توصيف مقررات الخطة الدراسية لقسم الكيمياء (التحول البرامجي)

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General Chemistry (1); Chem 101-4 (3+1)

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Introduction, Atomic theory, Chemical calculation, Solutions, Electronic configuration and periodic table, Chemical bonds, Gas laws, Chemical equilibrium, Ionic equilibrium, Introduction to organic chemistry.

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General Chemistry (2); Chem 211-3 (2+1)

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General Chemistry is considered the backbone of physical chemistry , and it include many of main principle topics in physical chemistry , it concern by  basic principles of thermodynamics, thermo-chemistry, electrochemistry, solution chemistry, phase rules,......

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Organic Chemistry (1); Chem 221-3 (2+1)

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Introduction, Alkanes and cycloalkanes, Functional groups, Aliphatic Aldehydes and ketones, Aliphatic Carboxylic acids and their derivatives, Aliphatic Alkyl halides, Aliphatic Alcohols and thiols, Aliphatic Ether, Epoxide and thioether, AliphaticAmines and nitriles.

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Volumetric and Gravimetric Analysis; Chem 241-3 (2+1)

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Principles of the qualitative and quantitative analysis, The treatment of analytical data and the estima-tion of experimental error, Chemical calculation in volumetric analysis,, Acid-base titration, Precipitate titration, Redox titration, Compleximetric titration, Introduction to separation methods, Gravimetric analysis, Introduction to *spectroscopic methods* of *chemical analysis*, Introduction to *electricchemical* analysis.

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Inorganic Chemistry (1); Chem 231-2 (2+0)

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Periodicity and the chemistry of the elements, Electron configurations of elements and ions, Periodic trends: atomic radii, ionic radii, ionization energy, electron affinity, Ionic bonds, the formation of ionic solids and lattice energies in ionic solids, Covalent bonding in molecules, Comparison of ionic and covalent compounds, Electron-dot structures, Molecular shapes: The VSEPR model, Valence bond theory, Molecular orbital theory, Intermolecular chemical forces, Chemistry of s-block elements, Chemistry of p-block elements.

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Quantum Chemistry; Chem 212-2 (2+0)

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Historical development of Quantum Mechanics, Definition: Electron – Neutron – Proton – Positive Rays – Subatomic particles - Alpha particles, Quantum Mechanics Arose Out of the interplay of experiments and theory: Blackbody radiation – Atomic and molecular spectra, The photoelectric effect – Compton effect, Particles Exhibit Wave –like Behaviour and quote de Broglie relation, Atomic Spectra and the Bohr Model of the Hydrogen Atom, What Determines if a system Needs to be Described Using Quantum mechanics?, Classical waves and the Non-dispersive wave Equation, Waves Are conveniently represented as complex functions, Quantum Mechanical Waves and the Shrodinger Equation, Solving the Shrodinger Equation: Operators, Obsevables,Eigenfunctions,and Eigenvalues. The orthogonality of eigenfuncations, The Quantum Mechanical Postulates: The physical meaning associated with the wave function, The Quantum Mechanical Postulates: Every observable has a corresponding Operator, The Quantum Mechanical Postulates: The result of an individual measurements.

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Inorganic Chemistry (2); Chem 232-3 (3+0)

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The transition elements play important roles in our daily life and in keeping the living organisms alive. Many materials those we encounter each day contain transition element such as iron, copper, nickel etc., in one form or another. Production of various materials using chemical processes invariably involved catalysis which are mostly transition metal and their compounds. In order to understand roles of transition elements in biological systems or in chemical processes involving them, it's essential to understand the principals underlying the chemistry of these elements.

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Organic Chemistry (2); Chem 222-3 (2+1)

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Introduction to aromatic organic compounds - Structural composition of benzene and its property with resonance study, Aromaticity Naming organic compounds of various aromatic mono-and multi-replacements- Common names- IUPAC names, Naming organic compounds of various aromatic mono-and multi-replacements- Common names- IUPAC names, Aromatic organic compounds of multiple compact rings (polynuclear aromatic hydracarbons) (naphthalene - anthracene – phenanthrene- Biphenyl): Naming- Resonance-Preparation – Reactions, Aromatic organic compounds of multiple compact rings (polynuclear aromatic hydracarbons) (naphthalene - anthracene – phenanthrene- Biphenyl): Naming- Resonance-Preparation – Reactions, Electrophilic substitution reactions of Di- and Tri-substituted benzenes- Oxidation and Reduction of aromatic rings, Preparation and reactions of halogen derivatives of benzene: Electrophilic Substitution of halobenzenes- Nucleophilic Substitutions of halobenzens, Acid- Base reaction, Functional group transformations- Electrophilic substitution reactions- Oxidation: Claisen Condensation.

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Thermodynamics; Chem 213-3 (3+0)

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Thermodynamic terms – system , boundary , surroundings, Types of thermodynamic systems, Intensive and extensive properties – Thermodynamic process, Nature of heat and work – isothermal reversible expansion work of an ideal gas - isothermal irreversible expansion work of an ideal gas, Maximum Work done in reversible expansion – Internal energy, First law of thermodynamic, Enthalpy of the system - Molar Heat capacities, Joule – Thomson Effect, Adiabatic expansion of an ideal gas, Work done in adiabatic reversible expansion, Enthalpy of reaction – Exothermaic and endothermic reaction, Different type of heat of reaction, Change during transition or phase change, Hess’s law

Application of Hess’s law, Bond Energy, Measurement of heat of reaction, Spontaneous process – non spontaneous process, Entropy: Units – standard entropy – numerical definition – physical significance, Entropy change for an ideal gas, Accompanying change of phase, Gibb’s Helmholtz equations- Clausis – clapryon equation, Vant hoff isotherm, Chemical potential.

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Spectral Analysis; Chem 242-3 (2+1)

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Effect of different types of electromagnetic radation on the substance, and its importance in qualitative and quantitative analysis, Quantitative specttral analysis using UV and viscible radiation, Quantitative spectral analysis using atomic absorption and emission spectra, Qualatitive spectral analysis using using IR radiation, Qualatitive spectral analysis using short and radio wave radiation, Molecular emission fluorescence and phosphorescence, Arc spark atomic emission spectrometry, Plasma atomic emission spectrometry.

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Biochemistry; Chem 321-3 (2+1)

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This course is designed to give an extensive knowledge of biochemistry science, this include carbohydrates, amino acids. Proteins nucleic acids ,lipids and enzymes.

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Stereochemistry; Chem 322-2 (2+0)

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Introduction of stereochemistry; classifications of Isomerism, Structural isomerism and stereochemistry isomerism, Chain isomerism; Positional isomerism; Functional isomerism; and Tautomer’s, Conformation analysis of ethane; Conformation of n-propane; Conformation analysis of n- butane; Conformation analysis of cyclohexane, Geometrical isomerism: (Cis and Trans form) and (E and Z form), Optically isomerism: (stereogenic, asymmetric carbon and chiral carbon of one and more than carbon atoms), Configuration (Enantiomers- diastereomers- meso compounds-epimers), Racemic mixture and how can separate of racemic mixture and their biological activity.

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Chromatographic Separation Methods; Chem 341-3 (2+1)

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Introduction on separation and extraction science, Definition and classification of chromatography, Principles and theory, Planar chromatography( Paper chromatography), Planar chromatography (Thin layer chromatography), Column chromatography, Affinity chromatography, Ion Exchange Chromatography, Gas Chromatography and it’s applications, High performance liquid chromatography and it’s applications, Capillary electrophoresis.

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Chemical Kinetics; Chem 311-3 (2+1)

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Concepts of Chemical Kinetics, Factors affecting on reaction rates, Calculations of Reaction Order, Types of chemical kinetics reactions, (Theories of velocities) for Different Types of Chemical Reactions, Kinetics and Mechanisms of some Special Enzymatic Reactions (Homo- or Heterogeneous Reactions ).

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Electrochemistry; Chem 312-3 (2+1)

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Oxidation-Reduction Reactions, Reduction processes, Galvanic Cells, Concentration Cells, Batteries, Lead Storage Battery, Other Batteries, Fuel Cells, Electrolytic cells, Faraday laws, Application of Electrolysis.

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Coordination Chemistry; Chem 331-3 (2+1)

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Basic terms used in the field of coordination chemistry, Recognize the properties of the transition elements, Types of complexes, Rules of Nomenclature of complexes, Werner and chain theory, Coordination number, Types of ligand, Effective atomic number, VBT theory, CFT theory, C.F.T theory and spin-orbit coupling, Electron paramagnetic resonance.

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Inorganic Reaction Mechanism; Chem 332-2 (1+1)

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Basic terms used in the field of chemical reaction mechanisms, Possible mechanisms of ligand exchange reactions, Methods of investigation of inorganic reaction mechanisms, Reactions of coordinated ligands, Mechanism of substitution reactions, Square-planar complexes, Werner Oh complexes, Organometallic complexes, including multinuclear metal complexes, Mechanism of redox reactions, Mechanism of isomerization reactions, Mechanism of proton-transfer reactions, Mechanism of important industrial catalytic reactions, Mechanism of reactions occurring in the environment, Mechanism of biological processes catalyzed by metal-containing enzymes, Photochemical reactions of complexes, Detailed mechanism of cisplatin’santimetastatic effect, Transition metal ion – DNA interactions, Pt(II) and Ru(II). Interactions with biological thiols and proteins.

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Physical Organic Chemistry; Chem 323-2 (2+0)

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This course focuses on the quantitative aspects of structure and reactivity, molecular orbital theory, and the insight it provides into structures and properties of molecules, stereochemistry, thermochemistry, kinetics, substituent and isotope effects, and pericyclic reactions.

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Chemistry of Environmental Analysis; Chem 342-2 (1+1)

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Introduction and Basic concept of ecosystem and Atmospheric composition, Concept of environmental pollution and the definition of different type of pollutants, Atmospheric pollution, air pollutants, effect of pollutants on the human health, animal, plant and soil, Ozone layer, air sampling and the chemical analysis methods, Water cycle, water natural, different types of water, water pollution, definition of water pollutants, Sources of water pollutants: Organic, Inorganic, Oils, Pesticides, Radioactivity, Heavy metals, …, International standard for drinking water, analysis of contamination of drinking water, All methods of water treatments, Soil pollutions, limits and treatment of soil pollutant: Organic, Inorganic, Oils, Pesticides, Radioactivity, Heavy metals,…, International lows and legislations designed to reduce the environmental pollutions in air, water and soil.

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Group Theory; Chem 333-2 (2+0)

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This course deals with the basic principles of group theory, Symmetry elements and symmetry operations, Some general rules for multiplications of symmetry operations, Axis of symmetry, Plane of symmetry, Reflection process, Rotation process, Centre of symmetry, Symmetry elements and Practical Examples, Point groups of many different inorganic molecules, Classified of inorganic compounds and find their point group, Character tables for each point groups, Analyses of on infrared and Raman spectra for different inorganic compounds, Elective law for infrared and Raman spectra, Practical examples.

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Solid State Chemistry; Chem 313-2 (2+0)

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Introduction to the solid materials: Distinction Between Gases, liquid and solid states, Important of Solid State Chemistry, Classification of solids: **Crystalline and  Amorphous solids** , Isotropic and anisotropic, Basic concepts crystal structure: unit cell and lattice, The Seven Crystal Systems, Bravais Lattices and Miller Indices, Properties of crystals: Symmetry elements, **Number of atoms in unit cells, Packing Efficiency, Coordination numbers**, Classification of solids **based on binding forces:** Ionic crystals, Covalent crystals, Molecular crystals and Metallic crystals, Crystal defects : Point defects, Types of point defects, alloys, semiconductors Crystal defects : Point defects, Types of point defects, alloys, semiconductors, Characterization of Solid Materials: X-ray Diffraction, Optical Microscope, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Thermal Analysis, Solid state reaction (ceramic reaction): mechanism, advantage and disadvantages, producers, Basic apparatus.

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Heterocyclic Chemistry; Chem 324-3 (2+1)

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Brief Introduction of heterocycles and their importance, Nonaromatic Heterocyclic (three, four, five and six members with one heteroatom, Different methods for the preparation of oxirane, aziridine and thiirane, Different methods for the preparation of oxirane, aziridine and thiirane, Five-memberdheterocycles rings with one heteroatom, Chemical structures of furan, pyrrole and thiphene, and degree of aromaticity, General syntheses methods for 5-member rings, Paal-Knorr synthesis, Feist-Benary synthesis of furans. Hantzsch and Knorr syntheses of pyrroles, Electrophilic substitution in this kind of rings, reactants employed and orientation of the substituent on the ring, Some heterocyclic ring Contact opening in the case of furans, Benzoderivatives of five-memberdheterocycles with one heteroatom, Indole- Preparation of indole derivatives, Pyridine- Influence of the imine group on the reactivity of the pyridine ring, Examples of nucleophilic substitution on pyridine derivatives.

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Organometallic Chemistry; Chem 425-2 (2+0) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

History and key advances (Why Study Organometallic Chemistry-classification of organometallic compounds- Bonds- types transition metals- d-electrons- 18e rule- Limitation of 18 rule)- Recognize the types of Reaction (M-carbonyls -M-alkyls/hydrides- M-olefins/arenes- Mcarbenes -Physical methods in Organometallic(IR)- applications to organic synthesis-Organometallic complexes in catalysis (Hydrogenation: symmetric and asymmetric-Carbonylations: hydroformylation-Polymerization- oligomerization- cyclizations).

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Inorganic Spectroscopy; Chem 431-2 (2+0)

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General Introduction to Spectroscopy, Mossbauer Spectroscopy, Nuclear Quadrupole, Resonance Spectroscopy, Electronic Absorption Spectroscopy, Spectra of Transition, Metal Complexes, Vibration and Rotation Spectroscopy, Application of Electronic Absorption and IR Spectroscopy, Nuclear Magnetic Resonance Spectroscopy, Application of NMR, Nuclear Magnetic Resonance Spectra of, Paramagnetic Transition Metal ion complexes, Electron Paramagnetic Resonance, Mass Spectrometery.

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Organic Spectroscopy; Chem 421-3 (2+1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

This course is concerned with teaching the students how to elucidate the structure of known and unknown organic compounds using different spectroscopic techniques including; Infra red (IR), Ultraviolet (UV), Mass spectrometry (MS) and Nuclear magnetic resonance spectroscopy (NMR). For each technique, the students will the spectrometer`s structure, principle of working and applications on identifying different kinds of organic compounds containing different functional groups.

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Principle of Nanotechnology; Chem 411-2 (2+0)

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Nanomaterials, Properties of nanomaterials, Fabrication of nanomaterials, characterization of nanomaterials, Nanoparticles, Nanowires and Nanorods, Thin Films, Fullerenes, Carbon Nanotubes and Graphene

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Surface Chemistry and Catalysis; Chem 412-3 (2+1)

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Surface tension: the importance of studying surface chemistry , the phenomenon of surface tension – the capillary, measuring methods of surface tension of liquids, interfaces, interfacial tension, effect of temperature on surface tension.

Adsorption: Adsorption and absorption, examples of adsorption, heat of Adsorption, types of adsorption, a comparison between types of adsorption, adsorption Isotherms, adsorption theory, adsorption in solution.

Catalysis: Introduction in catalysis, catalysts properties, classification of catalytic process according to the phases of material, mechanism of catalysis and its theories, catalytic poisons, heterogeneous catalysis, steps of heterogeneous catalysis, chemical theory and the theory of desorption for heterogeneous catalysis, catalysis by enzymes, mechanism of enzymatic catalysis, factors affecting the enzymatic catalysis, comparison between enzymatic and chemical catalyses.

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Natural products; Chem 426-2 (2+0)

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This course concerned with the definition of a student on the different types of natural products that are found in living organisms of plant and animal. This course describes how to separate natural products and to identify the chemical composition by different methods. Also, this course includes the study of some classes of terpenes; alkaloids and steroids.

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Radio Nuclear Chemistry; Chem 417-2 (2+0)

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Nuclear Reactions and their Characteristics, Nuclear Reactions and Radioactivity, Radioactivity and Decay Rates, Half lifes, Energy Changes During Nuclear Reactions, Radioactive series, Radiation detections, Nuclear Fission, Nuclear Transmutation, Detecting and measuring radioactivity, Biological Effects of Radiations, Applications of, Nuclear Chemistry, Introduction to radiation Chemistry.

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Graduate Project; Chem 420-3 (3+0)

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Definition of the research problem and plan – Steps of Research plan - Design of articles and dissertation – Writing the introduction - Preparation of literature review - Design the experiment - Collecting results- Data Analysis- Reviewing the paper and thesis elements - Writing thesis in final form Scientific Publishing.

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Polymer Chemistry; Chem 422-2 (2+0)

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Introduction, definition, general properties of polymers. Characterization and determination of Molecular weight of polymers, physical properties of polymers, step Polymerization, chain polymerization, anionic Polymerization, cationic and ring opening polymerization, physical forms of polymerization, living radical polymerization.

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Petroleum Analysis; Chem 441-2 (2+0)

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Source, production, chemical composition, and calcification of petroleum, Physical and chemical properties of petroleum, Petroleum refinery and petrochemicals, Application of petroleum, Petroleum manufacture, Separation of natural gas from petroleum, Analysis of natural gas, Analysis of gas and liquid fuel from petroleum, Analysis of petroleum cuts (Gasoline, Kerosene, Gas oil), Recycle of petroleum wastes.

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Advanced Material Science; Chem 413-2 (2+0)

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Porous Metals Fabrication, Porous Metals Applications, Porous Ceramics Fabrication, Porous Ceramics Applications, Polymer Foams Fabrication, Polymer Foams Applications, Polymer Matrix Composites, Ceramic Matrix Composites, Carbon Fiber / Carbon Matrix Composites, Fullerenes Fabrication and Applications, Carbon Nanotubes Fabrication and Applications.

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Molecular Spectroscopy; Chem 424-2 (2+0) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The purpose of this course is to provide an advanced level undergraduate student in Chemistry or Physics with a general overview of molecular spectroscopy. Specifically, the underlying principles of spectroscopy are examined using quantum mechanics, the interaction of light and matter, and group theory as starting points. The main focus of this course is the various forms of optical spectroscopy, including rotational, vibrational and electronic spectroscopy, as well as a brief look at photoelectron spectroscopy and lasers.

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Biophysical Chemistry; Chem 423-2 (2+0) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

General introduction, Biophysical systems, Forces in proteins, Protein folding and unfolding, Enzyme kinetics, Biophysical techniques, Conformational transitions in peptides and proteins, Membrane biophysics, Case study: stopped flow fluorimetry using Voltage sensitive fluorescent membrane probes.

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Corrosion Chemistry; Chem 414-1 (1+0) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Principles of corrosion, Concepts of Electrochemical corrosion, Corrosion thermodynamics, Corrosion kinetics, Linear Polarization measurement, Tafel Plot measurement, Electrochemical Impedence Spectroscopy, High Temperature oxidation and corrosion, Corrosion Control Fundamentals, Cathodic Protection, Coatings, Inhibitors, Materials selection, Design.

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Modern Trends in Analytical Chemistry; Chem 442-2 (2+0)

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Modifications of working electrode in Voltammetry - Ion selective electrodes in Potentiometry hyphenated techniques in chromatography (GC-MS, LCP-MS), high performance electrophoresis.

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Industrial Chemistry; Chem 415-2 (2+0)

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Basic consideration and technical expressions, Insudtrail processes calculations, Separation processes, Isolating the product, Fluides flow, Heat transfer, Cement manufacturing, Iron and steelmaking, Water treatment.

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Computational Chemistry; Chem 418-2 (1+1)

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Cheminformatics- computational chemistry– theoretical chemistry an overview, Building and displaying molecules- Hyperchem Calculations, Overview on computational Chemistry and Hyperchem software, Molecular Mechanics, Electronic Structure Methods – Model Chemistries, Single point Energy Calculations, Geometry optimization – Potential energy surfaces, Transition state search, Molecular, Dynamics, Langevin Dynamics, Mont Carlo Simulation, Density Functional Theory (DFT).