

## . محتويات المقررات

المستوي الاول (برنامج الكيمياء)

### . ١ الفصل الدراسي الأول

#### Principle of Physical Chemistry

ك ١٠١ أسس الكيمياء الفيزيائية

Significant figures, Measurement and unit: The gaseous state, the gas laws, real and ideal gases, the liquid state and the solid state. Thermo-chemistry, thermo-chemical equations, Hess's law;  $\Delta H$  for various processes; bond energies, variation of  $l_e$  with temperature; heat capacities. Kirchhoff's equation. The Solution Process, Ways of Expressing Concentration. Factors Affecting Solubility Raoult's Law Colligative Properties- Lowering the Vapor Pressure " Boiling-Point Elevation - Freezing Point Depression - Osmosis –Determination of Molar Mass, Chemical equilibria: The equilibrium state. The Reaction Quotient - The relationship between  $K_c$  and  $K_p$  - Heterogeneous Equilibria - Le-Chatelier's Principle and Chemical Equilibrium. Equilibria in Aqueous Solutions The Arrhenius Theory of Acids and Bases, Bronsted-Lowry and Lewis theory of Acids and Bases - Auto-ionization of water and pH. Ionization Constants of Weak Electrolytes and Polyprotic Acids - Common Ion Effect and Buffers - Hydrolysis Constants - Acid-Base Titration Curves. Solubility and  $K_{sp}$  Relationship.

#### Integration and Differentiation

١٠١ جبر وتفاضل

**Algebra:** Mathematical induction and partial fractions. Binomial theorem and its applications, solution of cubic equations, solution of 4th degree equations, sets, subsets, set operations and inductively definition of sets, equivalence relations, equivalence classes, partitions and partial order, maps, composition of maps, kinds of maps and inverse functions. Differentiation: A) Review and preparation for calculus. B) Limits and their properties. C) Differentiation: (Basic ideas; tangent of curve; the product and quotient rule; the chain rule); D): higher derivatives. Differentiation of trigonometric functions and their inverse; Differentiation of the logarithmic function; the exponential function, hyperbolic functions and their inverse. Applications of Differentiation.

#### Heat and properties of matter

فا ١٠١ حرارة وخواص المادة

**Part I:** Properties of Matter: Units and dimensions – Motion in a circle – Oscillations – Gravity–Moment of Inertia - Surface tension – Viscosity – Elasticity. **Part II:** Heat: Theories of the heat energy – Temperature scales and measurements – Thermal Expansion – Calorimeter – Vapors – Heat transfer.

### Functional form

ج ١٠١ الشكل الوظيفي

Cell structure and function, structure and function of digestive system and digestion, endocrine immunity and immune system blood.

### Crystallography and Mineralogy

ج ١٠٣ البلورات والمعادن

Crystallography: Definition and crystal parts, Interfacial angles and their law, Crystallographic elements, Crystal symmetry, Crystal habit and forms, Crystal aggregates, Crystal systems, holohedral and hemihedral forms, Hemimorphism and enantiomorphism, Axial ratios-crystal parameters and Miller indices, Zone, Zone axes and zone symbols and law, General description of the crystal systems, Stenographic projection, Practical examination of models representing crystal forms of seven crystal systems. Mineralogy: Definitions, Physical and chemical, Properties of minerals, Chemical compositions, Origin of minerals, Classification of minerals, Minerals of the Earth's crust –Mineral associations in rocks and ore deposits, Description of crystal forms, genesis, Field occurrences and uses of some important minerals, Laboratory investigation of hand specimens representing the major mineral groups.

### Introduction to Computer Science

ع ١٠١ مقدمة في الحاسب الآلي

Introduction to computer and information systems. Types of computers. Computer hardware and software components. Data representation and number systems. Introduction to networking. Introduction to internet, hardware and software components for internet access. Algorithm development, algorithm representation, stepwise refinement, problem solving tools. Introduction to specialized application areas.

### English Language

ع ١٢٠ لغة انجليزية

**Part I:** Definitions, Language development, Reading comprehensions on different science topics such as genetics, recent discoveries, new technologies, etc., knowing the different English language accents. **Part II:** Grammar: tenses, sentence structure, and how to write correct English. **Part III:** Writing: Using basic English grammar and sentence structure to write a report or a short essay of students' choices. **Part IV:** Vocabulary: identification of scientific terms, confusable words, and proper use of prepositions.

## ٢. الفصل الدراسي الثاني:

### Principles of Inorganic Chemistry

ك١٠٢ أسس الكيمياء غير العضوية

Chemical Calculations, Atomic Spectra (Electromagnetic waves, Bohr's theory, principles of wave mechanics), Atomic Structure, Electronic Configuration of Atoms, Periodic Table and the General Properties of Representative Elements (Size of Atoms and Ions, Ionization Energy, Electronic Affinity, Electro Negativity, Electro Positivity and Polarization), Oxidation States, Types of Chemical Bonds (Ionic, Covalent, Coordinate, Hydrogen and Metallic), Lewis Structure and Formal Charge. Theories of Bonding: Valance Shell Electron, Pair Repulsion (VSEPR), Valence Bond Theory (VBT), Molecular Orbital Theory (MOT) and Molecular Geometry.

### Principles of Organic Chemistry (1)

ك١٠٣ أسس الكيمياء العضوية (١)

Introduction to organic chemistry: Atomic orbitals - Chemical bonding - Molecular orbital theory - Hybridization - Alkanes: Introduction - Structural isomerism - Nomenclature Conformation - Physical properties - Preparation - Reactions of cycloalkanes - Conformation Alkenes and Alkynes: Introduction - Nomenclature - Physical properties Preparation - Reactions - Geometric isomerism Polymerization Aromatic compounds: The Benzene story - Aromaticity - Physical properties - Nomenclature of benzene derivatives - Electrophilic aromatic substitution - Halogenation - Sulfonation - Nitration Friedel Craft's alkylation and acylation - Reactions of alkyl benzenes - Effect and orientation of substituents groups - Polynuclear aromatic compounds - Nomenclature Preparation - Electrophilic substitution reactions. Organic halides: Introduction - Physical properties - Preparation of alkyl and aryl halides - Reactions of organic halides - Formation of Grignard's reagent- Electrophilic aromatic substitution Nucleophilic aliphatic substitution - Elimination reactions.

## Geometry and Integration

ر ١٠٣ هندسة وتكامل

**Geometry:** coordinate plane – rectangular coordinates and polar coordinates. Change of axes – straight line in plane and the common equation of two lines – circle – the conic section: parabola – ellipse – hyperbola. The general equation of the second degree in two variables. Integration: Integration and techniques of Integration: (Integration by substitution - Integration of trigonometric and hyperbolic functions - Integration by parts - Integration of rational functions by partial fractions) – Application of integration.

## Electrical & magnetic and light

ف ١٠٢ كهربية ومغناطيسية وضوء

**Part I:** Electricity and Magnetism Electrical Units – Electric charge – Coulomb's law of electric force – Electric field – Electric potential – Gauss Theory – Electric current – Ohm's law – Heat effect of electric current – Chemical effect of electric current – Magnetic poles – Coulomb's law of magnetic force – Magnetic effect of electric current – Magnetic force on moving charge – Magnetic force on a conductors carries electric current. **Part II:** Geometrical Optics: Nature of light – Refraction of light – Reflection of light – Dispersion of light through prisms – Total reflection of light– Reflection of light through a spherical surfaces – lenses – Newton's law of lenses – Eye – Optical Instruments.

## Physiologists and Microbiology

ن ١١٠ فسيولوجي وميكروبيولوجي

**Part I: Physiology:** Solutions: types of solutions, true solutions, suspension solutions, emulsion solutions. Colloids: properties of colloids. Permeability: factors affecting on permeability, cell membrane as example. Diffusion: factors affecting diffusion, rate of diffusion, diffusion of ions through gel. Osmosis: permanent and temporary osmosis, plasmolysis and deplasmolysis. Enzymes: classification of enzymes, mechanism of enzyme action, factors affecting enzyme activity. Photosynthesis and respiration. **Part II: Microbiology:** Introduction in Microbiology, Sterilization and disinfection, Kinds of micro organisms, Virus (shape, structure, reproduction), Bacteria (shape, anomatically,, structure, reproduction, factors affecting bacterial growth, type of media, methods, solarisation. Algae (nostoc, oscillatoria , chlamydomonas, volvox, diatoms, vaucheria, spirogyra, zygnetia).

## Human Rights

ع ٢١٠ حقوق الإنسان

حقوق الإنسان (المفهوم – النشأة – التطوير) – ماهية طبيعة وحقوق الإنسان – حقوق الإنسان في الإسلام – التعليم وحقوق الإنسان – حقوق الإنسان والتنمية – دور المجتمع المدني في الدفاع عن حقوق الإنسان – حقوق الطفل والمرأة - حقوق الإنسان في الدستور.

## Ethics and scientific research skills

## ٢١٠ ث أخلاقيات ومهارات البحث العلمي

يبدأ المقرر بمفهوم أخلاقيات البحث العلمي ويدرس الطالب معايير وضوابط السلوك الأخلاقي للباحث، والاعتبارات الأخلاقية للبحث العلمي، أخلاقيات البحث العلمي في العلوم البيولوجية، وأخلاقيات البحث العلمي والتكنولوجي من المنظور الإسلامي، وقواعد الأمان والسلامة في المختبرات.

### المستوي الثاني (برنامج الكيمياء)

#### ١. الفصل الدراسي الأول

## Principles of analytical chemistry

## ٢٠٤ ك أسس الكيمياء التحليلية

Analytical objectives, Qualitative and quantitative analysis, the analytical process and validation of a method, Data Handling, Accuracy and precision, rounding off, determination of errors, indeterminate errors, standard deviation, propagation of error, significant figures and propagation of error, the confidence limit, the Q test, the correlation coefficient, detection limits and static of sampling Stoichiometric Calculations, Review of fundamental concepts, concentrations of solutions and titer, Acid , Base titrations, Neutralization reactions of different acids with different bases and their titration curves, Solubility and Ksp, Relationship of Ion Product to Solubility, predicting, Precipitation titrations, their types and their curves, Complexometric Titrations, Formation constants of complexes, EDT A titrations, their curves and their indicators, Oxidation- Reduction reactions and titrations Oxidation, Reduction reactions, electrochemical cells, electrode potentials, the potential of electrochemical cell, redox titrations curves, indicators and applications.

## Chemistry of non-transition metals

## ٢٠٥ ك كيمياء العناصر غير الإنتقالية

General properties of the elements. ‘Metallurgy and isolation. Chemistry of hydrogen and chemistry of the Alkali metals. Chemistry of alkaline earth metals and chemistry of group (IV) elements. Chemistry of group (V) elements. Chemistry of group (VI) elements, Chemistry of halogens. Chemistry of insert gases. Applications

## Principles of Organic Chemistry (2)

ك ٢٠٦ أسس الكيمياء العضوية (٢)

Alcohols: Introduction - Nomenclature - Physical properties Preparation and Reactions. Phenols: Introduction - Nomenclature- Preparation - Physical properties and reactions - Ethers and Epoxides: Ethers: Introduction ~ Nomenclature - Physical properties - Preparation and reactions - Epoxides: Introduction - Preparation and reactions - Aldehydes and Ketones: Introduction - Nomenclature – Physical properties Preparations - Reactions - Nucleophilic addition reactions - Condensation reactions - Carboxylic acids and their derivatives: Introduction - Nomenclature - Physical properties ~Acidity constant - Preparations and reactions. Amines: Introduction - Nomenclature - Physical properties Preparations - Reactions - Diazonium salts - Coupling reactions - Application to use diazonium salts - Nitro and sulphonic acid compounds

## Organic reaction mechanisms (1)

ك ٢٠٧ ميكانيكا التفاعلات العضوية (١)

Stereochemistry - Ionic Reactions - Molecular Orbital theory - Hybridization - Electromeric effect -Inductive effect - Conjugation effect - Hyperconjugation - Mesomeric effect - The strength of organic acid and base substitution reaction mechanism.

## Chemical Thermodynamic

ك ٢٠٨ الديناميكا الحرارية

The first law of thermodynamics; Reversible, irreversible processes. Adiabatic processes. Isothermal. p.V work. Heat Capacities, Relationship. The Joule Thompson Expansion. Entropy: The second law of thermodynamics-Carnot cycle, Clausius inequality; quantitative measures. of  $\Delta S$ : entropy changes during the phase change, changes in entropy during isothermal expansions of an ideal gas, changes in entropy during the heating of an ideal gas; variation of  $\Delta S$  with temperature – the third law of thermodynamics - absolute entropies; entropy and chemical processes;  $\Delta S$  in chemical reactions, Free energy functions:- free energy functions; Helmholtz free energy; Gibbs free energy; properties of the Gibbs free energy, pressure dependence of the Gibbs free energy, temperature dependence of the Gibbs free energy .Gibbs free energy for chemical reactions, Gibbs free energy and the equilibrium constant. Gibbs energy, entropy and enthalpy of mixing, liquid mixtures. Response of equilibria to pressure, response of equilibria to temperature (Vant Hoff equation). Electrochemical work. Clapeyron and Clausius-Clapeyron equations.

Kinetic theory of gases, ideal gas model, kinetic theory of gases, equipartition theorem. Two parameter Equations of State, Virial Coefficients, van der Waals interactions and Molecular Potentials, Temperature as a measure of Kinetic Energy. The Maxwell-Boltzmann distribution for molecular speeds, The Mean Free Path and Collision frequencies, Diffusion, viscosity, thermal conductivity. Brownian movement and Avogadro's number-theory of non ideal behavior- principle of corresponding states. Partition Functions, Translational Partition Functions. Electronic Partition Functions Vibrational Partition Functions4 Rotational Partition Functions. Phase rule, Application of the thermodynamic concepts to the analysis of phase equilibrium, phase transformations, -Gibbs Phase Rule and phase diagrams in one - component system4 Binary phase diagrams. Binary phase diagrams and Gibbs free. energy curves Binary solutions with unlimited solubility. Relative proportion of phases (tie lines and the lever principle). Binary eutectic systems (limited solid solubility). Solid state reactions (eutectoid, peritectoid reactions). Binary systems with intermediate phases/compounds. Gibbs phase rule. Temperature dependence of solubility. Multi-component (ternary) phase diagrams. Important examples of poly condensations (polyesters, phenol, formaldehyde resins, amino plastic resins, polyamides, silicones and polyurethane) - Degree of polymerization and reactivity of functional groups - Kinetics of step growth polymerization - Molecular weight distribution in the linear polymerization - Chain Growth Polymerization: Free radical vinyl polymerization - Mechanism ~ Steady state kinetics of vinyl radical polymerization - Kinetic chain transfer reaction in the free radical addition polymerization - Kinetic chain length – Cationic Polymerization: Kinetics - Mechanism - Anionic Polymerization: Kinetics - Mechanism. Insertion Polymerization: Kinetics - Mechanism - Olefin Metathesis and Ring Opening Polymerization: Kinetics - Mechanism - Copolymerization: Kinetics of copolymerization – Structure - Stereoregularity and chirality - Technical Methods of Polymerization: Polymerization in homogeneous system (bulk and solution) - Polymerization in heterogeneous system (emulsion and suspension) - Classes of polymer product - Testing of the Physical Properties of Polymer: Determination of molecular weights - Molecular weight distribution in linear polymers - Molecular weight distribution in non- linear polymers and theory of gelation - Configuration of polymer chain - Polymer chain flexibility - Internal rotation molecules – Configuration and Conformation of molecules.

Introduction to materials Science, types of materials - Electronic structure of atoms and types of bonding between atoms - Crystallography and diffraction - Solid solutions and crystal imperfections - Phase diagrams - Optical and electron microscopy. Scanned probe microscopy. Solidification, grain structure and texture - Solid diffusion - Processing of metals - Stress and strain, mechanical testing - Plastic deformation in metals, recovery and recrystallization - Strengthening', of metals by cold work, solute atoms and grain boundaries - Creep and stress rupture - Common engineering alloys - Ceramics, their structure, processing and properties. Glasses - Corrosion, electrochemistry, types of corrosion Oxidation - Electrical properties, the energy band model of metals, semiconductors & insulators - Magnetic materials, permeability, susceptibility and six types of magnetism - Polymers and composite materials.

### Biophysics

ف٢١١ فيزياء حيوية

Electricity within bio systems-temperature and thermograph of the bio systems- X-ray application in bio systems- Nuclear radiation applications in the bio systems.

### Optics

ف٢١٧ ضوء فيزيائي

Interference of light – Thin films – Polarization of light – Diffraction of light.

## ٢. الفصل الدراسي الثاني

### Nuclear Chemistry - symmetry and connectivity

ك٢١١ الكيمياء النووية – التماثل والربط

Composition of Nucleus - Isotopes, Isotones, Isobars, Isodiapheres, Nuclear stability - Factors effecting Nuclear stability, mass defect, binding energy, Average binding energy, N/P ratio, Magic Numbers). Radio-active disintegration and its rate-Half-life and average



life. Natural and artificial radio-activity.

### Organic reaction mechanisms (2)

ك ٢١٢ ميكانيكية التفاعلات العضوية (٢)

Nucleophilic Substitution reactions - Elimination reactions Electrophilic aromatic substitution reactions - Nucleophilic aromatic substitution reactions - Nucleophilic addition to carbonyl compounds-Aldol reactions-. Addition of Enolate anions to aldehydes and ketones - Nucleophilic addition-Elimination at the acyl carbon of carboxylic acid and their derivatives - Reactions of Amines - Rearrangement reaction mechanism - Free radical reaction mechanism.

### Spectroscopy and Photochemistry

ك ٢١٣ كيمياء الأطياف (١) – كيمياء ضوئية

Molecular spectroscopy studies the interaction of light and matter and probes the matter and its environment It is the basis of molecular structure determination, many microscope techniques, and most remote sensing techniques, This graduate-level class will be techniques oriented and cover IR, visible, UV, and emission (fluorescence) spectroscopy. We' will also discuss most current laser spectroscopic techniques. We'll also discuss X-ray, photoelectron and other less "standard" spectroscopic methods.

### Chemistry biomolecules

ك ٢١٤ كيمياء الجزيئات الحيوية (الأحماض الأمينية والبروتينات)

Amino Acids and peptides: Chemical reactions and physical properties of amino acids - Physiologically active peptides - Separation techniques of amino acids and peptides - Determination of amino acid sequence of peptides - Synthesis of polypeptides - Proteins : Protein structure - Globular and fibrous proteins - Lipoproteins - Glycoprotein - Hemoglobin and bile pigments » Chlorophyll - Carotenoids and other plant and animal pigments. Lipids: Classification - Saturated and unsaturated fatty acids Triglycerides - Waxes - Phospholipids - Terpenoids Prostaglandins - Steroids - Bile acids and lipoproteins ~ Properties and reactions of lipids - Methods of lipid analysis - Lipids in membranes, micelles and emulsions - Amino acids and protein metabolism: Nitrogen fixation and metabolism of nitrogen – Sulphur metabolism. - Biosynthesis of amino acids - Catabolism of amino acids nitrogen (urea cycle) - Catabolism of Purine and pyrimidine bases – Lipid metabolism: Metabolism of saturated and unsaturated fatty acids Metabolism of acylglycerols and sphingolipids - Role` of hormones in fat mobilization - Methods of study of fat metabolism in plants and animals.

Approximate methods of quantum chemistry: variational principle; LCAO approximation; Huckel Theory; Time - independent perturbation theory. Many electron atoms: Orbital approximation, Slater determinant; Hartree-Fock self consistent field theory; Slater type orbitals Angular momentum of many-particle systems. Spin orbital interaction; LS and JJ coupling. Spectroscopic term- symbols for atoms. Molecules and Chemical bonding: Born Oppenheimer approximation, MO and VB theories illustrated with H<sub>2</sub>-molecule; Spectroscopic term symbols for diatomic; Directed valence & hybridization in simple polyatomic molecules. An elementary treatment of scattering theory.

Pure Substances and Mixtures: Partial Molar Quantities and Molar Quantities. Explicit Expressions for Various Extensive Variables. Gibbs Duhem Equation, Partial Molar Quantities Measurement of Partial Molar Volumes, Thermodynamics of Gases: Pure Ideal Gas. Mixtures of Ideal Gases. Pure Real Gases. Mixtures of Real Gases. Ideal Mixtures of Gases. Thermodynamics of Perfect and Ideal Solutions. Effect of Pressure and Temperature. on Liquid Vapor Equilibria. Depression of the Freezing. Elevation of the Boiling Temperature of a Solvent in the Presence of a Non Volatile Solute. Osmotic Pressure. Non Ideal Solutions. Variables and Excess Variables of Mixing. Effect of Temperature and Pressure on the Activity Coefficient. Applications of the Gibbs-Duhem Equation Isothermal Diagram. Isobaric Diagram. Standard State. Liquid - Liquid Extraction. Thermodynamic .Polar liquids: dielectric properties, water, structural properties of liquid water, non-aqueous polar liquids. Electrical conductance: The phenomena of electrolysis. Electrolysis Factors affecting the electrolysis The Faraday constant: the Avogadro constant: their relationship. Industrial uses of electrolysis. conductance- Application- Electromotive force and Electrode potential. Cell reaction and E.M.P. Electrode potential - Electrochemical series.

Functions of more than one variable – Continuity - Partial differentiation and its applications: implicit function, Taylor expansion, differentiation under the sign of integration, maximum and minimum values - Multiple integrals - Line integrals - Conditional maxima and minima (Lagrange multiplier). Differential equations: separable- homogeneous- equations tend to homogeneous and separable. Exact-

Integrating factor- Bernoulli's equations. Applications. Linear differential equations with order two and three.

## Biomathematics

٢٠٢ الرياضيات الحيوية

Single species population dynamics: Models in discrete and continuous time. Harvesting: maximum sustainable yield, yield effort curves. Population dynamics of interacting species: host parasitoid interactions. Predator prey models: Lotka Volterra model, phase plane analysis. Infectious diseases: SIS epidemic models- basic reproductive number, threshold theorem. SIR epidemic and endemic models: threshold criterion, size of the epidemic. Vector borne diseases and sexually transmitted diseases

المستوي الثالث (برنامج الكيمياء)

### ١. الفصل الدراسي الأول

## Gravimetric analysis - thermal gravimetric analysis

٣١٧ك التحليل الوزني - التحليل الوزني الحراري

General principles; preliminary treatment; precipitation step, filtration and washing of the precipitate; drying or ignition of the precipitate; thermal analysis; Volatilization or evolution methods.

## The Chemistry of Transition Metals

٣١٨ك كيمياء العناصر الانتقالية

General properties of transition metals (d-block elements)- Chemistry of scandium, titanium, vanadium, chromium, manganese, iron, cobalt, nickel, copper and zinc groups in terms of their electronic configuration, different oxidation states, physical and chemical properties of the elements and their compounds. Structure of some important compounds. Isolation of elements. Uses and applications.

## Heterocyclic Chemistry

٣١٩ك كيمياء غير متجانسة الحلقة

Aromatic Heterocycles: Definition of aromaticity – Heterocyclic Compounds: Nomenclature - Five Membered Ring Compounds: Furan - Thiophene - Pyrrole - Synthesis - Reactions - Six Membered Ring Compounds: Pyridine - Pyrans - Pyrones - Quinolines - Isoquinolines - Synthesis - Reactions - Other Heterocyclic Compounds: Indole - Pyrazole Imidazoles - Oxazoles - Thiazoles - Diazines - Coumarins - Chromones

- Flavones - Isoflavones - Purines and Petridines: Synthesis - Reactions - Alkaloids: Definition ~ Extraction and Properties Examples of the different types of alkaloids (phenylethylamine group, pyrrolidine group, piperidine and pyridine group, quinoline group, isoquinoline group, phenanthrene group, indole group) - Synthesis and structure elucidation Chemotherapy: Sulphonamides (preparation and properties) Antibiotics (pencillin, streptomycin, chloramphenicol, tetracycline antibiotics, polypeptide antibiotics) Antimalarials - Antihistaminics - Antipyretics - Analgesics - Antiseptics.

## Organic Synthesis (1)

ك ٣٢٠ كيمياء تخليقية (١) - كيمياء عضوية فلزية

Named reactions: Condensation reactions - Degradation reactions- Oxidation reactions - Rearrangement reactions - Reduction reactions - Beckmann rearrangement - Gatten-nann aldehyde synthesis - Gatterman- Koch aldehyde synthesis - Oppenaur oxidation - Pinacole-Pinacolone rearrangement - Claisen reaction - Dieckmann reaction - Diels-Alder reaction - Elhs reaction - Vilsmeier-Haak aldehyde synthesis – Wittig reaction - Japp-Klingermanri reaction - Knoevenagel reaction – Mannich reaction - Sandmeyer reaction - Stobb condensation - Hydroxy acids and keto acid, - Synthesis - Reactions and sleieochurnisly Ketoesters - Claisen condensation - Tautomerism and reaction of ethylacetoacetate - Dialdehydes and diketone - Unsaturated alcohols - Unsaturated aldehydes - Ketones and acids: Unsaturated aldehydestetones and acids: Synthesis and reactions.

## Electrochemistry

ك ٣٢١ كيمياء كهربية

Reversible processes; Reversible galvanic cells- EMF and its measurements- types of electrodes- relation between cell potential and free energy- types of cells (concentration cells electrochemical cells-cells with and without transfer)" applications of EMF measurements Irreversible processes; Types of over potential (ohms-concentration-activation) electrode kinetics- Tafel equation- exchange current- mechanism of hydrogen and oxygen reduction storage cells (reversible and irreversible)- fuel cells.

## Chemical kinetics

ك ٣٢٢ كيمياء حركية

Elementary reaction kinetics: Definition of Elementary reactions – The molecularity of a reaction - Molecularity vs. order -The rate laws Variations of concentrations with time. The determination of the reaction order from the integration method - Fractional life time method The isolation method - Comparison of these methods. The temperature dependence of reaction rates (The Arrhenius equation). Energy of activation, calculation

of activation energies. Potential energy surfaces. Consecutive elementary reactions - Mechanism of chemical reactions - The rate-determining step - The steady state approximation. Kinetic of reversible reactions. Chain Reactions: Introduction - The rate laws of chain reactions: Example of a chain reaction having a complicated rate law – The formation of HBr from hydrogen and bromine. Special case: Explosions parallel reactions. A theoretical approach to chemical kinetics: Collision theory -The reaction profile in the Collision Theory- Derivation of the rate law through the Collision theory – Activated complex theory -The reaction profile in the ACT Derivation of the rate law through the-ACT (the thermodynamic derivation) -The activated complex theory and reactions between ions. The Lindemann Hinshelwood Mechanism - First order gas phase kinetics Unimolecular Reactions. Influence of solvent and pressure on rates in solution – Primary salt effect in ionic reactions.

## Petroleum Petrochemicals

## Chemistry and

ك ٣٢٣ كيمياء البترول والبتروكيماويات

Petroleum and gas: Introduction - Chemistry of petroleum hydrocarbons - Refining - Petrochemicals - Evaluation of crude oil processes - Catalytic processes - Thermal processes - Solvent processes - Treating processes Miscellaneous processes - Classification of crude petroleum (according the chemical composition and the sulphur percentage) some physical aspects concerning petroleum fuels (diesel , index, cetane number and octane number of motor and aviation fuel) manufacturing processes and oil refinery- separation processes - distillation- absorption - adsorption solvent extraction- conversion processes-production of motor and jet fuels-cracking- reforming- risonierisatori - refining and treating processes-refining of light petroleum products - removal of H<sub>2</sub>S, of mercaptans, sweetening –and desulphurization processes, and hydrogen treatment refining of lubricating oils- acid treatment, clay tieannoin and dewaxing miscellaneous refining processes (water removal, and stability of gasoline) motor aviation, jet and diesel fuels composition - volatility, combustion, stability, corrosion petro-chemistry - Detergents: Introduction - Functions and properties of detergent components - Classification - Ionic detergents -Cationic and anionic detergents - Nonionic detergents Synthesis - Chemistry- Paints; Introduction – Paint fundamentals - Raw materials -Classification - Synthesis - Chemistry - Properties Selecting the paint system - Coatings for steel - Coatings for Wood - Roof coatings - Marine paints - Fertilizers: introduction - Functions and properties - Classification - Synthesis.

## Stereochemistry

ك ٣٢٤ كيمياء فراغية

This course covers the stereochemistry of organic compounds; chirality's; resolution and analysis of enantiomers and diastereomers, conformational isomerism and geometrical isomerism. Introduction to stereo selective synthesis and drug design will be given. In addition, stereo selectivity in nature and spectroscopic determination of relative and absolute chirality's will be discussed.

## ٢. الفصل الدراسي الثاني

### Chromatographic Techniques      طرق الفصل الكروماتوجرافي – التحليل الكهربائي      ك٣٢٥

Principles of chromatography; classification of chromatography; techniques of column chromatography; column efficiency - in chromatography; size exclusion chromatography, ion exchange chromatography; gas chromatography; gas chromatography-mass spectrometry; high performance liquid chromatography (HPLC); super critical fluid chromatography; thin-layer chromatography ; paper chromatography; electrophoresis capillary Zone.

### Inorganic Chemistry: coordination Chemistry      كيمياء المترابطات      ك٣٢٦

Werner theory of coordination chemistry": Classification of ligands. and complexes Nomenclature- Coordination number and Stereochemistry of complexes- preparation of complexes- isomerism among inorganic complexes- Detection of complexes in solid and solution- Nature of metal-ligand bonding in complexes- Valence bond, Crystal field and ligand field theories. Stability of complexes - Inorganic reaction mechanism.

### Chemistry of Natural Products      كيمياء منتجات طبيعية      ك٣٢٧

Terpenoids: Introduction - Occurrence - Isolation - General methods of determining structure - Classification - Monoterpenoids: Myrcene - Citral - Ionones - Geraniol - Terpineol - Carvone - Limonene – Menthol and Menthone -Pulegone - The thujane group - The pinane group – The camphene group - Wagner-Meerwein rearrangements. Sesquiterpenoids: Famesol -Nerolidol Diterpenoids: Phytol - Retinal, Triterpenoids: Squalene - Synthesis. Carotenoids: Occurrence - Carotenes. Vitamin A: Occurrence - Vitamin A1 - Vitamin A2 Synthesis. . Steroids: Introduction - Nomenclature of steroids, Diel's hydrocarbon Spectral properties of steroids - Stereochemistry of steroids -

Configuration of the nucleus - Configuration of substituent groups – Some reactions of steroids. Sterols: Cholesterol - Structure of the ring system -Position of the hydroxyl group and double bond - Nature and position of the side chain - Position of the two angular methyl groups Ergosterol: Occurance - Structure - Elucidation - Vitamin D (Ergocalciferol) - Structure - Synthesis - Vitamin D3 - Vitamin D4 - Phytosterols: Stigmasterol - Occurance - Structure elucidation - Reactions – Bile acids: Occurance - Structure - Cholanic acid -Allocholanic acid - Synthesis - Lithocholic acid - Cholic acid. III Steroid Hormones; Sex Hormones: Androgens (Androsterone, Testosterone) Oestrogens (Estrone, Oestriol, Oestradiol) - Gestogens (progesterone) - Adrenocortical Hormones: Aldosterone - Cortisol - Conisone – Isolation - Structure elucidation - Synthesis and functions.

### Organic reactions and orbital symmetry

ك ٣٢٨ التفاعلات العضوية وتمائل المدارات

Organic reactions and orbital symmetry A concerted and stepwise reactions - theory of concerted reactions - molecular orbital theory - pericyclic reactions - general rules for pericyclic reactions -the Woodward Hoffmann selection rules - frontier orbital approach (HOMO - LUMO ) concept, the energy correlation diagram approach, the aromatic transition slate concept - aromaticity and aromatic character ~ valence bond theory of aromaticity - molecular orbital theory of aromaticity - non-benzenoid current research progresses on topics in materials chemistry, nanoscience, nanotechnology, and nanobiotechnolgy. Synthetic and characterizations methods used to various types of Inorganic based nanomaterials and their potential applications in areas such as catalysis, photovoltaics and medicine will be discussed.

### Surface chemistry-colloid chemistry

ك ٣٢٩ كيمياء السطوح والغرويات

The terminology of surface chemistry is introduced, Liquid-gas interface and liquid-liquid interface, Measurement techniques for surface and interfacial tension are discussed, The importance of interfacial, free surface science is explained through relevant examples, Wetting, detergency, micelle formation, emulsions, microemulsions, foam stability, ore flotation, and adsorption at the gas-solid and liquid-solid interfaces, The terminology of colloid chemistry is introduced, The importance of polydispersity in colloidal systems is explained, Osmotic pressure, light scattering (Tyndall effect) and sedimentation methods for measuring particle size and particle weight are reviewed, Among the topics treated are the formation and stability of colloidal systems.

## Nanochemistry

ك ٣٣٠ كيمياء النانو

The course introduces basic synthesis and fabrication methods to make the nano-scaled structures and assemblies of various sizes, shapes, compositions and functionalities. The outline of the course includes: (1) an introduction to chemistry of nanomaterials, (2) the “bottom-up” and “top-down” methods for the synthesis/fabrications of nanostructures and/or nanomaterials and (3) the basics in bionanotechnology.

## Physical Photochemistry

ك ٣٣١ الكيمياء الضوئية الفيزيائية

Basic principles of photochemistry: photo physical processes and Photo dissociation. Absorption and emission of radiation. Nature of color. Charge transfer photochemistry. Molecular emission. Energy transfer processes. Kinetics of photo physical processes. Reactions of excited species: photochemical reactions Techniques in photochemistry. Kinetics. Production of excited states. Deactivation of excited states, Radiative processes, Fluorescence, Phosphorescence, Kinetics, Quantum Yields and Lifetimes, Quenching processes: the Stern- Volmer equation. Lasers. Optical materialst Vision. Photo imaging. Photochromism and chemiluminescence. Solar energy storage. Photo polymerization. Supramolecular

## Biostatistics

ك ٣١٦ إحصاء حيوي

Organizing and displaying data. Basic summary of statistics: measures of Central tendency and measures of dispersion. Basic probability concepts. Probability distributions: Binomial - Poisson - Normal and t. Sampling distributions and estimation of parameters for one and two Populations: Mean and Proportion. Testing of hypotheses about parameters of one and two populations: Mean and proportion.

المستوي الرابع (برنامج الكيمياء)

١. الفصل الدراسي الأول



## Research Project

ك ٤٠٠ مشروع بحث ومقال (مشروع تخرج)

Handling of a research problem which includes realization of appropriate techniques, presentation of data and discussion of the results in view of relevant literature. Presentation of all aspects in a dissertation format.

## Organometallic Chemistry

ك ٤٣٢ كيمياء المركبات الفلزية العضوية

Introduction to Organometallic: Metal Carbonyls - The Sixteen and Eighteen electron Rule – Carbon  $\sigma$  - donors - Metal Alkyls and Aryls - Carbon  $\pi$  donors of Metallocenes. Preparation of Organometallic Carbon  $\sigma$  - donors and Carbon  $\pi$  donors Compounds - Catalysis: Involving Organometallic Compounds - polymerization of olefins - Hydrogenation of olefins hydroformylation of olefins -Wacker's process and the oxidation of olefins - Polymerization of olefins - Fischer-Tropsch process and the gasification of coal - Catalysis of metal clusters. Oxidation Reduction Reactions of Organometallic Compounds: Theoretical considerations - Outer sphere electron transfer - inner sphere electron transfer - Nature of bridging ligand – Multi-electron transfer: Ligand 'substitution Reactions of Metal Complexes and Organometallic Compounds: Square planar complexes - Trans effect of Octahedral complexes - Organometallic substitution reactions, carbonyl substitution reactions, Substitution reactions on alkyl compounds.

## Spectroscopy Organic Chemistry

ك ٤٣٣ كيمياء الأطياف العضوية (٢)

The theoretical basis of infrared Spectroscopy - Applications of infrared spectroscopy to organic chemistry - An introduction to  $^1\text{H}$  and  $^{13}\text{C}$  nuclear magnetic resonance spectroscopy – Applications of nuclear' magnetic resonance spectroscopy in organic chemistry - The theoretical basis of ultraviolet spectroscopy - Applications of ultraviolet spectroscopy to organic chemistry - An introduction to mass spectrometry - The mass spectrum, determination of the molecular formula - Application of Mass spectrum in organic chemistry – The theoretical basis of fluorescence and phosphorescence – spectroscopy technique - Application of fluorescence and phosphorescence techniques.

## Chemistry of dyes

ك ٤٣٤ كيمياء الأصباغ

Dyes: color, photoelectric theory, complement-dry light, classification of dyes nitroso, nitro dyes azo-dyes ( mono-azo and di-azo dyes) triarylmethane dyes and related dyes-

triphenyl methane dyes, xanthene dyes, vat dyes, indigo dyes, anthraquinone dyes, introduction to reactive dyes, photographic sensitizers. Fibers: textile fibers- fiber structure – fiber properties fiber identification classification of fibers cellulose fibers- cotton flax, hemp jute-man - made cellulosic fibers- rayon acetate and triacetate protein fibers- wool and silk mineral fibers- introduction to rayon made fibers" the processing of textiles- purification and preliminary singeing" desizing-scouring bleaching and mercerizing dyeing, the kinds of forces by which dye molecules are bound to the fiber - Historical development of dyes - Dye equipment - Metric system – Dye safety -Record keeping - Fiber Reactive Dyes ~ Color Theory and Dyeing: Plangi (Tie-Dye): Cultural context - Design potentials – Fabric preparation - Bound resist - Fold dyeing - Tritik (stitch resist) – Clamp resists ~ Combined plangi techniques - Batik and Starch Resists: History of batik and starch resists 1 Design potentials - Fabric preparation - Design techniques ~ Screen Printing on Fabric: Historical overview - Equipment-frames, screens, squeegees, printing table- Design systems and printing techniques - Stencils-paper and photographic emulsions - Fabric preparation - Thickened dye - Printing procedures ~ Multicolor printing and registration - Marbling on Fabric: History and cultural context - Materials size, colors, dispersing agent, alum - Surfaces to marble wood, clay, paper, fabric - Equipment - Work space – Marbling affecting dye process-acid, salt, heat, agitation, time-Stock solutions - Fiber or fabric preparation - Other dye techniques - Combining dye techniques to develop individual creativity.

## Chemotherapy - Environmental chemistry

ك ٤٣٥ – كيمياء طبية – كيمياء البيئة

Chemotherapy: Disinfectants drugs - approaches to the problem of finding a drug to compact a particular disease - antibacterial agents - sulphonamides - sulphanilamide - sulphapyridine - sulphathiazole - Sulphadiazine - sulphamathzine -sulphaguanidine - prontosil - prontosils - antimalarials - plasmoquin, mepacrin proguanil - arsenical drugs ~ antibiotics ~ thepenicillins -synthetic penicillins (cephalosporinic, streptomycin, tetracycline, chloramphenicol) - five-membered heterocycles derivatives of pyrrolidine, nitrofurans, oxazolidinediones and isoxazole, pyrazolones and pyrazolodiones. I Environmental chemistry : Some concepts and principles of Chemistry involved in environmental processes, Chemistry related to atmosphere, hydrosphere and lithosphere, Pollutants, Atmospheric pollution (Air pollutants, Chemistry involved in Green house effect, Ozone depletion, Acid rain and Photochemical smog), Air quality standards, Aquatic pollution (Aquatic pollutants, eutrophication, Chemical speciation), Techniques

of monitoring air pollutants and aquatic pollutants, Methods for minimizing pollution, Treatment methods for sewage and industrial effluents, Treatment of water for domestic use.

## Catalysis

ك ٤٣٦ الحفز

Catalysis: This course focuses on homogeneous catalysis – Enzyme Catalysis - Acid base catalysis - heterogeneous catalysis- kinetics and mechanisms- absolute rates of surface reaction- surface heterogeneity.

## Laser Applications in Chemistry

ك ٤٣٧ تطبيقات الليزر في الكيمياء

Fundamental Principles. Types of Lasers, Continuous Lasers, Gas Lasers, Ion Lasers, Chemical Lasers, Pulsed Lasers, Solid State Lasers, Nitrogen and Excimer Lasers, Dye Lasers, Nonlinear Optics Laser Power Measurements. Techniques: Time-correlated single photon counting, Up conversion technique, Laser Flash Photolysis

## Spectroscopy analysis and raw materials analysis

ك ٤٣٨ التحليل الطيفي وتحليل الخامات

Overview of spectroscopic theory and technique such as ultraviolet and visible spectroscopy - atomic absorption and emission. X-ray fluorescence spectroscopy - infrared spectroscopy - application.

## Preconcentration for trace elements determination

ك ٤٣٩ طرق التركيز المسبق لتقدير العناصر

There is a need for Pre-concentration of trace elements or ions in aqueous solutions. This course is intended to focus on the following techniques: Evaporation of Solvents; Electrodeposition; Liquid - Liquid Extraction; Surface Adsorption; Precipitation; Ion Exchange; Ion-Exchange Materials; Immobilized Reagents (e.g. foam, silica gel,...); Flotation and Other Methods.

## Environmental Analytical Chemistry

ك ٤٤٠ كيمياء تحليلية بيئية

This course is designed to the present environmental problems and the role of chemical analysis in environmental monitoring. It deals with the various analytical methods

employed in the detection and analysis of chemical pollutants (toxic metals, pesticides, phenolic). Industrial wastes in the atmosphere, hydrosphere, lithosphere, and biosphere, the qualitative and quantitative aspects of common and individual pollutants analysis will be emphasized. Radioactive pollutants (air borne dust and gases) will be covered.

### Group theory and its applications

ك ٤٤١ نظرية المجموعات وتطبيقاتها

Symmetry and point groups: rotation, reflection, improper rotation, inversion, multiplications of symmetry operations Character table, its use, representation of molecular orbital. Transformation matrices and species-character tables- deduction of the symmetry properties of orbital and vibrations of molecules- effect of symmetric field on an atom or ion. Chemical applications: molecular shapes, selection rules in spectroscopy, crystal field theory, molecular orbital theory spin-orbit coupling, and stretching frequencies in IR and Raman spectroscopy. Woodward Hoffmann rules and symmetry.

### Mechanism of inorganic Reaction - Advanced inorganic coordination chemistry

ك ٤٤٢ آلية التفاعلات غير العضوية ومترابكات متقدمة

Mechanism of Inorganic Reaction: Introduction- Mechanism and structure- Electron transfer reactions- Oxidative addition- Reductive elimination- Tetrahedral substitution - Substitution in square planar complexes- Trans effect in square planar complexes- Substitution in octahedral complexes. Advanced inorganic coordination chemistry and complexes of acceptor ligands: Acid ligands- Carbon monoxide complexes- Mono and polynuclear metal carbonyls~ Vibration spectra - Carboxylate anions and carbonyl hydrides- Carbonyl halides- Nitric oxide complexes Donor complexes of groups V and VI Cyanide: complexes.

### Advanced Chemical Kinetics

ك ٤٤٣ كيمياء حركية متقدمة

Rate of Chemical reactions, rate law, rate constant, reaction order Experimental determination of the rate law\_ Kinetic measurements Integrated rate laws, half-lives Reaction schemes: Opposing reactions, parallel reactions, temperature dependence reaction rates, Consecutive reactions, rate -determining step, steady-state approximation, Kinetic isotope effect.

History and Development of Carbohydrate Chemistry - Structures of Carbohydrates - Emil Fisher's determination of carbohydrate structures - Formation of sugar rings, Haworth structures; conformation of carbohydrates - Reactions of carbohydrates at C-1 mutarotation and other reactions - Reactions of carbohydrates at C-1, oxidation and reduction, additions - Effects of acids and alkali on carbohydrates. Reactions of carbohydrates at C-1, formation of acetals; structures of disaccharides - Reactions of other carbons: formation of esters & ethers – Specific reactions of primary alcohols and modification of primary alcohols - Formation of - anhydrides, isopropylidene, V and benzilidene – Synthesis of glycoside linkages, modifications at C-2 - Chemical modifications at C-3, C-4, and C-5 - Chemical tests and quantitative methods for analyzing carbohydrates, Polysaccharide structures - Structure of starch and starch granules - Structure of cellulose, chitin, murein, xanthenes, and algin - Structures of other  $\alpha$ -linked polysaccharides: pullulan, dextrans, alteman - Glycogen and glycosaminoglycans - Structure and function of glycoprotein.

Chemistry and Biochemistry of Nucleic acids: general introduction on nucleic acids as the fourth major compounds (carbohydrates, proteins, lipids) - Structural units of nucleic acids (mononucleotides) ~ Chemical composition of mononucleotides - Carbohydrate metabolism: Glycolysis - Glycogen formation and degradation - Hexose-monophosphate shunt - Glucogenesis and minor pathways of glucose metabolism - Citric acid cycle - Role of hormones and methods of study { of carbohydrate metabolism in animals, plants and microorganisms

Organic synthesis, Formation of carbon - Carbon bonds: (a) Base - catalyzed condensation: Condensation of carbanions with aldehydes, ketones and esters - The alkylation of carbanions - Addition of carbanions to activated olefins. (b) Acid - Catalyzed condensations: The self condensation of olefins - Friedel Craft's reactions - Perkin reaction - condensation of aldehydes and ketones - Mannish reaction. (c) Enolates Control of extent of alkylation - Michael reactions - Robinson annelation. Carbanions stabilized by second-row elements: Use of sulphur- and phosphorus stabilized Nucleophilic species in C-C bond formation, especially olefinations (Wittig and Julia olefinations reactions) - concept and use of umpolung-type reagents. Organometallic chemistry. Organometallic compounds contain a carbon-metal bond – Organolithium reagents - Grignard reagents - Using organometallic to make organic molecules – Organosilicon compounds – Organotin compounds – Retro-synthetic analysis: creative

chemistry – retro-synthetic analysis: synthesis backwards -disconnections must correspond to known, reliable reactions - synthons are idealized reagents - choosing a disconnection - multiple step syntheses: avoid chemo selectivity - problems – functional group interconversion.

## **Molecular Spectroscopy**

ك ٤٤٦ الطيف الجزيئي

Nature of Light and general principles" Rotation spectra- vibration spectra- electronic spectra, solvent effects on electronic spectra, chemical constitution and color. Basic theory of spectral techniques-infrared, ultraviolet visible spectroscopy, NMR, mass spectrometry EPR Mossbauer spectroscopy and Raman spectra pertaining to electronic and molecular transitions, applications in determining the structure and bonding of molecular compounds with emphasis on spectral interpretation skills needed for the elucidation of structure.

## **Chemistry of Polymers**

ك ٤٤٧ كيمياء البلمرات

Classification of Polymers: Classification based on the source, chemical nature, homogeneity, structural shapes of molecules and reaction mechanism - Step Growth Polymerization: Technically.

## **Chemistry of Pesticides**

ك ٤٤٨ كيمياء المبيدات

Introduction - botanical insecticides - synthetic - fungicides - herbicides - fumigants - rodenticides - pesticides in the environment - nematicides - future developments4 Toxic chemical in air, water, pesticides in Watch, Biochemical aspects of pesticides and carcinogens in air.