Study Plan

School: School of Sciences and Technology
Degree: Bachelor
Course: Biochemistry (cód. 730)

1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
BIO13568L	Cell Biology	Biological Sciences	6	Semester	156
FIS13595L	PHYSICS 1	Physics	6	Semester	156
MAT11960L	Mathematics I	Mathematics	6	Semester	156
QUI13539L	Principles and Methods of Chemistry	Chemistry	6	Semester	156
QUI13536L	Laboratory Techniques I	Chemistry	3	Semester	78
QUI13645L	Perspectives in biochemistry	Biochemistry	3	Semester	78

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT12237L	Mathematics II	Mathematics	6	Semester	156
QUI13548L	Principles and Methods of Biochemistry	Biochemistry	6	Semester	156
QUI1084L	Physical Chemistry I	Chemistry	6	Semester	156
QUI13564L	Organic Chemistry	Chemistry	6	Semester	156
QUI13565L	Inorganic Biochemistry	Biochemistry	3	Semester	78
QUI13559L	Laboratory Techniques II	Chemistry	3	Semester	78

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT11959L	Biostatistics with Computer Software	Mathematics	6	Semester	156
QUI0348L	Biochemistry	Biochemistry	6	Semester	156
QUI12394L	Physical Biochemistry	Biochemistry	6	Semester	156
QUI0344L	Biochemical Analysis I	Biochemistry	6	Semester	156
BIO0408L	Microbiology	Biological Sciences	6	Semester	156

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI0347L	Biomembranes	Biochemistry	6	Semester	156
QUI12396L	Enzymology	Biochemistry	6	Semester	156
QUI13561L	Bioorganic Chemistry	Chemistry	3	Semester	78

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI12395L	Biochemical Analysis II	Biochemistry	6	Semester	156
QUI12398L	Biochemistry of Nucleic Acids	Biochemistry	3	Semester	78
QUI12399L	Nucleic Acids Biochemistry Lab	Biochemistry	6	Semester	156

3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI0358L	Metabolism and Energetics	Biochemistry	6	Semester	156
QUI13634L	Biochemical Research Seminar	Biochemistry	3	Semester	78
QUI13535L	Chemistry of Natural Products	Chemistry	3	Semester	78
QUI12401L	* Learning in Work Context	Biochemistry	15	Semester	390

Group of Options-Group 1

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
BIO12411L	Animal Physiology	Biological Sciences	6	Semester	156
BIO12352L	Plant Physiology	Biological Sciences	6	Semester	156

Group of Options-Group 2

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI0350L	Microbial Biochemistry	Biochemistry	6	Semester	156
QUI11483L	Introduction to Clinical Biochemistry	Biochemistry	3	Semester	78
QUI12243L	Bromatology and Nutrition	Biochemistry	6	Semester	156
QUI11482L	Cell Biophysics	Biochemistry	6	Semester	156
QUI13628L	Fermentation Technology	Biochemistry	6	Semester	156
QUI13653L	Animal Cell and Tissue Culture Technology	Biochemistry	3	Semester	78
QUI13614L	Enzyme Technology	Biochemistry	6	Semester	156
BIO12417L	Immunology	Biological Sciences	6	Semester	156
BIO12405L	Human Genetics	Biological Sciences	3	Semester	78
BIO12418L	Virology	Biological Sciences	6	Semester	156
QUI11983L	Forensic Chemistry	Chemistry	6	Semester	156
QUI11980L	Chemistry Applied to Heritage	Chemistry	6	Semester	156
QUI13563L	Chemistry of Natural Waters	Chemistry	6	Semester	156
Free option					

3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI12401L	Learning in Work Context	Biochemistry	15	Semester	390
QUI12400L	Biochemical Toxicology	Biochemistry	6	Semester	156

Group of Options-Group 2

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI0350L	Microbial Biochemistry	Biochemistry	6	Semester	156
QUI11483L	Introduction to Clinical Biochemistry	Biochemistry	3	Semester	78
QUI12243L	Bromatology and Nutrition	Biochemistry	6	Semester	156
QUI11482L	Cell Biophysics	Biochemistry	6	Semester	156
QUI13628L	Fermentation Technology	Biochemistry	6	Semester	156
QUI13653L	Animal Cell and Tissue Culture Technology	Biochemistry	3	Semester	78
QUI13614L	Enzyme Technology	Biochemistry	6	Semester	156
BIO12417L	Immunology	Biological Sciences	6	Semester	156
BIO12405L	Human Genetics	Biological Sciences	3	Semester	78
BIO12418L	Virology	Biological Sciences	6	Semester	156
QUI11983L	Forensic Chemistry	Chemistry	6	Semester	156
QUI11980L	Chemistry Applied to Heritage	Chemistry	6	Semester	156
QUI13563L	Chemistry of Natural Waters	Chemistry	6	Semester	156
Free option					

Conditions for obtaining the Degree:

*** TRANSLATE ME: ara obtenção do grau de licenciado em Bioquímica é necessário obter aprovação a 153 ECTS em unidades de curriculares obrigatórias e 27 ECTS em unidades curriculares optativas, distribuídas da seguinte forma:

1º Ano

1º Semestre:

6 UC Obrigatórias num total de 30 ECTS

2º Semestre

6 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

3 UC Obrigatórias num total de 12 ECTS

UC Optativa do Grupo de Optativas I num total de 6 ECTS

UC Optativa do Grupo de Optativas II num total de 12 ECTS

6º Semestre

1 UC Obrigatórias num total de 6 ECTS

Estágio num total de 15 ECTS

UC Optativa do Grupo de Optativas II num total de 9 ECTS

***

Program Contents

Back

Cell Biology (BIO13568L)

Methods and Techniques used in cell study. Biomolecules. Origin of life. Cells: paradigms and diversity.
Cellular organization: cell membrane; membrane-bound organelles; semi-autonomous organelles; cytosol and its inclusions. Cytoskeleton. Extracellular structures: cell wall, extracellular matrix. Transmembrane transport and metabolism: Functional order. Energy: thermodynamics in the cell; redox reactions; energy conversion. Information: genomic information; intercellular and intracellular communication; cell recognition. Cell Reproduction: Mitosis; mitotic chromosomes; the mitotic cycle. Meiosis. Cell proliferation and differentiation: growth factors; mechanisms of differentiation. Cell death (apoptosis). Applications of cell biology.

Back

PHYSICS 1 (FIS13595L)

I. Mechanics
• The scientific method. Measurements, units, and dimensions.
• Kinematics and dynamics of mass points. Newton's laws and its applications.
• Work and energy. Collisions and momentum. Conservation laws.
• Systems of many particles. The rigid body. Angular momentum.
II. Electromagnetism
• Electrostatics. Electric charges and forces.
• Electric potential. Capacity and capacitors.
• Electric current. Kirchhoff's rules. RC circuits.
• Reference to Maxwell's equations and electromagnetic waves.
III. Optics
• The nature of light. Geometric optics. Image formation by mirrors and lenses.
• Lasers
IV. The nucleus, nuclear reactions and radioactivity.

Back

Mathematics I (MAT11960L)

1. Topological concepts in IR
2. Differential calculus in IR: Derivative at a point and physical interpretation. Rules of derivation. Rolle, Lagrange and Cauchy Theorems. L'Hôpital and Cauchy 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 fundamental theorem of calculus and Barrow's formula. 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 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

Principles and Methods of Chemistry (QUI13539L)

Atomic theory. Atomic models. Quantum theory and electronic structure of atoms. Periodic relations between the elements. Basic concepts of chemical bonding. Ionic bonding. Fajans rules. Covalent bonding (Lewis structures, Valence Shell Electron Pair Repulsion model, Valence Bond theory, Molecular Orbital 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

Laboratory Techniques I (QUI13536L)

- Solutions.
- Laboratory Regulations and Safety Procedures.
- Classification and Labelling of Chemicals (GHS and CLP)
- Principles of Good Laboratory Practice (GLP)
- Information Sources.
- Experimental Planning and Production of Reports and Scientific Posters.
- Laboratory Techniques and Unit Operations.
- Volumetric Analysis.
- Distillation.
- Extraction
- Introduction to Chromatography:
- Thin Layer Chromatography and column chromatography.
- High performance liquid chromatography.
- Gas chromatography

Back

Perspectives in biochemistry (QUI13645L)

1. The history and evolution of Biochemistry
- Definition of Biochemistry
- Biochemistry over time
- The current state of Biochemistry

2. Innovative perspectives and challenges of Biochemistry in the different areas
- The importance of Biochemistry
- Biochemistry applications
- in health and in the environment; in food production and quality control; in the assessment and mitigation of climate change.
- Bioethics in Life Sciences
- The employability of biochemistry graduates

Back

Mathematics II (MAT12237L)

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

Principles and Methods of Biochemistry (QUI13548L)

Biochemistry: An Introduction. Methodology and technical approaches used in Biochemistry.
Water and biological systems. Functional characteristics of biomolecules. Carbohydrates: Mono and Polysaccharides. Amino acids, peptides and proteins. Nucleotides and nucleic acids. Lipids and lipoproteins. Structure and properties of biomembranes. Enzymes and enzymatic kinetic. Introduction to bioenergetics and bioelectrochemistry. The role of ATP in metabolic processes. Introduction to the metabolism and to major metabolic pathways.

Back

Physical Chemistry I (QUI1084L)

Back

Organic Chemistry (QUI13564L)

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

Inorganic Biochemistry (QUI13565L)

Introduction to Inorganic Biochemistry: scope and importance. Fundamentals of chemistry applied to biological systems: the importance of water; general considerations on chemical equilibrium, metal ion coordination chemistry in biological systems, oxidation states, redox chemistry and precipitation; thermodynamic stability, kinetics and reaction mechanisms in biological media. Biochemistry of the elements. The reasons for the choice of chemical elements by living organisms. Essential and toxic elements, characteristics and occurrence in biological systems. Overview of the role of elements in biological systems. The elements with and without redox activity, chemical environment, structure and function. Integration and interaction of chemical elements in living organisms. Metalo-biomolecules and biomineralization. Brief reference to the elements in medicine: diseases, therapeutic applications and diagnosis.

Back

Laboratory Techniques II (QUI13559L)

Fundamentals of spectrometric methods. Molecular spectroscopy: an introduction to ultraviolet/visible molecular absorption spectrometry and molecular luminescence spectrometry. Applications. Equipment. Atomic spectroscopy. An introduction to optical atomic spectrometry, atomic absorption spectrometry and atomic emission spectrometry. Applications and equipment.
Electrochemical methods of analysis: fundamentals and applications. Instrumentation and types of electrodes used in conductometric and potentiometric methods: conductivity, reference and indicator electrodes. Conductometry and conductometric titrations. Potentiometric methods (selective electrodes and measurements, in particular, pH electrode and other ion (e.g., ammonium ion) selective electrode and respective measurements). Calibration methods for quantitative analysis.

Back

Biostatistics with Computer Software (MAT11959L)

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

Biochemistry (QUI0348L)

I – Lectures Program
1) Introduction to the metabolism. Metabolic pathways and their control. Clinical correlations.
2) Carbohydrate metabolism and their control: glycolysis. gluconeogenesis; glicogenolysis and glycogenesis; pentose phosphate pathways. Piruvic acid degradation.
3)Acetil Co-A pathways. Tricarboxylic acids cycle and their regulation.
4) Electron transport chain and oxidative phosphorylation.
5)Glyoxilic acid cycle. Photosynthesis and photorespiration.
6) Lipid metabolism and their control: Beta-oxidation and bio-synthesis of fatty acids; Ketone bodies; prostaglandins, thromboxanes and leukotrienes; phospholipids; sphingolipids; cholesterol; plasma lipoproteins.
7) Aminoacid metabolism and their control. Purine and pirimidine metabolism. Iron and heme metabolism.
8) Fundamentals of genetic information and expression. Acid nucleic biosynthesis. Transcription. Proteins biosynthesis.
9) Integration of metabolism. Metabolic interrelationships and their control. Role of hormones in Biochemistry.
10) Main metabolic correlations.

II - Laboratorial works:

1- Presentation. The Objectives and avaliationof laboratorial component.
2- Research and administration of Information in Biochemistry
3- Study of phosphate compounds hidrólise
4- Electron transport in thylakoid membrane and proton gradient
5- Oxydative Phosphorilation - Part I
6- Oxydative Phosphorilation - Part II
7- Biomembrane permebilization (Study of metabolic pathways in situ)

Back

Physical Biochemistry (QUI12394L)

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

Biochemical Analysis I (QUI0344L)

Microbiology (BIO0408L)

Back

Biomembranes (QUI0347L)

Lecture component

1. Introduction
f¡ Objectives of this course
f¡ Biomembranes: I) introduction to its chemical composition, structure and function; II) review of proposed models of biomembranes structure

2. Membrane lipids
f¡ Phospholipids, glucolipids and cholesterol
f¡ Lipid compositional changes among tissues
f¡ Aspects of macromolecular organization of membrane lipids: Monolayers, micelles and liposomes

3. Physical aspects of biomembranes
f¡ Fluidity and dynamic of biomembranes
f¡ Electrical properties of biomembranes

4. Biosynthesis of membrane lipids and biomembranes
f¡ Synthesis, transport e distribution of membrane lipids
f¡ Synthesis and insertion of protein into biomembranes
f¡ Association of lipids and proteins in biomembranes: Lipid protein interactions

5. Membrane-bound enzymes
f¡ Molecular structure of membrane bound enzymes: Peripheral, anchored and transmembrane enzymes
f¡ Sidedness and topography of membrane enzymes
f¡ Consequences of membrane biding: Role of lipid protein interaction (lipid annulus); Substrate compartmentalization; Bidimensional diffusion

6. Transmembrane transport
f¡ Thermodynamic of the do transport: Passive diffusion and primary and secondary transport
f¡ Kinetic and mechanism of the transport
f¡ Diversity of transport in bacteria

7. Ionic Transport
f¡ Ion pumps, exchangers and channels
f¡ Ionophores: Structure and mechanism of action

8. Ion channels
f¡ Structure and function
f¡ Kinetic properties and regulation

9. Electrical properties of biomembranes
f¡ Membrane potential and electrical activity
f¡ Electrophysiological methods

10. Signal transduction across biomembranes
f¡ Receptors for neurotransmitters: Structure and function
f¡ Receptors for peptide hormones: Structure and function
f¡ Intracellular messengers in signal transduction:
o G-proteins and Ras proteins
o cAMP and cGMP in signal transduction;
o Phospholipases and phospholipids in signal transduction;
o Membrane associated protein kinases and phosphatases;
o The role of Ca2+
f¡ Receptors and the intracellular messenger cascades

11. Intracellular vesicular trafficking
f¡ Membrane transport: Vesicle formation and transport; Vesicle coating and trafficking; Involvement of microtubules
f¡ Regulated endocytosis

Back

Enzymology (QUI12396L)

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

Bioorganic Chemistry (QUI13561L)

Carbonyl Compounds. Aldehydes and ketones, Electronic structure. Reactions: Nucleophilic addition reactions, including the aldol and its significance in biosynthesis.
Beta-dicarbonyl and alpha, beta-unsaturated compounds. Acidity, the malonic ester and acetoacetic ester synthesis, the Micheal addition and the Claisen condensation reaction.
Carboxylic acids and their derivatives. Synthesis and interconversion between carboxylic acid derivatives.
Stereochemistry. Fundamental concepts. Chiral compounds and chiral compounds without central chirality.
Relevance of carbonyl compounds in medicinal and pharmaceutical chemistry.
The importance of medicinal chemistry and its role in the pharmaceutical industry.
Spectrocopic methods in organic chemistry. Nuclear Magnetic Ressonance (NMR) 1H e 13C, Infra-Red spectroscopy, UV/VIS spectroscopy, Mass spectrometry.

Back

Biochemical Analysis II (QUI12395L)

Fundamentals, instrumentation, practical aspects and applications in Biochemistry of:
i) Vis/UV atomic spectrometry, with particular emphasis on the introduction to inductively coupled plasma spectroscopies (ICP-AES/OES and ICP-MS);
ii) Raman spectroscopies;
iii) Voltammetric and amperometric electrochemical methods;
iv) Electrochemical Biosensors (including the immunosensors);
v) Mass spectrometry and hyphenation to chromatographic analysis methods (GC-MS e LC-MS);
vi) Immunochemistry, production and analytical application of specific antibodies.
vii) Radiochemistry: Equipment, detection of radioactivity by liquid scintillation, applications. Intelligent data analysis: Data Mining applied to biochemistry databases; Treatment and quality of information; Trust score.
Mono and 2D NMR for structural analysis of biomolecules (1H, 13C, DEPT, COSY, HMBC, HMQC, INADEQUATE, NOESY, TOCSY,...); NMR of other important nuclei (15N, 19F, 31P e 29Si).

Back

Biochemistry of Nucleic Acids (QUI12398L)

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 (QUI12399L)

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

Metabolism and Energetics (QUI0358L)

Back

Biochemical Research Seminar (QUI13634L)

- Lectures by experts in the field of biochemistry
- Preparatory orientation of the internship to be held in the following semester.

Back

Chemistry of Natural Products (QUI13535L)

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

Learning in Work Context (QUI12401L)

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

Back

Animal Physiology (BIO12411L)

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

Plant Physiology (BIO12352L)

WATER RELATIONS: Functions and water movement. Responses to water stress.
TRANSPORT IN PHLOEM: Input and output of metabolites in phloem and transport. Distribution of assimilates.
MINERAL NUTRITION: Essential elements. Criteria of essentiality. Absorption of minerals. Ion movement in roots.
Ion transport in membranes.
PHOTOSYNTHESIS: Reactions directly dependent on light. CO2 reduction. Metabolism C3, C4 and CAM. Photorespiration.
Abiotic factors that affect photosynthesis.
RESPIRATION: Pentose phosphate pathway. Abiotic factors that affect respiration.
DEVELOPMENT AND PHYTOHORMONES: Growth and differentiation. Auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, salicylic acid and estrigolactonas.
PIGMENTS and Photo-Morphological Characteristics: The pigments of blue light receptors. The family of Phytocrome.
PHOTOMORPHOGENESIS AND FLOWERING

Back

Microbial Biochemistry (QUI0350L)

Back

Introduction to Clinical Biochemistry (QUI11483L)

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

Bromatology and Nutrition (QUI12243L)

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

Cell Biophysics (QUI11482L)

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

Fermentation Technology (QUI13628L)

. 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

Animal Cell and Tissue Culture Technology (QUI13653L)

Cell culture: advantages and limitations.
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

Enzyme Technology (QUI13614L)

Enzymes properties and kinetics (revision).
Enzyme production: Sources of enzymes; advantages and disadvantages of enzyme production and extraction from microbial strains, plants and animals. Factors affecting enzyme production from microbial sources. Optimization of enzyme production. Enzyme production by fermentation. Submerged and solid state fermentations. Extraction and purification of enzymes. Downstream processing. Removal of cells, purification and final isolation. Chromatographic techniques: Affinity, immunoaffinity, ion-exchange, hydrophobic interaction, gel filtration and immobilized metal affinity chromatography (IMAC).
Chemical modification of proteins. Protein engineering: site-directed mutagenesis of enzyme gene and overproduction of transformed enzymes.
Immobilization of biocatalysts. Methods of immobilization. Advantages and disadvantages of immobilized enzymes and cells.
Reactors for immobilized and free biocatalysts. Industrial applications of biocatalysts.

Back

Immunology (BIO12417L)

1. Theoretical programme
a. Introduction to the immune system. General aspects.
b. Components of the immune system
c. Antigens and antibodies
d. Gene organisation and expression of immunoglobulin's
e. Immune responses
f. Effector mechanisms of the immune response
g. The immune system in the health and disease
h. Monoclonal antibodies
i. Experimental immunology
2. Laboratory programme
a. Introduction. Programming of the course
b. Experimental immunisation
c. Purification of immunoglobulin's
d. Test to the students natural immunity
e. Immunoprecipitation techniques
f. Observation of blood cells
g. ELISA
h. Autonomous laboratory work: goat immunisation and its characterisation

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Human Genetics (BIO12405L)

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 (BIO12418L)

Theoretical Programme
1. Introduction and functioning of the course
2. General and Molecular Virology
3. Taxonomy and Sistematics
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.

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Forensic Chemistry (QUI11983L)

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.

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Chemistry Applied to Heritage (QUI11980L)

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

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Chemistry of Natural Waters (QUI13563L)

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.

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Biochemical Toxicology (QUI12400L)

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