholipids in signal transduction; Membrane associated protein kinases and phosphatases; The role of Ca2+.
Biomembranes production and isolation.
Biomembranes in industry.

Back

**Chemistry of Natural Products (QUI1080)**

Different classes of natural products and main secondary metabolic pathways. Methodology for identification of natural products and establishment of biosynthetic pathways.
Study of the biosynthesis of the terpene compounds. Biosynthesis and biological functions of representative terpene compounds: gibberellins, taxoids, cholesterol, steroids, sex hormones, etc.
Study of the biosynthesis and biological functions of metabolites derived from polyvinyl chains. Biosynthesis of fatty acids and eucosanoids (prostaglandins, thromboxanes and leukotrienes). Biosynthesis of aromatic compounds.
Study of the biosynthesis and biological functions of shikimic acid derivatives. Shikimic acid biosynthesis, phenylalanine, tyrosine and tryptophan. Aliphatic alkaloids and alkaloid derivatives of phenylalanine and tryptophan. Metabolites biosynthesis mixed.

Back

**Organic Chemistry II A (QUI12397)**

1. Spectrocopic Methods in Organic Chemistry. Nuclear Magnetic Ressonance (NMR) 1H e 13C, Infra-Red spectroscopy, UV/VIS spectroscopy, Mass spectrometry.
2. Carbonyl Compounds. Aldehydes and ketones, Electronic structure. Reactions: Nucleophilic addition reactions, including the aldol and its significance in biosynthesis. β-dicarbonyl and α.β-unsaturated compounds. Acidity, the malonic ester synthesis, acetoacetic acid synthesis, the Claisen condensation and the Michael addition reaction. Carboxylic acids and their derivatives. Synthesis and interconversion between carboxylic acid derivatives.
4. Heterocyclic aromatic compounds. Synthesis and reactivity of pyridines, pyroles, imidazoles, and pyrazoles, their application in medicinal and pharmaceutical chemistry.

Back

**Enzymes Technology (QUI12253)**

Back

**Animal Physiology (BIO12411)**

Syllabus (main topics) of Seminar Lectures

1. Definitions and concepts in animal physiology.
2. Neuron physiology.
3. Information flow between neurons (synapses and neural networks).
4. Muscle physiology and movement.
5. Sensory physiology.
6. Nervous system.
7. Glands and endocrinology.
8. Circulatory system.
9. Gas exchange and acid-base balance.
10. Ionic and osmotic balance.
11. Feeding and digestion.
12. Metabolism and energy.

Syllabus (main topics) of Tutorial-based Group Work

Experiment simulations using dedicated software simulators as tools for problem-solving based acquisition of knowledge and competences.

1. Electrochemical potential and balance, relative ionic permeability and membrane potential.
2. Action potential and underlying membrane mechanisms.
3. Ionic currents across membrane channels; intracellular recording simulation (“current-clamp”, “voltage clamp”) and “patch-clamp”.
4. Axon electric-circuit equivalent.
5. Synaptic transmission (chemical synapse).
6. Neuron networks and lateral inhibition in sensory systems.
7. Regulation of striated muscle contraction.
8. Neural and endocrine regulation of the cardiovascular system in a virtual rat.

Back

**Biochemistry of Nucleic Acids (QUI12398)**

1. Gene concept, housekeeping and inductive genes.
2. Genetic material in eukaryotes, bacteria and viruses. Structure of DNA and RNA.
3. Restriction and modification systems.
4. DNA sequencing.
5. DNA replication, mutation and repair mechanisms.
6. Localizing and specific identification of genes.
7. Detection and amplifying sequences of DNA by PCR.
8. Transcription. RNA processing and maturation. Reverse transcription.
9. Regulation of gene expression.
10. DNA clonning, vectors. DNA and cDNA libraries.
11. Analysis of gene expression by RT-PCR and microarrays.
12. Functional genomic.
13. Aplications of recombinant DNA technology in bacteria, yeasts, plants and animals.
14. Gene therapy.
15. Translation, genetic code. Chaperones and folding.
16. Oncogenes and tumor-supressor genes.
17. Bioinformatics, homologies, ORFs, metabolic pathways, protein sequence and protein localization.

Back

**Nucleic Acids Biochemistry Lab (QUI12399)**

1. Extraction of nucleic acids from different biological materials, viral, bacterial and plasmid DNA, nuclear and organelles DNA; RNA and mRNA .
2. Utilization of restriction endonucleases, DNA ligases and DNA polymerases.
3. Restriction maps and DNA sequencing.
4. Polymophisms detection, RFLP, RAPD and microssatelites.
5. DNA Polymerisation chain reaction (PCR), detection and amplifying of specific sequences. Technical modifications of PCR: RT-PCR, quantitative PCR and real-time PCR.
6. DNA clonning, vectors, host cells, construct and analysis of DNA and cDNA libraries.
7. Gene expression, analysis of genetic expression by northern and western blotting and RT-PCR.
8. Clonning and heterologe expression of gene sequences.
9. OGMs and detection of OGMs in food using PCR.
10. DNA technology in industry, medicine, agriculture and research. Ethic and risks.

Back

**Inorganic Biochemistry (QUI12402)**

Introduction to Inorganic Biochemistry: scope and importance.
Fundamentals of chemistry applied to biological systems: the importance of water; fundamental concepts of thermochemistry, thermodynamics and kinetics; the elements and formal oxidation states; redox chemistry; coordination geometry and electronic structures of biologically important metal ions; thermodynamic stability, kinetics and mechanisms of reactions involving metal complexes.
Biochemistry of the elements: essential and toxic elements; occurrence in biological systems; chemical environment and/or structure; relation structure-function in vivo.
Metals with non-redox activity: Na, K, Ca, Zn, Cd.
Metals with redox activity: Fe, Mn, Cu, V, Cr, Mo, W, Ni, Co.
The non-metals with non-redox activity: Si, P, B.
The non-metals with redox activity: S, Se, halogens, As.
Brief reference to the elements in medicine: therapeutic and diagnostic applications.

Back

**Cell Biophysics (QUI11482)**

1. Water and electrolytes in biology. 2. Permeability diffusion and across biomembranes. 3. Bioelectricity: electrical phenomena in cells; membrane resistance and capacitance; origin of resting membrane potential. Techniques for the study electrical phenomena in biological systems. 4. Ionic transport: pumps, exchangers and ionophores. Thermodynamic of ionic transport. 5. Ionic channels: structure, function and ionic permeation; Patch-clamp technique. 6. Electrogenesis and cellular excitability; 7. Propagation of electrical signals. 9. Sensorial transduction. 10. Anomalies in ionic transport and related pathologies.

Back

**Introduction to Clinical Biochemistry (QUI11483)**

Basic concepts in Clinical Biochemistry. The problematic of a Clinical Biochemistry Lab. Quality management. Biological specimens. Collection and handling of biological samples. Quality control. Techniques and methods of analysis used individually or in automatic analyzers. Reference values and their clinical significance.
Main biochemical markers used in diagnosis and monitoring of these diseases. Plasmatic proteins.Water and electrolytes balance. Disorders of renal and liver function. Main serum biochemical markers on diagnosis and monitoring of hepatic disease, acute myocardial infarction and pancreatic. Plasmatic lipoproteins metabolism, metabolic disorders and risk factor for cardiovascular diseases.

Back

**Pharmacognosy (QUI12403)**

General concepts, historical development of Pharmacognosy and its relationship with other disciplines
Drugs, pharmaca and medicines of natural origin
Products of primary and secondary metabolism, with medicinal or pharmaceutical interest: biogénese, obtaining, conservation and control
Pharmacokinetics principles applied to drugs of natural origin
Mechanisms of action and toxicity of drugs of natural origin
Research of new drugs of natural origin, its efficacy and safety
Some of common therapeutic uses of drugs and drugs of plant origin and their interactions

Back

**Bromatology and Nutrition (QUI12243)**

Diet and human Nutrition. Food Story. Principles of Nutrition. The nutritional needs of the human body. Macro and micronutrients. The nutrition on the various steps of life and on hospital patient. Functional, diet and light foods. Special foods for people with genetic anomalies and another change of metabolism. Characterization of the different groups of nutrients. Physical and chemical methods to preserve foods. Chemical and Biochemical analysis of foods. Food safety. HACCP system and Food Quality Control.

Back

**Fermentation Technology (QUI12254)**

1. Introduction to fermentation technology
2. Microorganisms and culture media for industrial applications
3. Cleaning procedures
3.1.Sterilization
4. Design of bioreactors
4.1. Bioreactor classification
4.2. Bioreactor scale-up and scale-down
4.3. Aeration and agitation
4.4. Bioreactor configuration. Reactor size. Mode operation.
5. Fermentation process
5.1- Kinetics of fermentation processes
5.2. Fermentation control, monitoring and modelling
6. Downstream processes (recovery and purification of fermentation products)
7. Examples of the most important industrial fermentation processes

Back

**Chemistry of Natural Waters (QUI12404)**

Water history, art and culture
The hydrological cycle
Sources of water
National and European regulation of water industry
Drinking water production
Qualitative and quantitative characterization of water
Chemical and physical properties of water
Chemical equilibriums in natural water
Atmosphere – water – sediments interactions
Cycling, regulation and biological role of trace metals
Regulation of chemical composition of natural water
Water quality modelling

Back

**Forensic Chemistry (QUI11983)**

The crime scene.
Collection and handling of evidence.
Analysis of drugs.
Analysis of traces of fuel in arson.
Analysis and processing of fingerprints.
DNA analysis.
Fiber analysis.
Analysis of firing of firearms.
Analysis of traces of paint.
Analysis of explosives.

Back

**Chemistry Applied to Heritage (QUI11980)**

Introduction and background (Art and Heritage, Conservation and the Charter of Venice, Heritage Science vs Heritage and Science). Color: physical, chemical and physiological properties. Pigments: history of its use, physical and chemical properties. Binders, varnishes, consolidants and glues. Easel painting - production techniques and conservation. Mortar and stone materials - classification, pathologies and conservation. Metals - classification, corrosion and conservation. Glass and ceramics - classification, production, pathologies and conservation. Textile and dyes – classification and conservation. Documents - classification, pathologies and conservation. Photography - chemistry of photographic processes, pathologies and conservation. Techniques of physical and chemical analysis of cultural and artistic artifacts - area exames, in-situ analytical techniques, microanalysis techniques

Back

**Immunology (BIO11471)**

Theoretical programme:
1. Introduction to the immune system. General aspects.
2. Components of the immune system
3. Antigens and antibodies
4. Gene organisation and expression of immunoglobulin's
5. Immune responses
6. Effector mechanisms of the immune response
7. The immune system in the health and disease
8. Monoclonal antibodies
9. Experimental immunology

Laboratory programme:
1. Introduction. Programming of the course
2. Experimental immunisation
3. Purification of immunoglobulin's
4. Test to the students natural immunity
5. Immunoprecipitation techniques
6. Observation of blood cells
7. ELISA
8. Autonomous laboratory work: goat immunisation and its characterisation

Back

**Human Genetics (BIO12405)**

Characteristics of nuclear and mitochondrial genomes. Population genetics. Mechanisms of occurrence of mutations and mechanisms for redress. Two genome diseases - mitochondrial citopathology. Complex diseases, degenerative diseases and the example of autism. Chromosomal diseases. Hereditary errors of metabolism of amino acids, lipids and carbohydrates. General notions of Nutrigenomics. The Nutrigenomics and cellular metabolism. Pharmacogenomics. Epigenetics. microRNAs. Gene Therapy. Ethics. Legislation. Genetic Counseling. Theoretical-practical: Case studies. Heredogramas analysis. Genetic databases. Biostatistics applied genetics to the Hardy-Weinberg equilibrium and association studies. Methods of analysis in human genetics. Application of Molecular genetic methods to the study of pathology and validation of pathogenicity of mutations. Methods of large-scale Genomics analysis

Back

**Virology (BIO11480)**

Theoretical Programme
1. Introduction and functioning of the course
2. General and Molecular Virology
3. Taxonomy and Systematics
4. Infection and infectious agents
5. Immunology of viral infections
6. Epidemiology of viral diseases
7. Treatment and prevention of viral diseases
8. Diagnostic of viruses
9. Biotechnological applications of virus

Laboratory Programme
1. Theoretical introduction. Biosafety in the laboratory.
2. Experimental study of virus
3. Plant viral Infection (tobacco)
4. Bacterial growth curve
5. Preparation of an elevated titre virus
6. Dosing of virus - Plaque forming assay
7. Dosing of virus - Limiting dilutions
8. Autonomous laboratory work: isolation and characterisation of an wild bacteriophage

Back

**Techniques of Animal Tissue Culture (QUI12242)**

Cell culture: advantages and disadvantages.
Type of cell culture: embryonic and adult tissue. Primary or tumor cell culture.
Adherent cell cultures: Epithelium, fibroblasts, neuroendocrine and neuronal cells.
Nonadherent cell cultures: blood cells.
Production and maintenance of cell lines.
Cell culture media composition, supplements, pH buffers, O2, CO2 and saline solutions and indicators;
Chemical defined media; Enzymes.
Normal cell culture procedures: separation, purification and identification.
Culture cell lines procedures and preservation methods.
Viability of cells maintained in culture.
Safety aspects of handling cells.
Transfection and hybridome production.
Applications of cell cultures for research purposes (biomedicine and cellular biology) and in biotechnological industry (production of valuable compounds using cell cultures).

Back

**Entrepreneurship and Innovation (GES2310)**

Module 1 - Introduction to Entrepreneurship and Innovation
a. Determinants of Entrepreneurship
b. International comparison and analyses of entrepreneurship
c. What is innovation? Types of innovation
d. Dynamics of innovation
e. International comparison of innovation and situation of Portugal
f. Entrepreneurship and innovation
g. Intraentrepreneurship
Module 2 - From Ideas to Firm creation: The Process
a. Analysis of Markets
b. Analysis of business ideas
c. Creating a viable business idea- the structuring process
d. Simulation games- from ideas to business formation

Back

**Introduction to Programming (INF11968)**

Introduction to Programming with Python language
Use of interpreter in script and interactive modes
Variables, expressions and statements
Defining and Using Functions
Control structures
Native data structures
Sequential data structures: lists, tuples and strings.
Associative data structures: dictionaries.
Basics of input / output (I / O)
File manipulation
Graphic interface
Use of libraries
Libraries with advanced functionality for scientific calculation
Program development

Back

**Bioethics (FIL0637)**

1 – Introduction to Bioethics. The relations between Ethics, Moral and Bioethics. Free will as condition of possibility of any Bioethics project. Introduction to a History of Ethics. From Biology to Philosophy: the limits between animal and human. Bioethics and Epistemology.
2 – Bioethics, Deontology and Professional Activities: Teaching, Researching, Paramedical Activities.
3 – Some Contemporary Bioethical Problems: abortion, cloning, euthanasia, animal rights.

Back

**Foreign Language - English (LLT2285)**

- Language then and now: The history and spread of English; English around the world; English at work and play; Varieties of English - Identity: The four nations (England, Scotland, Wales and Ireland); National identity; Britain, a cultural kaleidoscope; America, a nation of immigrants; The USA, a pluralist society
- Developing reading skills: linking ideas: expressing contrast; predicting content; skimming and scanning; getting information from diagrams and pictures; identifying the writer's opinion; looking at data (tables, charts and graphs); using headings to find information; organizing notes; using text and visuals to understand statistics
-Writing: letter/email; description; summary; statistics
- Vocabulary: languages and nationalities; people and identity

Back

**Biochemical Toxicology (QUI12400)**

History of Toxicology
Dose-response relationships
Factors afffecting toxic responses
Absoption, distribution, excretion, biotransformation and diposition of toxicants
Factors affecting biotransformation and disposition
Toxic responses to foreign compounds
Biochemical mechanisms of toxicity: Tissue lesions, neurotoxicity, immunotoxicity, teratogenesis, genetic toxicity, chemical carcinogenesis and multi-organ toxicity.
Risks to health and environment associate to toxicants, by-products and radiations
Safety in production, packaging, transportation, storage, dispensing and use of toxicants.
Legislation on toxicants in the EU and in other countries

Back

**Metabolism and Energetics (QUI0358)**

Theoretical sessions: 1. Concepts and experimentation in the study of metabolism. 2. Bioenergetics. 3. Oxidative phosphorilation. 4. Metabolism of the main nutrients. Reaction mechanisms and energetic balancing. 5. Metabolic integration. 6. Metabolic regulation. 7. Hormonal regulation of the metabolism. 8. Evolution of the metabolic pathways. 9. Introduction to nutrition. Diet, energy balance its implications in metabolism.10. Fasting and well fed states. Metabolic unbalance and disease: Obesity, diabetes and exercise.
Practical sessions: Redox reactions; determination of the redox state of a molecule. Nernst equation. Bioenergetics: thermodynamic concepts applicable to metabolism. Energy balance: determination of Gibbs free energy and efficiency of metabolic pathways. Lab. sessions: ATP production in glicolysis and its regulation. Determination of mitochondria potential. Determination of specific activity of hexokinase and LDH in muscle, kidney, liver and cerebral tissues.

Back

**Learning in Work Context (QUI12401)**

Choosen / offered subject in any area of biochemical sciences. It consist in an individual project. This students to engage in a complete a laboratory research project or a computer based research project or an extended literature review and associated extension exercise