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QA112 Fundamental Analytical Chemistry I
OF:S-1 T:04 P:00 L:04 HS:08 SL:08 C:08 AV:N FM:75 EX:S
Introduction to Analytical Chemistry. Stoichiometry. Errors and statistic treatment of data. Sampling. Precipitation and acid-base equilibria with applications to the identification of chemical species. Gravimetry. Introduction to volumetric analyses. Precipitation and neutralization volumetry.

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QA217 Fundamental Analytical Chemistry II
OF:S-2 T:04 P:00 L:04 HS:08 SL:08 C:08 AV:N FM:75 EX:S
Prerequisites: QA112 QG109
Complexation and redox equilibria with applications to the identification and quantification of chemical species. Electrochemical cells. Complexation and redox volumetry. Introduction to potenciometry. Samples preparation.

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QA282 Classic Chemistry
OF:S-5 T:04 P:00 L:04 HS:08 SL:08 C:08 AV:N FM:75 EX:S
Prerequisite: QG109
Techniques of qualitative analyses involving separation and identification of cations and anions. Quantitative analysis. Volumetry. Gravimetry. Ionic, acid-base, complexation and redox equilibria. Solubility and solubility product. Treatment of data.

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QA316 Analytical Chemistry III
OF:S-1 T:04 P:00 L:04 HS:08 SL:08 C:08 AV:N FM:75 EX:S
Prerequisite: QA217
Fundamentals of instrumental analyses. Spectro-analytical, electro-analytical and separation methods. Statistic treatment of data and interpretation of results obtained through instrumental methods.

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QA416 Analytical Chemistry IV
OF:S-2 T:04 P:00 L:04 HS:08 SL:08 C:08 AV:N FM:75 EX:S
Prerequisite: QA316
Samples preparation. Applications of spectro-analytical, electro-analytical and separation techniques in analytical methodologies. Validation of analytical methodologies.

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QA582 Instrumental Analytical Chemistry I
OF:S-2 T:03 P:03 L:00 HS:06 SL:06 C:06 AV:N FM:75 EX:S
Prerequisite: QA282
Fundamental of spectro-analytical, electro-analytical and separation methods. Statistic treatment of data and interpretation of results obtained through instrumental methods.

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QA682 Instrumental Analytical Chemistry II
OF:S-1 T:03 P:00 L:03 HS:06 SL:06 C:06 AV:N FM:75 EX:S
Prerequisite: QA582
Applications of spectro-analytical, electro-analytical and separation techniques in analytical methodologies. Validation of analytical methodologies. Samples treatment.

QA815 Environmental Chemistry
OF:S-5 T:02 P:00 L:00 HS:02 SL:02 C:02 AV:N FM:75 EX:S
Prerequisite: AA475
Chemistry of soils, water and atmosphere; its dynamics. Environmental pollution: prevention and treatment. Chemical reactions and processes of interest to human health in waters, soils and atmosphere. Legislation and environmental pollution. Prevention and processes of treatment (remediation).

QA910, QA 911...to QA929 Special Topics in AnalytIcaI Chemistry I to XX
OF:S-6 T:01 or 02 P:00 or 01 HS:02 SL: 01 or 02 C:02 AV:N or C FM:75 EX:S or N
Prerequisite: AA200
Summary: different topics available when the course is offered.

QF053 Laboratory of Applied Chemistry
OF:S-2 T:01 P:03 L:00 HS:04 SL:04 C:04 AV:N FM:75 EX:S
Prerequisite: *EQ481
Experiments in Applied Chemistry, developed at the pilot plant of the Institute of Chemistry, illustrating unitary operations relevant to the chemical industry.

QF331 Physical Chemistry
OF:S-5 T:04 P:00 L:00 O:00 D:00 HS:04 SL:04 C:04 AV:N EX:S FM:75%
Prerequisites: MA111/ MS220/ MS380 QG101/ QG104/ QG108
Real gas, Gibbs free energy, physical and chemical equilibria, phase diagrams, chemical kinetic.

QF431 Physical Chemistry I
OF:S-5 T:04 P:00 L:00 HS:04 SL:04 C:04 AV:N FM:75 EX:S
Prerequisites: MA211 QG108
Gas state: properties (PVT) of the ideal gas and of the real gases; the van der Waals' equation; principle of the corresponding states. Basic concepts of thermodynamics: first, second and third laws; thermodynamic functions; thermochemistry; applications. Conditions for equilibrium and phase rule: single- and multi-component systems. Properties of liquids and solids: superficial tension, viscosity. Mixtures; colligative properties; activity.

QF530 Introduction to Quantum Chemistry and Molecular Spectroscopy
OF:S-2 T:04 P:00 L:00 HS:04 SL:04 C:04 AV:N FM:75 EX:S
Prerequisites: MA311 *F 428 QI145
Notions of spectroscopy and postulates of Quantum Mechanics. Particle in the box and electronic structure. Rigid rotor and rotational spectroscopy of diatomic molecules. Harmonic oscillator and vibrational spectroscopy of diatomic molecules. Rotovibrational spectroscopy of diatomic molecules. Electronic structure, ground and excited states. Photochemistry and photophysics.

QF531 Physical Chemistry II
OF:S-5 T:04 P:00 L:00 HS:04 SL:04 C:04 AV:N FM:75 EX:S
Prerequisite: QF431
Kinetic Theory of gases: barometric equation, Maxwell-Boltzmann's law; intermolecular potential. Chemical kinetics: rate equations; homogeneous and heterogeneous catalysis; fast reactions, notions on molecular dynamics. Electrochemistry: conductivity of solutions, Ostwald's law; ionic equilibrium; thermodynamic properties; activity coefficients; Debye-Hückel theory; piles and electrochemical reactions; passivation and corrosion;

QF535 Introduction to Quantum Chemistry
OF:S-2 T:04 P:00 L:00 O:02 HS:06 SL:04 C:06 AV:N FM:75 EX:S
Prerequisites: MA311 QI246 *F 328/ MA311 QI245 *F 328
Historical evolution of the description of light and matter. The old quantum mechanics, quantization of the radiation and mechanic energy. Postulates of the wave quantum mechanics. Application to simple systems. Quantum chemistry: atomic structures and molecular structures of simple systems. Teaching quantum chemistry: supervised activities using TI resources and other media. Critical evaluation of the bibliography related to instructional material and knowledge construction.

QF536 Quantum Chemistry
OF:S-2 T:04 P:00 L:00 HS:04 SL:04 C:04 AV:N FM:75 EX:S
Prerequisites: MA311 QI245 *F 328
Postulates of Quantum Mechanics. Schrödinger's equation. Exact solutions and approximation methods. Hydrogen atom and multi-electron atoms. Methods of electronic structures for molecular systems.

QF573 Introduction to Thermal and Dynamical Analysis of Materials
OF:S-2 T:02 P:00 L:00 HS:02 SL:02 C:02 AV:N FM:75 EX:S
Prerequisites: QG108 *QF431
Introduction to thermal and mechanical techniques for the characterization of new materials.

QF632 Experimental Physical Chemistry I
OF:S-2 T:02 P:04 L:00 HS:06 SL:06 C:06 AV:N FM:75 EX:S
Prerequisites: QA217 *QF531
Experiments related to chemical thermodynamics, kinetics, electrochemistry, phase equilibrium and colligative properties.

QF637 Introduction to Spectroscopy and Statistical Thermodynamics
OF:S-1 T:04 P:00 L:00 HS:04 SL:04 C:04 AV:N FM:75 EX:S
Prerequisites: QF536 *F 428
Molecular optical spectroscopy. Electron Paramagnetic Resonance Spectroscopy (EPR) and Nuclear Magnetic Resonance Spectroscopy (NMR). Lasers. Photochemistry. Ensembles and postulates. Partition functions and thermodynamic connection. Systems of independent particles: distinguishable e indistinguishable particles. Applications.

QF661 Applied Chemistry
OF:S-5 T:04 P:00 L:00 HS:04 SL:04 C:04 AV:N FM:75 EX:S
Prerequisites: *QF531 *QO521
Materials: polymers, metals, ceramics and glasses. Colloids and surfaces: surfactants, foams, wetting, detergence, stability and properties of dispersions.

QF732 Experimental Physical Chemistry II
OF:S-1 T:02 P:04 L:00 HS:06 SL:06 C:06 AV:N FM:75 EX:S
Prerequisite: QF530/ QF536 / QF535
Experiments related to molecular spectroscopy, properties of materials and physical chemistry of colloids and surfaces.

QF835 Industrial Processes
OF:S-2 T:04 P:00 L:00 HS:04 SL:04 C:04 AV:N FM:75 EX:S
Prerequisite: *EQ582
Kinetic of reactors. Description of selected processes found in chemical industries. Fermentations, oil refining, paper manufacture, etc.

QF930, QF931...to QF949 Special Topics in Physical Chemistry I to XX
OF:S-6 T:01 or 02 P:00 or 01 HS:02 SL:02 C:02 AV:N or C FM:75 EX:S or N
Prerequisite: AA200
Summary: different topics available when the course is offered.

QF952 Experimental Physical Chemistry
OF:S-2 T:00 P:06 L:00 HS:06 SL:06 C:06 AV:N FM:75 EX:S
Prerequisite: *QF531
Experiments related to chemical thermodynamics, kinetics, electrochemistry, phase equilibrium, colligative properties, properties of materials and physical chemistry of colloids and surfaces.

QF953 Rheology and Polymer Processing
OF:S-2 T:04 P:00 L:00 HS:04 SL:04 C:04 AV:N FM:75 EX:S
Prerequisite: QF661
Classification and description of the main techniques of polymer processing. Rheological behavior of polymers.

QI145 Chemical Interactions
OF:S-5 T:02 P:00 L:00 O:00 D:00 HS:02 SL:02 C:02 AV:N EX:S FM:75%
Prerequisite: QG108
Molecular orbital theory for polyatomic molecules. Introduction to group theory. Acids and bases.

QI242 Theoretical Inorganic Chemistry
OF:S-2 T:04 P:00 L:00 O:00 D:00 HS:04 SL:04 C:04 AV:N EX:S FM:75%
Prerequisites: QG101 QG102/ QG108 QG109
Atomic Structure. Periodicity. Chemical Bonding Models. Acidity and Basicity. Coordination Compounds. Introduction to Organometallic Compounds and Catalysis.

QI244 Experimental Inorganic Chemistry
OF:S-2 T:00 P:00 L:04 O:00 D:00 HS:04 SL:04 C:04 AV:N EX:S FM:75%
Prerequisites: QG101 QG102/ QG108 QG109
Fundamental concepts involved in chemical reactions: reactivity of species, equilibrium, stoichiometry, oxidation-reduction, yield of reaction, chemical kinetics and catalysis. Reactivity of metals. Preparation of complexes of transition metals applying ligand field theory (ligand effect, coordination number and color).

QI245 Solid State Chemistry
OF:S-5 T:02 P:00 L:00 O:00 D:00 HS:02 SL:02 C:02 AV:N EX:S FM:75%
Prerequisite: QI145
Close packed structures. Some important crystalline structure types. X-ray diffraction. Defects and non-stoichiometric compounds. Electronic, optical and magnetic properties of solids.

QI246 Inorganic Chemistry
OF:S-2 T:004 P:00 L:00 O:00 D:00 HS:04 SL:04 C:04 AV:N EX:S FM:75%
Prerequisite: QG108
Lewis acidity and basicity: hard and soft acids and bases. Coordination and organometallic chemistry of transition metals.

QI345 Coordination Chemistry
OF:S-5 T:02 P:00 L:00 O:00 D:00 HS:02 SL:02 C:02 AV:N EX:S FM:75%
Prerequisite: QI145
Coordination compounds. Chemical bond theories applied to coordination compounds. Introduction to electronic spectroscopy: Tanabe-Sugano diagrams. Mechanism classifications of ligand exchange and electron transfer reactions.

QI446 Application of Group Theory in Electronic and Vibrational Spectroscopy
OF:S-2 T:02 P:00 L:00 O:00 D:00 HS:02 SL:02 C:02 AV:N EX:S FM:75%
Prerequisite: QI245/ QI246
Group Theory. Electronic and vibrational spectroscopy applied to inorganic compounds. Interpretation of spectra.

QI542 Experimental Inorganic Chemistry II
OF:S-1 T:00 P:00 L:08 O:00 D:00 HS:08 SL:08 C:08 AV:N EX:S FM:75%
Prerequisites: QG564 QI445 QI545/ QG564 QI446 QI545
Synthesis of transition metal complexes (coordination and organometallic compounds), bioinorganic model compounds and oxides and/or sulfides. Characterization of the synthesized metal complexes exploring the nephelauxetic series, including measurements of electronic spectra, magnetic properties, circular dichroism, vibrational spectroscopy, nuclear magnetic resonance, electrochemical properties and luminescence. Kinetics of ligands substitution in transition metal complexes. Intercalation reactions. Catalysis (homogeneous and heterogeneous).

QI543 Experimental Inorganic Chemistry II
OF:S-1 T:00 P:00 L:06 O:00 D:00 HS:00 SL:06 C:06 AV:N EX:S FM:75%
Prerequisites.: QG650 QI445 QI545/ QG650 QI446 QI545
Synthesis, characterization and applications of inorganic compounds, especially transition metal compounds.

QI545 Organometallic Chemistry
OF:S-5 T:02 P:00 L:00 O:00 D:00 HS:02 SL:02 C:02 AV:N EX:S FM:75%
Prerequisite: QI345
Organometallic chemistry of the main group and transition metal compounds. Catalysis.

QI940, QF941...to QF959 Special Topics in Inorganic Chemistry I to XX
OF:S-6 T:01 or 02 P:00 or 01 HS:02 SL:02 C:02 AV:N or C FM:75 EX:S or N
Prerequisite: AA200
Summary: different topics available when the course is offered.

QO321 Organic Chemistry I

OF:S-5 T:04 P:00 L:00 HS:04 SL:04 C:04 AV:N FM:75 EX:S

Prerequisite: QG108

Review of selected historic and structural aspects of organic chemistry. Electronic structure and chemical bonding. Organic structures. Organic reactions. Alkanes. Reactions of alkanes. Stereochemistry. Alkyl halides and organometallics. Structure and physical properties of alkyl halides. Uses of alkyl halides. Nomenclature, structure, physical properties, preparation and reactions of organometallic compounds. Nucleophilic substitutions and eliminations. Alcohols and ethers. Alkenes. Alkynes and nitriles.

QO323 Organic Chemistry I (Chemical Engineering)

OF:S-1 T:04 P:00 L:00 O:00 D:00 HS:04 SL:04 C:04 AV:N EX:S FM:75%

Prerequisite: QG101/ QG107

Hybrid orbitals. Hydrocarbons. Petroleum. Benzene and related compounds. Organic halides. Alcohols. Ethers. Carboxylic acids and derived compounds. Aldehydes and ketones. Amines. Heterocyclic compounds. Polymers. Notions of stereochemistry.

QO327 Organic Chemistry II (chemical Engineering)

OF:S-1 T:04 P:00 L:04 O:00 D:00 HS:08 SL:08 C:08 AV:N EX:S FM:75%

Prerequisite: QO427

Laboratory techniques in organic chemistry. Differentiation between hydrocarbons. Obtainment of alkenes, ketones, esters, alkyl halides, phenols and amines. Aldol condensation. Polymers. Dyes. Soaps. Introduction to chromatography and absorption spectroscopy.

QO421 Organic Chemistry II

OF:S-5 T:04 P:00 L:00 O:00 D:00 HS:04 SL:04 C:04 AV:N EX:S FM:75%

Prerequisite: QO321

Aldehydes and ketones. Carboxylic acids and derived compounds. Conjugation, allylic systems, dienes and polyenes, unsaturated carbonyl compounds, Diels-Alder reactions. Benzene and aromatic ring. Aromatic electrophilic substitution. Aryl halides and aromatic nucleophilic substitution. Phenols. Amines. Other nitrogen-based functions.

QO422 Organic Chemistry II (Chemical Engineering)

L:00 O:00 D:00 HS:08 SL:08 C:08 AV:N EX:S FM:75%

Prerequisite: QO323/ QO421

Laboratory techniques in organic chemistry. Differentiation between hydrocarbons. Obtainment of alkenes, ketones, esters, alkyl halides, phenols and amines. Aldol condensation. Polymers. Dyes. Soaps. Introduction to chromatography and absorption spectroscopy.

QO423 Fundaments of Mass Spectrometry

OF:S-5 T:02 P:00 L:00 HS:02 SL:02 C:02 AV:N FM:75 EX:S

Prerequisite: QO521

Basics of experimental mass spectrometry. Interpretation of data and applications of the technique.

QO424 Fundaments of Nuclear Magnetic Resonance and Spectroscopy

OF:S-5 T:02 P:00 L:00 HS:02 SL:02 C:02 AV:N FM:75 EX:S

Prerequisite: QO521

Basics of experimental nuclear magnetic resonance spectroscopy. Interpretation of spectra and applications of the technique.

QO427 Organic Chemistry I
OF:S-2 T:04 P:00 L:00 O:00 D:00 HS:04 SL:04 C:04 AV:N EX:S FM:75%
Prerequisite: QG101
Hybrid orbitals. Hydrocarbons. Petroleum. Benzene and related compounds. Organic halides. Alcohols. Ethers. Carboxylic acids and derived compounds. Aldehydes and ketones. Amines. Heterocyclic compounds. Polymers. Notions of stereochemistry.

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QO521 Organic Chemistry II
OF:S-5 T:06 P:00 L:00 HS:06 SL:06 C:06 AV:N FM:75 EX:S
Prerequisite: QO321
Aldehydes and ketones. Carboxylic acids and derivatives. Conjugation, allylic systems, dienes and polyenes, unsaturated carbonyl compounds, Diels-Alder reactions. Benzene and aromatic rings, aromatic electrophilic substitution. Aryl halides and aromatic nucleophilic substitution. Phenols. Amines. Other nitrogen-based functions. In all cases, relationship between structure and reactivity will be analyzed, with emphasis in mechanisms and stereochemistry. Applications.

QO551 Biochemistry I
OF:S-5 T:04 P:00 L:00 HS:04 SL:04 C:04 AV:N FM:75 EX:S
Prerequisite: QO521
Introduction. Amino-acids, protein: structure, methods for analyses of protein, protein functions, carbohydrates, nucleic acids and structure of RNA and DNA, methods for analyses of nucleic acids, principles of the technology of recombining DNA, lipids and biologic membranes, transportation through membranes, enzymology, selected topics.

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QO620 Experimental Organic Chemistry II
OF:S-1 T:00 P:06 L:00 HS:06 SL:06 C:06 AV:N FM:75 EX:S
Prerequisites: QG650 QO423 QO424
Qualitative analyses of organic compounds employing chemical and physical methods. Projects in synthesis of organic and natural products.

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QO621 Organic Chemistry III
OF:S-2 T:04 P:00 L:00 HS:04 SL:04 C:04 AV:N FM:75 EX:S
Prerequisite: QO521
Introduction to the philosophy and practice of organic syntheses: main transformations of functional groups; protecting groups. Use of poly-functional compounds in the formation of carbon-carbon and other bonds. Specific methods of carbon-carbon bond formation. Pericyclic reactions: frontier molecular orbitals; cyclo-addition reactions; sigmatropic rearrangement. Projects in synthesis of organic and natural products.

QO622 Experimental Organic Chemistry II
OF:S-2 T:02 P:00 L:06 O:00 D:00 HS:08 SL:08 C:08 AV:N EX:S FM:75%
Prerequisites: QG564 QO423 QO424/ QG565

Qualitative analyses of organic compounds employing chemical and physical methods. Projects in synthesis of organic and natural products.

QO623 Experimental Organic Chemistry
OF:S-1 T:04 P:04 L:00 O:00 D:00 HS:08 SL:08 C:08 AV:N EX:S FM:75%
Prerequisite.: QO321
Experiments related to acid-base extraction, isolation of natural products, preparation of organic compounds and drugs, basic knowledge of isolation, purification and characterization of the synthesized products by spectroscopy techniques: infrared, ultraviolet, nuclear magnetic resonance and mass spectrometry. Chromatographic methods. Principles of organic analysis. Projects in synthesis of organic and natural products.

QO651 Biochemistry II
OF:S-1 T:04 P:00 L:02 HS:06 SL:06 C:06 AV:N FM:75 EX:S
Prerequisite: QO551
Introduction to metabolism, catabolism of glucose, signal transduction, metabolism of glycogen, citric acid cycle, glycogenesis, pentose pathway, electrons transport and oxidative phosphorylation, photosynthesis, metabolism of lipids, metabolism of amino-acids, metabolism of nucleotides, integration and regulation of metabolism, gene information flow, expression and cellular folding of protein, expression control and principles for the engineering of protein.

QO652 Experimental Biochemistry
OF:S-2 T:00 P:00 L:04 O:00 D:00 HS:04 SL:04 C:04 AV:N EX:S FM:75%
Prerequisite: QO551
Fundaments of experimental biochemistry. Knowledge of techniques used for isolation and characterization of biomolecules: proteins, lipids, saccharides and nucleic acids (RNA e DNA). Principles of molecular biology: biological material, biosecurity, from the gene to the recombinant protein, computational tools.

QO653 Biochemistry II
OF:S-1 T:00 P:00 L:00 O:00 D:00 HS:04 SL:04 C:04 AV:N EX:S FM:75%
Prerequisite: QO551
Introduction to metabolism, catabolism of glucose, signal transduction, metabolism of glycogen, citric acid cycle, glycogenesis, pentose pathway, electrons transport and oxidative phosphorylation, photosynthesis, metabolism of lipids, metabolism of amino-acids, metabolism of nucleotides, integration and regulation of metabolism, gene information flow, expression and cellular folding of protein, expression control and principles for the engineering of protein.

QO721 Organic Chemistry III
OF:S-2 T:00 P:00 L:00 O:00 D:00 HS:04 SL:04 C:04 AV:N EX:S FM:75%
Prerequisite.: QO421
Frontier molecular orbitals. Introduction to and revision of aromaticity. Differences between hetero-aromatic and heterocyclic compounds. Main reactions involving hetero-aromatic with 5 and 6 members containing one or two heteroatoms (N,O,S). Synthesis of hetero-aromatic with 5 and 6 members containing one or two heteroatoms. Synthesis of fused hetero-aromatic compounds. Examples of synthesis of drugs containing heterocyclic rings.

QO920, QO921... to QO939 Special Topics in Organic Chemistry I to XX
OF:S-6 T:01 or 02 P:00 or 01 L:00 HS:02 SL:02 C:02 AV:N or C FM:75 EX:S or N
Prerequisite: AA200
Summary: different topics available when the course is offered.

Captions:

OF: semester offering (S-1: 1stS; S-2: 2ndS; S-5: both semesters; S-6: at the convenience of the institute)

T: weekly hours of theoretical classes

P: weekly hours of practical classes

L: weekly hours of laboratory classes

O: weekly hours of supervised work

HS: total weekly hours (T + P + L + O)

SL: weekly hours in class (T + P + L)

C: number of credits

AV: criteria of evaluation (N = note, from zero to 10; F = Frequency; C = sufficient or insufficient)

FM: minimal frequency needed for approval (minimum of 75%)

EX: Existence (S) or not (N) of a final examination

Prerequisites:

AA200: authorization of the coordinator

AA4XX: XX is related to the progress of the student (AA475: the student must have obtained 75% of the credits needed to obtain the BSc degree).

* Partial prerequisite (a note $\geq$ 3.0 is sufficient)
