Study Plan

School: School of Sciences and Technology
Degree: Bachelor
Course: Chemistry (cód. 166)

1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT00911L	Biostatistics with Computer Software	Mathematics	6	Semester	156
FIS00691L	Physics 1.1	Physics	5	Semester	136
MAT00933L	Mathematics I	Mathematics	6	Semester	162
QUI01064	Principles and Methods in Chemistry	Chemistry	9	Semester	234
QUI01115	Lab Techniques and Methods I	Chemistry	4	Semester	104

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT00934L	Mathematics II	Mathematics	6	Semester	162
QUI00359	Principles and Methods in Biochemistry and Bioinorganics	Biochemistry	8	Semester	208
QUI01084L	Physical Chemistry I	Chemistry	6	Semester	156
QUI01096L	Organic Chemistry I	Chemistry	6	Semester	156
QUI01116	Lab Techniques and Methods II	Chemistry	4	Semester	104

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI01051L	Advanced Chemistry Laboratory I	Chemistry	6	Semester	156
INF00878L	Programming	Informatics	6	Semester	156
QUI01067	Analytical Chemistry I	Chemistry	6	Semester	156
QUI01091	Inorganic Chemistry I	Chemistry	6	Semester	156
QUI01097	Organic Chemistry II	Chemistry	6	Semester	156

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS00692L	Physics 1.2	Physics	5	Semester	136
QUI01053	Advanced Chemistry Laboratory II	Chemistry	7	Semester	182
QUI01069	Analytical Chemistry II	Chemistry	6	Semester	156
QUI01085	Physical Chemistry II	Chemistry	6	Semester	156
QUI01092	Inorganic Chemistry II	Chemistry	6	Semester	156

3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI01043	Colloids and Surfaces	Chemistry	6	Semester	156
QUI01072	Computational Chemistry	Chemistry	6	Semester	156
QUI01087	Physical Chemistry III	Chemistry	6	Semester	156

3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI01111	Chemical Synthesis	Chemistry	6	Semester	156

3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI00344L	Biochemical Analysis I	Biochemistry	6	Semester	156
QUI00345	Biochemical Analysis II	Biochemistry	6	Semester	156
MAT00907L	Mathematical Analysis III	Mathematics	6	Semester	162
BIO00302	Molecular Biology	Biology	6	Semester	156
QUI00348L	Biochemistry	Biochemistry	6	Semester	156
QUI01042	Catalysis	Chemistry	6	Semester	156
QUI01045	Complements of Organic Chemistry	Chemistry	6	Semester	156
QUI00538	Quality Control	Chemical Engineering	5	Semester	130
ECN00052	Natural Resource Economics	Economy	6	Semester	159
ECN00490	Economics and Management	Economy	6	Semester	159
EME00507L	Electronics I	Electrotechnical Engineering	6	Semester	156
QUI00352L	Enzymology	Biochemistry	6	Semester	156
MAT00919L	Multivariate Statistics	Mathematics	6	Semester	156
FIS00694L	Atmospheric Physics	Physics	6	Semester	156
FIS00696	Physics of Matter	Physics	6	Semester	160
FIS00706	Nuclear and Particle Physics	Physics	6	Semester	156
GES00790L	Management	Management	5	Semester	135
GES00090	Project Management	Non Available	6	Semester	162
ECN00493	Economic Globalization and European Integration	Economy	4	Semester	109
BIO00311	Immunology	Biology	6	Semester	156
ECN00494	Introduction to Economics	Economy	6	Semester	159
FIS00711	Introduction to Earth and Space Physics	Physics	6	Semester	156
GES00106L	Introduction to Management and Entrepreneurship	Management	5	Semester	130
MAT00926L	Introduction to Quality Control and Reliability	Mathematics	6	Semester	156
GES00118	Marketing I	Management	6	Semester	161
QUI01056L	Carbon Based Materials	Chemistry	6	Semester	156
QUI01057	Membranes and Transport Properties	Chemistry	6	Semester	156
MAT00937L	Computational Methods	Mathematics	6	Semester	160
BIO00408L	Microbiology	Biological Sciences	6	Semester	156
QUI01059	Organisation of Chemical Analysis Laboratories	Chemistry	3	Semester	78
QUI00545	Chemical Processes	Chemical Engineering	7	Semester	182
INF00876L	Production of Multimedia Content	Informatics	6	Semester	158
INF00880L	Programming I	Informatics	6	Semester	162
INF00881L	Programming II	Informatics	6	Semester	162
QUI01071	Chemistry Applied to Heritage	Chemistry	6	Semester	156
QUI01074	Chemistry of Natural Waters	Chemistry	6	Semester	156
QUI01075	Chemistry of Soil and Environment	Chemistry	6	Semester	156
QUI01076	Chemistry of Organometalic Compounds	Chemistry	6	Semester	156
QUI01078	Chemistry of Materials	Chemistry	6	Semester	156

3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours

3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
QUI01047	Scientific Training	Chemistry	15	Semester	390
QUI01061	Scope of Present Chemistry	Chemistry	3	Semester	78

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
QUI00344L	Biochemical Analysis I	Biochemistry	6	Semester	156
QUI00345	Biochemical Analysis II	Biochemistry	6	Semester	156
MAT00907L	Mathematical Analysis III	Mathematics	6	Semester	162
BIO00302	Molecular Biology	Biology	6	Semester	156
QUI00348L	Biochemistry	Biochemistry	6	Semester	156
QUI01042	Catalysis	Chemistry	6	Semester	156
QUI01045	Complements of Organic Chemistry	Chemistry	6	Semester	156
QUI00538	Quality Control	Chemical Engineering	5	Semester	130
ECN00052	Natural Resource Economics	Economy	6	Semester	159
ECN00490	Economics and Management	Economy	6	Semester	159
EME00507L	Electronics I	Electrotechnical Engineering	6	Semester	156
QUI00352L	Enzymology	Biochemistry	6	Semester	156
MAT00919L	Multivariate Statistics	Mathematics	6	Semester	156
FIS00694L	Atmospheric Physics	Physics	6	Semester	156
FIS00696	Physics of Matter	Physics	6	Semester	160
FIS00706	Nuclear and Particle Physics	Physics	6	Semester	156
GES00790L	Management	Management	5	Semester	135
GES00090	Project Management	Non Available	6	Semester	162
ECN00493	Economic Globalization and European Integration	Economy	4	Semester	109
BIO00311	Immunology	Biology	6	Semester	156
ECN00494	Introduction to Economics	Economy	6	Semester	159
FIS00711	Introduction to Earth and Space Physics	Physics	6	Semester	156
GES00106L	Introduction to Management and Entrepreneurship	Management	5	Semester	130
MAT00926L	Introduction to Quality Control and Reliability	Mathematics	6	Semester	156
GES00118	Marketing I	Management	6	Semester	161
QUI01056L	Carbon Based Materials	Chemistry	6	Semester	156
QUI01057	Membranes and Transport Properties	Chemistry	6	Semester	156
MAT00937L	Computational Methods	Mathematics	6	Semester	160
BIO00408L	Microbiology	Biological Sciences	6	Semester	156
QUI01059	Organisation of Chemical Analysis Laboratories	Chemistry	3	Semester	78
QUI00545	Chemical Processes	Chemical Engineering	7	Semester	182
INF00876L	Production of Multimedia Content	Informatics	6	Semester	158
INF00880L	Programming I	Informatics	6	Semester	162
INF00881L	Programming II	Informatics	6	Semester	162
QUI01071	Chemistry Applied to Heritage	Chemistry	6	Semester	156
QUI01074	Chemistry of Natural Waters	Chemistry	6	Semester	156
QUI01075	Chemistry of Soil and Environment	Chemistry	6	Semester	156
QUI01076	Chemistry of Organometalic Compounds	Chemistry	6	Semester	156
QUI01078	Chemistry of Materials	Chemistry	6	Semester	156

3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours

Conditions for obtaining the Degree:

*** TRANSLATE ME: Química{\}newline

Para obtenção do grau de licenciado em Química é necessário obter aprovação a 162 ECTS em unidades de curriculares obrigatórias e 18 ECTS em unidades curriculares, distribuídas da seguinte forma:

1º Ano

1º Semestre:

5 UC Obrigatórias num total de 30 ECTS

Exame de Aferição de Inglês

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

6º Semestre

2 UC Obrigatórias num total de 18 ECTS

2 Optativas num total de 12 ECTS ***

Program Contents

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Biostatistics with Computer Software (MAT00911L)

Introdutory concepts
Descriptive statistics
Basic notions of probability — revision
Discrete and continuous random variables
Introduction to sampling and sampling distributions
Point and interval estimation
Parametric hypothesis testing
Non-parametric tests
One-way analysis of variance
Linear regression analysis

The IT component consists in the use of SPSS software and of a spreadsheet in the resolution of statistical problems.
NOTE: We strongly advise students to install on their personal computers the software SPSS (please conctat the Serviços de Informática for a free instalation) and Excel (or equivalent) and to bring their PCs to the classes.

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Physics 1.1 (FIS00691L)

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Mathematics I (MAT00933L)

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Principles and Methods in Chemistry (QUI01064)

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Lab Techniques and Methods I (QUI01115)

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Mathematics II (MAT00934L)

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Principles and Methods in Biochemistry and Bioinorganics (QUI00359)

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Physical Chemistry I (QUI01084L)

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Organic Chemistry I (QUI01096L)

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Lab Techniques and Methods II (QUI01116)

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Advanced Chemistry Laboratory I (QUI01051L)
The three components include: a) Preparation and characterisation of inorganic compounds. b) Use of several analytical techniques. c) synthesis of organic compounds. d) data analysis. e) laboratory work planning.

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Programming (INF00878L)

Introduction to programming in Python.
Using the interpreter in script and interactive mode.
Variables, expressions and instructions.
Definition and Use of Functions.
Control structures.
Native data structures.
Sequential data structures: lists, tuples, and strings.
Associative data structures: dictionaries.
Basic concepts of input / output (I / O).
File manipulation.
Graphic interface.
Using to libraries / modules.
Libraries with advanced functionality for scientific calculation.
Program development.

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Analytical Chemistry I (QUI01067)

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Inorganic Chemistry I (QUI01091)

Part A- Foundations 1. Introduction Inorganic Chemistry: scope and influences on actual chemistry panorama and general society. Review of the fundamental concepts of atomic and molecular structure and chemical bonding. Fundamental concepts of thermochemistry, thermodynamics and kinetics. 2. Acids and bases Brønsted acidity. Characteristics of Brønsted acids: acidity and periodic trends of binary hydrides, simple oxoacids, oxides and aquo-cations. Lewis acidity: examples of Lewis acids and bases and periodicity. Reactions and properties of Lewis acids and bases: types of reaction, HSAB concept, thermodynamic acidity parameters and solvents as acid and bases. Heterogeneous acid-base reactions. Other acid-base concepts. 3. Oxidation and reduction Review of the fundamental concepts in redox chemistry: redox half-reactions, standard potentials, the electrochemical series and Nernst equation. Rates of redox reactions and overpotential. Redox stability in water. Disproportionation, comproportionation and oxidation by atmospheric oxygen. The influence of complexation. The diagrammatic presentation of potential data: Latimer, Frost and Pourbaix diagrams. 4. Introduction to coordination chemistry Definitions, constitution and geometry. Representative ligands and nomenclature. Isomerism and chirality.Part B- The chemistry of the elements and their compounds 1. General aspects The nature and types of the elements. The chemistry of the elements in relation to its position in the periodic table. 2. Systematic description Atomic, physical and chemical properties, occurrence, preparation and uses of the elements. Hydrogen: physical and chemical properties of dihydrogen and simple hydrides. G1,2: structure, physical and chemical properties of representative compounds. Solubility and hydration. Solutions in liquid ammonia. Contrasting light and heavy elements: anomalous behaviour of lithium and berilium. G13: structure, physical and chemical properties of representative compounds. Contrasting light and heavy elements: differences in the chemistry of boron relatively to the other elements. G14: structure, physical and chemical properties of representative compounds. Contrasting light and heavy elements: differences in the chemistry of carbon and silicon relatively to the other elements. G15: structure, physical and chemical properties of representative compounds. Contrasting light and heavy elements: differences in the chemistry of nitrogen and phosphorous relatively to the other elements. G16: structure, physical and chemical properties of representative compounds. Contrasting light and heavy elements: differences in the chemistry of oxygen and sulfur relatively to the other elements. G17: structure, physical and chemical properties of representative compounds. G18: structure, physical and chemical properties of Xenon compounds. Examples of coordination compounds. Other representative compounds. d-Metal elements: trends in chemical properties (oxidation states, structures and noble character). Structure, physical and chemical properties of representative compounds.Part C- d-Metal complexes 1. Chemical bonding and electronic spectra Crystal-field theory and the consequences of the splitting of the ligand field: magnetic, thermodynamic and structural effects. Ligand field bonding. Electronic spectra: ligand-field transitions,ptheory: σ and spectrochemical series, charge transfer bands, selection rules and intensities. 2. Reactions of complexes Ligand substitution reactions: thermodynamic considerations, rates and mechanisms. Ligand substitution in square-planar and octahedral complexes. Redox reactions: the inner and outer-sphere mechanisms. Photochemical reactions. 3. d-Metal organometallic compounds Foundations of structure and bonding. Stable electron configurations. Electron counting: ionic and covalent models. Nomenclature. Survey of organometallic compounds according to the type of ligands.

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Organic Chemistry II (QUI01097)

1. Carbonyl Compounds. Aldehydes and ketones, Electronic structure. Reactions: Nucleophilic addition reactions, including the aldol and its significance in biosynthesis.
-dicarbonyl and -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.
2. Stereochemistry. Fundamental concepts. Chiral compounds without central chirality.
3. Relevance of carbonyl compounds in medicinal and pharmaceutical chemistry.
4. Spectrocopic Methods in Organic Chemistry. Nuclear Magnetic Ressonance (NMR) 1H e 13C, Infra-Red spectroscopy, UV/VIS spectroscopy, Mass spectrometry.

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Physics 1.2 (FIS00692L)

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Advanced Chemistry Laboratory II (QUI01053)

Building models of inorganic solids and its interpretation. Study of X-ray diffractograms of simple solid structures. Interpretation of X-ray data. Phase identification through X-ray data. Laboratory projects concerning the synthesis and characterisation of polycrystalline solids, solids characterisation by X-ray diffraction and FTIR and the determination of solid density.Electrochemical methods of analysis: Static interfacial methods (Realization of practical lab work about direct potentiometry Determination of ammonium ion; Importance of potentiometric titrations and resolution of problems, Dynamic interfacial methods, with total or partial controlled potential (Realization of practical lab work about voltammetry Determination of arsenic(III) by differential pulse anodic stripping voltammetry (DPASV) using a gold disc electrode and resolution of problems about voltammetry, amperometric titration, potentiostatic coulometry, and stripping cronopotentiometry); Galvanostatic dynamic interfacial methods (resolution of problems about coulometric titration) and bulk methods (resolution of problems about condutimetry and condutimetric titration). Presentation and discussion of considerations that is important in experimental work (e.g., equipment, material, reagents, solvents and the interferences). Results shape, its analysis and interpretation and, evaluation and improvement of its quality. Signals and relations used for quantification of analytes. Detection limits and quantification. Utilization of recent bibliographic material, that demonstrate to the students the potentialities, the versatility and importance of the different kind electrochemical methods, in several domains of analytical investigation.Spectral methods of analysis $\frac{3}{4}$ Fundamentals, applications, instrumental and experimental considerations, results and analytical relations of the following methods:, Flame Emissive Photometry, Atomic Fluorescence Spectrometry, Atomic Emissive Spectrometry, with high energy atomizers, Molecular Absorption Spectrometry in the UV/Vis and IF region, and Molecular Luminescence Spectrometry. Resolution of problems and lab work activities (Realization of practical lab work about Molecular Absorption Spectrometry Determination of phosphates and iron(II) and Atomic Absorption Spectrometry; - Determination of copper). Gas chromatography. Instrumental details. Discussion of a research paper concerning the use of GC-MS for the analysis of polutants (no experimental work was done due to the lack of gases to operate the GC-FID). Liquid Chromatography. Instrumental details. Quantification of clofibric acid in aqueous samples by HPLC-DAD. Analyte pre-concentration by SPE. Detection and quantification limits (LOD, LOQ) of an analytical method. Equilibrium and reactivity of complexes. Formation constants. Mechanisms, kinetics of redox reactions, substitution and ligand attack reactions on complexes. Laboratorial project concerning the synthesis, characterization, reactivity and kinetic study of metal transtion complexes. Analysis and explanation of questions concerning the equilibrium and reactivity of complexes.

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Analytical Chemistry II (QUI01069)

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Physical Chemistry II (QUI01085)

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Inorganic Chemistry II (QUI01092)

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Colloids and Surfaces (QUI01043)

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Computational Chemistry (QUI01072)

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Physical Chemistry III (QUI01087)

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Chemical Synthesis (QUI01111)

Back
Biochemical Analysis I (QUI00344L)

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Biochemical Analysis II (QUI00345)

Mathematical Analysis III (MAT00907L)

1. Elements of Differential Geometry in R3
1.1. General information on the space Rn
1.2. Contours and parameterized curves
1.3. Length of arc. Parameterization by arc length
1.4. Curvature and torsion. Frenet-Serret formulas
1.5. Surfaces.
1.6. Tangent plane and normal line to a surface. Orientability.
2. Introduction to Complex Analysis
2.1. General.
2.2. Complex functions and analytic functions.
2.3. Cauchy-Riemann equations.
2.4. Laplace equation. Harmonic functions.
2.5. Geometry of analytic functions. ConformalÂ transformation.
2.6. Elementary complex functions.
(I) Exponential function
(Ii) trigonometric and hyperbolic functions
(Iii) logarithm function
(Iv) Generalized complex powers functions
2.7. Complex integration
(I) Path Integral
(Ii) Elementary properties
2.8. Fundamental Theorem of Calculus.
2.9. Cauchys theorem and its evolution.
2.10. Cauchy integral formula and applications
3. Ordinary Differential Equations
3.1. Definitions and generalities.
3.2. Exact equations and integrating factors.
3.3. Basic equations of 1st order
(I) equation with separable variables
(Ii) homogeneous equation
(Iii) homographic Equation
(Iv) linear equation of 1st order
(V) Bernoulli Equation
(Vi) Ricati Equation
3.4. Linear equations of 2nd order
(I) reduction of order.
(Ii) Particular solution of the nonhomogeneous equation
(Iii) homogeneous equation with constant coefficients
4. Systems of ordinary differential equations
4.1. Introduction and notations
4.2. Linear systems
4.3. Systems with constant coefficients
4.4. Linear periodic systems
4.5. Asymptotic behavior of solutions for linear systems.
4.6. Stability of solutions
4.7. Planar autonomous systems
5. Fourier series
5.1. Periodic functions.
5.2. Trigonometric series.
5.3. Euler formulas for Fourier coefficients.
5.4. Orthogonality.
5.5. Uniform convergence
5.6. Convergence and the sum of the Fourier series.
5.7. Functions with a generic period 2L
5.8. Expansion in series of sines and cosines
5.9. Periodic extensions
5.10. Complex Fourier series.
5.11. Fourier integrals.

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Molecular Biology (BIO00302)

Part I. DNA REPLICATION
1. Genes and chromosomes
2. Replication of DNA
3. Recombination and transposition
4. Mutation and repair mechanisms

Part II. GENE EXPRESSION
5. Transcription
6. Translation
7. Regulation of gene expression

Part III. TECHNIQUES AND APPLICATIONS
8. Analytical and preparative methods in Molecular Biology
9. Techniques in molecular biology. Recombinant DNA techniques. Bioinformatics.

10. Applications in genetic engineering.

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Biochemistry (QUI00348L)

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)

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Catalysis (QUI01042)

Basic concepts in catalysis. The role of the catalyst. Homogeneous catalysis and heterogeneous catalysis. Acid-base catalysis. Organometallic catalysis. catalysis by electronic transfer (hydrogenation, isomerization, hydroformylation of alkenes, alcohols, carbonyls, oxidation; catalysts for stereospecific synthesis). Heterogeneous catalysis. Definition of basic concepts. General mechanism of catalytic reactions. Types and characteristics of heterogeneous catalysts. Properties of the catalysts: selectivity, activity and stability. Characterization of catalysts. Kinetics and mechanisms of heterogeneous catalytic reactions. Catalysis in porous materials. Application of zeolites in catalysis.

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Complements of Organic Chemistry (QUI01045)

Heterocyclic synthesis. Introduction to combinatorial chemistry, solid-phase synthesis. Molecular recognition.. Enzymatic mechanisms. General and specific catalysis. The molecular action of drugs. Artifical enzymes.
Includes advanced practical classes to accompany the material given in the lectures.

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Quality Control (QUI00538)

4. Programa da Disciplina 4.1 Os Conceitos e as Definições 4.1.1 Conceitos Gerais. Qualidade e a sua evolução histórica.4.1.2 Controlo da qualidade. Garantia de qualidade. Gestão de qualidade. Melhoria de qualidade.4.1.3 Políticas e objectivos da qualidade4.1.4 Custos da qualidadeCustos de prevenção, de detecção e de retorno. O custo da não-qualidade. 4.2 Ferramentas de Qualidade 4.2.1 Introdução4.2.2 As sete ferramentas básicasFluoxograma, Histograma, Diagrama de Pareto, Diagrama de Causa-Efeito, Cartas de Controlo…4.2.3 Ferramentas de Planeamento ou Ferramentas de Gestão 4.3 Controlo da qualidade num laboratório 4.3.1 Definição do vocabulário 4.3.2 Definição de objectivos específicos (mensuráveis e datados).4.3.3 Medição dos desvios.4.4.4 Instituição de alguma metodologia que leve à redução daqueles desvios. 4.4 Amostragem 4.4.1 Definição4.4.2 Tipos de amostragem 4.4.3 Plano de amostragem por variáveis (definição e implementação, cálculo do tamanho da amostra e dos limites de aceitação, controlo dos riscos).4.4.4 Planos de amostragem por atributos (planos simples curva característica de operação, risco do fornecedor e risco do consumidor.4.4.5 Fases para o estabelecimento de um sistema de inspecção por amostragem.4.4.6 Qualidade da amostragem. 4.5 Estatística Aplicada à Qualidade 4.5.1 Introdução4.5.2 Controlo estatístico do processo utilizando Cartas de controloCartas de controlo por variáveis (cartas de médias e de amplitudes)Cartas de controlo por atributos (cartas p e np)Carta de controlo para a média Carta tipo Shewhart 4.6 Metrologia 4.61 Princípios gerais. 4.6.2 Boas práticas laboratoriais4.6.3 Calibração de aparelhos de medida4.6.4 Padrões e referências 4.7 Normas de Gestão da Qualidade 4.7.1 Fundamentos e vocabulário - ISO 9000 : 2000 4.7.1.1 Melhoria de desempenho - ISO 9004 : 2000 4.7.2 Sistema gestão da qualidade - ISO 9001 : 2008 4.7.3 Requisitos para laboratórios de ensaio e calibração Norma NP EN ISO/IEC 17025:20054.7.4Sistemas de gestão ambiental - ISO 14001 : 1996 4.7.5 Sistemas de gestão de segurança e saúde - OSHAS 18001: 1999 4.7.6 Sistemas de gestão de segurança e alimentar - ISO 22000 : 2005. 4.7.7 Sistema integrado

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Natural Resource Economics (ECN00052)

Economic exploitation of natural resources. Management of natural renewable resources. Economic management of fisheries. Economic management of forests. Economic management and distribution of hydro resources. Economics and environment

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Economics and Management (ECN00490)

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Electronics I (EME00507L)

1. Introduction to Circuit Analysis. Basic concepts revisited.
Fundamental electric units. Electric potential. Electric voltage. Current intensity. Electromotive force. Ohm's Law. Resistors in Series and Parallel. Direct current circuits.

2. Semiconductors
Semiconductor materials. Intrinsic and Doped semiconductors. Type N and type P semiconductors. PN junction. Potential energy barrier. Direct and Inverse Polarization.

3. Diode
The ideal diode. Characteristic curve. The real diode. Characteristic curve. Approximate models. Small-signal model e its applications. Rectifier circuits.
The Zener diode, the tunnel diode and the light emitting diode (LED). Applications.

4. Transistors
Bipolar Junction Transistor (BJT)
Characteristic curves. Operation regions. Polarization schemes. Typical configurations: common emitter, common base, and common collector. Characteristics. Small signal analysis. Applications.
Field Effect Transistor
The Junction FET (JFET). Characteristic curves. The Metal-Oxide Semiconductor FET (MOSFET). Characteristic curves.
5. Operational Amplifiers
Real and ideal characteristics. Analysis of OpAmps with feedback.
Linear circuits with OpAmps: inverting configuration, non- inverting configuration, voltage follower, current-voltage and voltage-current converters, differential amplifier.
Operational circuits with OpAmps: inverting and non-inverting summer, integrator and differentiator.
Nonlinear Circuits with OpAmps: comparators, rectifiers and limiting circuits.

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Enzymology (QUI00352L)

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Multivariate Statistics (MAT00919L)

Exploratory Analysis of Multivariate Data
Correspondence Analysis
Multidimensional Scaling
Decision Trees
Software: SPSS and R

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Atmospheric Physics (FIS00694L)

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Physics of Matter (FIS00696)

- Introduction to Quantum Physics. Atoms. The nucleous.
- Molecules and Solids.
- New materials.

Back

Nuclear and Particle Physics (FIS00706)

Rutherford scattering. General properties of nuclei. Nuclear models. Nuclear radiation. Applications of nuclear physics. Energy deposition in matter. Detectors and accelerators. Properties and interactions of elementary particles. Symmetries. Discrete transformations. Neutral kaons and CP violation. The Standard Model of particle physics. Physics beyond the standard model.

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Management (GES00790L)

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Project Management (GES00090)

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Economic Globalization and European Integration (ECN00493)

1. Economic Globalization

1.1. Concept and measurement of the concept of globalization
1.2. Economic interdependence and welfare gains
1.3. Interaction between economic, social, political and cultural dimension of the globalization process
1.4. Economic growth in the context of globalization
1.5. Economic and financial international crises: the causes and consequences
1.6. International Economic Organizations and their role in Global Governance

2. European Integration

2.1. Historical overview of European integration process
2.2. The European Economic and Monetary Union: the fundamentals and its institutional architecture

2.3. Socioeconomic impacts of the European integration project

3. Interactions between the Economic Globalization and European Integration

3.1. The European Union in the context of Globalization
3.2. The European institutions and their positioning in the global order
3.3. Governance and credibility of institutions

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Immunology (BIO00311)

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Introduction to Economics (ECN00494)

A few basic principles of Economics. The scientific method in economics; hypothesis, models and the distinction between normative and positive analysis. How markets works. Demand and Supply; determinants of the quantity demanded/supplied, the demand/supply schedule, shifts in the demand/supply curves and supply, market equilibrium. Elasticity and its application; Elasticity of Demand, price-elasticity and total revenue. Elasticity of supply. Demand and Supply and the presence of the government. Control of prices (price ceiling and price floor; case studies: minimum wage and rent control. Taxes and subsidies: who pays the bill? Consumer and producer surplus, Market efficiency and market failure: Causes of market failure: market power and externalities. Public goods and common resources. The Theory of consumer choice: From preferences to the Demand Curve: preferences, the instantaneous budget constrain and the consumer's optimal choice.

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Introduction to Earth and Space Physics (FIS00711)

Structure and evolution of the Universe, the Solar System - Formation of the solar nebula, the origin of planets, satellites, comets, asteroids and meteorites, Physics of atmosphere and interiors of the planets, celestial bodies dynamic?s and of orbital parameters, solar radiation, Tele-observation and observation in situ; importance of space missions, formation of planetary atmospheres, formation of surface and interior of the Planets; History of the evolution of planet Earth; Radiation transfer in the atmosphere and ocean; constitution and Dynamics of the Atmosphere and Oceans, climate variability, Physical processes Globe surface; constitution and physical properties of Earth's interior, gravity field and Earth's magnetic field, dynamic processes within the Earth, plate tectonics and Geodynamics, Earthquake and seismotectonics; deformation, sedimentary basins and mountain building, global balance energy.

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Introduction to Management and Entrepreneurship (GES00106L)

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Introduction to Quality Control and Reliability (MAT00926L)

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Marketing I (GES00118)

Module 1 - Introduction
1.1.Concepts of Marketing and its evolution
1.2.The importance of Marketing in the organizations
1.3.The attitude, the techniques and the models of Marketing
1.4.Organization forms of the function Marketing in the organizations
Module 2 – The Marketing Planning
2.1. Analysis of diagnosis the situation
2.2. Fixation of objectives of Marketing
2.3. Marketing strategy
2.4. Marketing mix
2.5. Nature and Contents of the Marketing plan
Module 3 – The Market
3.1. Concept market
3.2. Types and mensuration methods and forecast for the search
3.3. The studies of Marketing
3.4. The Competition
Module 4 -The Behaviour of Purchase of the Consumers and/or Buyers and the Organizations
4.1. Theories and explanatory models of the purchase behaviour
4.2. The process of taking decision of the consuming and/or buyer's purchase
4.3. The process of taking decision of purchase of organizations
4.4. Influences to the process of taking decision
Module 5 -The Segmentation and the Positioning
5.1. Approaches and segmentation methodology
5.2. Segmentation strategies
5.3. Forms of selections of the market-objective
5.4. Differentiation and positioning of the offer.

Back

Carbon Based Materials (QUI01056L)

1: Presentation. 2: Structure. 3: Reactivity. 4: Precursors. 5: Textural Characterisation. 6: Chemical Characterisation. 7: Carbon Black. 8: Problems. 9: Activated Carbon. 10: Carbon Membranes and Molecular Sieves. 11-16: Practical. 17: Carbon Fibres and Composites. 18: Problems. 19: Carbon in Metallurgy. 20: Problems. 21: Fullerenes and Nanotubes. 22: Problems. 23: Carbon in Electrochemistry and Catalysis. 24: Problems. 25: Diamond. 26: Problems. 27: Discussion of the Practical Work. 28: Presentation of the 2nd monography.

Back

Membranes and Transport Properties (QUI01057)

Introduction to the transport properties. Kinetic Theory of Gases.
Viscosity. Newton's law. Non-Newtonian fluids. Viscosities of gases at low densities. Viscosities of liquids.
Thermal conductivity. Fourier's law. Thermal conductivities of gases at low densities. Thermal conductivities of liquids. Thermal conductivities of solids.
Mass transfer. Diffusion of gases at low densities. Diffusion of liquids. Mass diffusion equation. Initial and boundary conditions. Diffusion without homogeneous reaction. Diffusion with homogeneous reaction. Transient diffusion.
Membranes.
Separations of gaseous mixtures. Porous membranes. Polymeric membranes. Separations of liquids. Dialysis. Membranes for liquid-liquid extractions. Pervaporation. Reverse osmosis. Ultrafiltration and microfiltration.
Practical examples of membrane applications.

Back

Computational Methods (MAT00937L)

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Microbiology (BIO00408L)

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. Staining methods
Microbial counts
Environmental conditions for growth (pH, temp., O2)
Anaerobic Culture
Antibiograms
Microbial spreading simulation
Water and milk analises
Plant symbiosis.

Back

Organisation of Chemical Analysis Laboratories (QUI01059)

Safety rules. Safety equipment and hygiene laboratory. Prevention of laboratory accidents. Emergency and evacuation plans. Laboratory waste disposal. Development of databases and laboratory management. Acquisition of goods and services.

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Chemical Processes (QUI00545)

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Production of Multimedia Content (INF00876L)

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Programming I (INF00880L)

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Programming II (INF00881L)

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Chemistry Applied to Heritage (QUI01071)

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Chemistry of Natural Waters (QUI01074)

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
Chemistry of Soil and Environment (QUI01075)

. SURFACE GEOCHEMISTRY
1.1 Constituents of soil
1.2. Weathering Processes
2. COMPOSITION OF SOIL
2.1 Solid Phase
2.2 Liquid Phase
2.3 Gaseous Phase
2.4 Complex Colloidal Soil and ion exchange processes
3. SOIL REACTION
3.1 Acid soils
3.2 Alkaline Soils
4. GROWTH OF PLANTS AND PLANT ELEMENTS
5. SOIL POLLUTION
5.1 Fertilizers
5.2 Pesticides
5.3 Organic wastes
5.4 Case studies (eg. Abandoned mines)
6. Remediation process
6.1 Main processes involved in Phytoremediation:
6.1.1 Phytostabilization
6.1.2 Phytovolatilization
6.1.3 Phytoextraction
6.1.4 Bioremediation of waters (case study)

Back

Chemistry of Organometalic Compounds (QUI01076)

Theoretical lessons and tutorial orientation 1. Introduction to the organometallic chemistry of the transition elementsOverview of Organometallic Chemistry: history, development and importance in the panorama of current chemistry. Revision of some concepts on chemistry applied to organometallic compounds: Werner Complexes, trans effect, soft and hard ligands, types of ligands, the crystal and ligand field, back bonding and electroneutrality. 2. Fundamentals of structure, bonding and general properties of organometallicsThe 18-Electron Rule. Limitations on 18-Electron Rule. Counting electrons: ionic and covalent model; counting electrons on common ligands and hapticity; counting electrons in reactions. Oxidation state, coordination number and geometry, effects of coordination, differences between metals and inner vs outer-sphere coordination. 3. Carbonyls and related ligand complexesCarbonyl complexes: structure and bonding, infrared spectra, synthesis and typical reactions. Carbonyl hydrides and halides. Thiocarbonyls, isonitriles, nitrosyls, thionitrosyls and nitrogen complexes: structure, bonding and properties. Phosphines and related ligands: structure, bonding, Tolman electronic parameter and cone angle. 4. Metal alkyls, aryls and related ligandsCoordination modes, structure and stability of metal alkyls, aryls and related ligands. Decomposition mechanisms: b-elimination, reductive elimination and importance of steric stabilization. Synthesis and typical reactions. 5. Complexes with Metal-Hydrogen bondsStructure and bonding and properties. Synthesis and typical reactions of classic metal hydrides. Complexes with bridging hydrogen, dihydrogen, agostic-H and other non-classical hydrides. 6. Complexes with Metal-Ligand Multiple BondsCarbenes and carbynes: structure, bonding and properties. Fischer and Schrock complexes: structure, distinctive properties, synthesis and typical reactions. Structure and properties of vinylidenes, allenidenes and metalocumullenes. Examples of carbides and complexes with multiple bonds to heteroatoms. 7. Complexes of p-bound ligandsStructure and bonding general properties.Alkene and conjugated diolefines complexes: structure and bonding (effect of metal, ligand, co-ligands and stereochemistry). Synthesis and typical reactions. Alkyne complexes: structure, bonding, synthesis and typical reactions.Allyl, enyl and polyenyl complexes: structure, bonding, synthesis and typical reactions.π-Cyclic complexes: structure, bonding, synthesis and typical reactions of metallocenes, monocyclopentadienyls, bent metallocenes, metal-arenes and related complexes. 8. Organometallic Reactionsa) Coordination/decoordinationDescription, reversibility and general concepts concerning their geometries. b) Ligand substitutionPrevious concepts: HSAB, transition state theory, the trans influence and trans effect. Dissociative, associative and interchange pathway substitution mechanisms: rate laws, stereochemistry and relative rates. Stereochemistry of chiral metal centres. c) Oxidative addition and redutive eliminationOxidative addition (OA): description, general properties, thermodynamic and kinetic aspects in several geometry complexes. The OA mechanisms. The concerted addition, nucleophilic addition and radical pathways: description, rate laws, relative rates, stereochemistry, thermodynamic and kinetic aspects in several geometry complexes.Reductive elimination (RE): description, general properties, mechanisms, thermodynamic and kinetic aspects in several geometry complexes. Dinuclear reductive eliminations and sigma-bond metathesis. Oxidative coupling and reductive cleavage.d) Insertion and eliminationIntramolecular insertion and elimination: description and general properties. 1,1- and 1,2-Insertions. Reactions involving CO, alkenes, alkynes, dienes and polyenes: thermodynamic and kinetic aspects, mechanisms, reversibility and stereochemistry. Examples of other insertion reactions. The α, β, γ and δ-eliminations.e) Nucleophilic and electrophilic addition and abstractionNucleophilic reactions. Regiochemistry of nucleophilic attack: description and favourable conditions. Nucleophilic additions to carbonyl, isonitrile, thiocarbonyl, carbene, carbine, alkene, alkyne, allyl, diene, dienyl and polyenyls: thermodynamic and kinetic aspects, mechanisms, reversibility and stereochemistry. The Green-Davis-Mingos rules. Nucleophilic abstractions: general description, deprotonation and alkyl and acyl abstractions. Electrophilic reactions: overview, favourable conditions, general properties and type of reactions. Electrophilic additions: to the metal, to the metal-ligand bond and ligands (carbenes, carbines, β and γ positions and polyenes). Electrophilic abstractions: thermodynamic and kinetic aspects, mechanisms, reversibility and stereochemistry. 9. Applications of Organometallic ChemistryApplications to catalysis: examples of catalytic cycles. Applications to organic synthesis. Applications in advanced material science. Laboratorial lessons Realization of a laboratorial project concerning the synthesis and spectroscopic characterization of organometallic complexes. The project covers the manipulation of inert atmosphere techniques, verification on the reactivity of organometallic compounds and application on catalytic processes.

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Chemistry of Materials (QUI01078)

1: Introduction to Polymers. 2: Polymer Molecular Structure. 3: Polymerisation Mechanisms. 4: Polymer Properties. 5: Liquid Crystals. 6: Polymer Processing. 7: Elastomers and Gels. 8: Network Polymers. 9: Natural Polymers. 10: Sol-Gel Syntheses. 11: Inorganic Gels. 12: Characterisation Techniques. 13: Biomaterials. 14: Other new Materials.
+ 14 practical and problems classes.

Back

Chemistry of Natural Products (QUI01080L)

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Chemistry of Natural Systems (QUI01081)

Chemistry of atmosphere Chemical composition; structure and function; chemical reactions and photochemistry reactions; anthropogenic action and its effects; air quality.
Chemistry of water physical and chemical properties of water; sources of water; water quality control; chemical equilibriums in natural waters; atmosphere water sediments interaction; water quality modelling.
Chemistry of soil Geochemistry of surface; soil composition; plants growth and trace elements; soil pollution.

Back

Physical Chemistry of Fluids (QUI01083)

Classes of liquids. Intermolecular forces. Empirical and semi-empirical potential models. Potential parameters. Corresponding states principle. Order and structure in liquids. Radial distribution functions. Correlations of molecular orientations. Organized systems: microemulsions, liquid crystals. Phase equilibria determination from volumetric properties. Applications of equations of state. Gibbs-Duhem equation: applications. Excess functions: significance and determination. Theories of liquids and solutions. Cell theory. Average potential theory. Perturbation theories. Solubilities of gases and liquids: experimental determination, pressure and temperature effects. Solubilities of solids in liquids. Polymer solutions. Flory-Huggins model and the theory of Prigogine-Flory-Patterson. Phase equilibrium at high pressures. Classification of phase diagrams. Critical state of binary mixtures. Pressure effect on liquidliquid miscibility. Supercritical extraction. Electrolyte solutions.

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Forensic Chemistry (QUI01089L)

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Industrial Chemistry (QUI00547)

The chemical industry worldwide and in Portugal. The history of Chemical industry (topics). The evolution of chemical industry in some countries. Comparison with the History of Science and History of Technology. The developement of chemical industry in Portugal. Chemical Process industry. Raw materials. Products from oil, natural gas, charcoal, carbohydrates, vegetal oils and greases. Raw materials for inorganc products. Recycled materials. Energy. Types of energy. Uses of energy in chemical industry. Commodities. Industrial gases. Oil refinning. Chemical and physical processes of refinning. Petrochemical products. Olefines. Polyolefines : production and applications. Syn gas production. Carbochemical products. Acetylene. Chemicals from syn gas. Acid acetic production. Tereftalic acid and polyesthers. Pulp and paper industry. Concrete industry.

Back

Organic Chemistry III (QUI01101)

Molecular orbital theory. Stereoelectronic effects. Aspects of structure activity relationships in organic chemistry (stereochemical effects on reactivity, reactive intermediates, quantitative structure activity relationships (QSAR). Rearrangements and fragmentations. Introduction to medicinal chemistry.
Includes advanced practical classes to accompany the material given in the lectures.

Back

Quantic Chemistry (QUI01103)

Reviews of quantum mechanics concepts. Postulates of quantum mechanics. Time independent perturbation theory. The hydrogen atom. The helium atom. Slater determinants. The Hartree-Fock method. The Koopman's theorem. Electronic correlation. The electron spin and the Pauli principle. Many-electron atoms. Homonuclear diatomic molecules. Ab-initio methods and the Density Functional Theory.

Back

Supramolecular Chemistry (QUI01106)

1. Introduction to Supramolecular Chemistry; classification of supramolecular compounds; nature of interactions.
2. The Supramolecular Chemistry in living organisms: cations; porphyrins and other macrocycles; DNA.
3. Hosts of cations; crown-ethers, cryptands, calixarenes; complexation of organic cations.
4. Hosts of anions; biological receptors, organometallic compounds.
5. Connection of neutral molecules; clathrates, organic hosts, cyclodextrins, cyclophanes, fullerenes.
6. Intermolecular interactions and crystal engineering.
7. Patterns and self-assembly: in biochemistry, in coordination compounds and due to interactions by hydrogen bond; catenanes, rotaxanes and helicates; molecular knots.
8. Molecular devices: electronic devices, molecular machines based on rotaxanes and catenanes, materials for nonlinear optical; dendrimers.
9. Liquid interfaces, liquid crystals.

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Molecular Simulation (QUI01109L)

Statistical thermodynamics: distribution of molecular states, partition functions, fundamental relationships, applications to the calculation of thermodynamic properties and chemical equilibrium.
Introduction to the molecular simulations. Periodic boundary conditions. Trajectories and properties. Ergodicity.
The Molecular Dynamics method. Simulations in the microcanonical ensemble. Simulations in the canonical ensemble: the Nosé-Hoover and the Berendsen thermostats. Simulations in the isobaric ensemble: the Berendsen and the Parrinello-Rahman barostats.
The Monte Carlo method. Canonical ensemble, isothermal-isobaric ensemble, grand canonical ensemble and Gibbs ensemble.
Analysis of simulations results. Radial distribution functions. Mechanical properties. Fluctuations. Correlation functions. Dynamical properties.

Back

Solids and Surfaces (QUI01113)

Structure and surface texture. Surface chemical properties - type and degree of regularity of the porosity of various materials of fundamental importance as adsorbents and catalysts. Infra-red spectroscopy applied to the study of surface chemistry. Helium and Hg pycnometry. Estimation of specific surface area from particle size from TEM, SEM and XRD. Adsorption from the liquid phase. Adsorption from the gas phase. Mercury porosimetry. Immersion calorimetry. Isosteric enthalpies of adsorption.
Execution of a laboratory project, analysis of the results, developed report and respective oral presentation.

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Enzymes Technology (QUI00361)

Lecture program of enzyme technology{\}newline
{\}newline
Chapter I Properties of enzymes (revision){\}newline
1.1.Nomenclature {\}newline
1.2.General characteristics of enzymes. Enzyme assays{\}newline
1.3. Enzyme kinetics: Michaelis Menten equation{\}newline
1.4. Factors affecting enzyme activity: pH, temperature, ionic strength, denaturing agents and modifiers of enzyme activity. {\}newline
{\}newline
Chapter II Enzyme production{\}newline
2.1 Sources of enzymes.{\}newline
2.1.1. Advantages and disadvantages of enzyme production and extraction from microbial strains, plants and animals. {\}newline
2.2 Extracellular and intracellular enzymes.{\}newline
2.3 Factors affecting enzyme production from microbial sources.{\}newline
2.3.1. Selection of microrganim producer of enzymes{\}newline
2.3.2. Extracellular and intracellular biosynthesis of enzymes.{\}newline
2.4. Optimization of enzyme production from microbial sources.{\}newline
2.4.1. Regulation of enzyme biosynthesis from microbial sources.{\}newline
2.4.2. Flow of genetic information for protein biosynthesis.{\}newline
2.4.3. Regulation of biosynthesis of enzymes: induction, catabolite repression and feedback repression.{\}newline
2.4.4. Overproduction of enzymes by environmental and genetic manipulations of microbial cultures.{\}newline
A- Isolation of constitutive mutants{\}newline
B- Genetic manipulation : Recombinant DNA technology{\}newline
Example of overproduction of amidase from Pseudomonas aeruginosa 8602 by recombinant DNA technology.{\}newline
2.5. Enzyme production by fermentation.{\}newline
2.5.1. Submerged and solid state fermentations.{\}newline
2.5.2. Several types and geometries of fermenters {\}newline
2.5.3. Mass balance for viable cells, dead cells, substrate and product {\}newline
2.5.4. Productivity in fermenters. {\}newline
{\}newline
Chapter III Extraction and purification of enzymes.{\}newline
3. Downstream processsing{\}newline
3.1. Removal of cells, purification and final isolation.{\}newline
3.2. Separation of liquid and solid fractions{\}newline
3.2.1. Filtration: applications. Types of filters. Factors affecting the rate of filtration. Microfiltration. {\}newline
3.2.2. Centrifugation: Applications. Types of centrifuges: tubular and continuous disc-stack centrifuges. Advantages and disadvantages. Theory of centrifugation: Stoke law.{\}newline
3.3. Cell rupture {\}newline
3.3.1. Mechanical methods : i- High pressure homogeneizer (Manton- Gaulin). Equation for cell rupture. Factors affecting cell rupture;{\}newline
ii- Mechanical agitator with glass beads/sand. Equation for cell rupture. Factors affecting cell rupture {\}newline
3.3.2. Enzymatic methods (lysozyme). {\}newline
3.4. Aqueous two phase systems.{\}newline
Equation for partition coefficient (K). Factors affecting solute partitioning. Equation for yield of solute at top and bottom phases.{\}newline
3.5. Affinity partitioning in aqueous two phase system.{\}newline
Equation for partition coefficient (DlogK). Factors affecting solute partitioning.{\}newline
3.6. Precipitation of proteins: inorganic salts. Factores affecting protein solubility. Hydrophobic and electrostatic interactions.{\}newline
3.7. Chromatographic techniques. {\}newline
3.7.1. Theory of chromatography. Adsorption Isotherms : Langmuir . Determination of capacity factor (K) and selectivity/relative retention (d).{\}newline
3.7.2. Gel filtration. Determination of partition coefficient (Kp). Comparative study between columns of different sizes. {\}newline
3.7.3. Theoretical plates in chromatography: HETP,N and HETP.{\}newline
3.7.4. Equation for Resolution (Rn). Relationship between N and HETP. {\}newline
3.7.5. Affinity, immunoaffinity, ion-exchange, hydrophic interaction, gel filtration and immobilized metal affinity chromatographies (IMAC).{\}newline
3.7.6. General rules for scale-up in chromatography. {\}newline

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Topics in Databases I (INF00892)

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Topics in Databases II (INF00893)

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Water Treatment and Wastewater (QUI00554)

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Cell Biology (BIO10917L)

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Scope of Present Chemistry (QUI01061)