

Course Description for the Chemistry Department Four-Year Plan

Course Number	Course Name	Course description
0306101	General Chemistry (1)	3 Credit Hours This course includes: Chemical foundations, atoms, molecules, and ions. The concept of moles and chemical calculations, the types of chemical reactions in the solution and the calculations based on them, Gases and gas laws, atomic structure and periodic trends. Chemical bonds: general principles And covalent Bonds: orbitals
0306102	General Chemistry (2)	3 Credit Hours This course includes solid and liquid states, Solutions, Thermodynamics, Equilibrium, Acid and base equilibria, Solubility equilibria, Chemical kinetics and reaction mechanisms, Electrochemistry.
0306103	General Chemistry Laboratory (1)	1 Credit Hour (3 practical hours) This course starts with an introduction to general safety in the lab and basic laboratory equipment (Bunsen burner, balances, glassware) and includes the following experiments: Preparation of potassium alum, limiting reactant, formulas of hydrated compounds, empirical formula, molecular weight of a volatile liquid, displacement reactions, the periodic table, standardization of a sodium hydroxide solution, titration of bleach.
0306104	General Chemistry Laboratory (2)	1 Credit Hour (3 practical hours) This course includes the following experiments: Colligative properties and determination of the molecular weight, thermochemistry, rate law of a chemical reaction, determination of the equilibrium constant, solubility product constant, common ion effect, acids and bases, qualitative analysis of selected anions and cations; their identification and separation.

0306111	Chemistry and the human	<p>3 Credit Hours</p> <p>This course includes the topics: Water and its physical and chemical properties, its role in the atmosphere and the organic and inorganic pollutants that affect water, water purification, important biomolecules and the role of chemistry in the human body, the role of chemistry in increasing food production to comply with the growth of human population with the focus being on fertilizers and pesticides. The course also talks about pharmaceuticals and their role in controlling both infectious and non-infectious diseases. The course includes some description of chemicals used to facilitate life for humans and finding chemical replacements for natural materials such as plastics and rubber. Finally, the course covers the techniques used to limit the negative effect of chemicals on the environments.</p>
0306201	Chemistry in our Life	<p>3 Credit Hours</p> <p>This course is given to students of the chemistry department to introduce the important role of chemistry in some key areas in our daily life, such as:</p> <ul style="list-style-type: none"> <li>• Industry (metals, alloys, glass, cement, ceramics, fibers, plastics, paints, detergents)</li> <li>• Food (water, carbohydrates, fats, proteins, vitamins, essential elements, food additives, and cooking).</li> <li>• Agriculture (fertilizers and pesticides).</li> <li>• Medicine (antagonists, antibiotics, antiseptics, analgesics, stimulants, inhibitors, controlled drugs, creams, ointments, and pastes).</li> <li>• War (explosives, chemical weapons, nuclear energy, and white phosphorous).</li> <li>• Energy (energy, petroleum, and renewable energy).</li> </ul>
0306206	Mathematics for Chemistry Students	<p>3 Credit Hours</p> <p>The course aims at introducing the student to mathematical functions, factorization and manipulation of simple mathematical equations, Binomial expansion and Pascal's Triangle, the use of Logarithms and Exponential functions in: Thermodynamic equations, Kinetic equations and Electrochemical equations, the use of Trigonometric functions in Chemistry, basic statistics and determination of errors in experimental results, Differentiation and partial Differentiation, Simple Integration methods, the use of Differential equations in Chemical Thermodynamics (like Heat Capacity and Gibbs relations), Statistics in Theoretical Chemistry and Boltzmann distribution, the use of complex numbers in Chemistry, Vectors, Matrices, determinants.</p>

0306211	Analytical Chemistry (1)	<p>3 Credit Hours</p> <p>This course includes statistical treatment of experimental results, errors: their sources and treatment, gravimetric methods, volumetric methods, aqueous solutions and equilibrium calculations, acid-base titrations, oxidation-reduction titrations, precipitation titrations, and complexometric titrations.</p>
0306212	Analytical Chemistry Laboratory	<p>1 Credit Hour (3 practical hours)</p> <p>This course includes the following experiments: gravimetric methods, determination of nickel by DMG, determination of sulfate, acid-base titrations, polyprotic acids, titrating mixtures of acids or bases, precipitation titrations, Mohr's method for determining chloride ion concentration, Volhard's method, determination of hardness of water by titration with EDTA, and redox titrations iodine.</p>
0306221	Inorganic Chemistry (1)	<p>3 Credit Hours</p> <p>This course includes the following topics: Electronic structure of the atom, Periodic Trends in periodic table, Atomic Term Symbols, ionic compounds, Theories of covalent bonding -Lewis's structure: valence bond theory, molecular orbital theory, crystal field theory, Bonding in polyatomic molecules, Electronegativity calculations, Structures, and energetics of metallic and ionic solids - lattice energy calculations.</p>
0306231	Organic Chemistry (1)	<p>3 Credit Hours</p> <p>This course includes an introduction to the electronic structure and bonding. Acids and bases. Functional groups. Alkanes and cycloalkanes: nomenclature, reactions, and stereochemistry. An introduction to common organic reactions: substitution, addition and elimination reactions. Alkenes: nomenclature, preparation and their main reactions. Alkynes: nomenclature, preparation and their main reactions. Stereochemistry. Organohalides. Reaction of alkyl halides, nucleophilic substitution and elimination reactions.</p>
0306232	Organic Chemistry (2)	<p>3 Credit Hours</p> <p>This course includes learning about the following functional groups and their reactions:</p> <p>Dienes, Benzene and aromaticity, chemistry of benzene, Alcohols and phenols, thiols and sulfides, ethers and epoxides, Aldehydes and ketones. Carboxylic acids, derivatives of carboxylic acids.</p>

0306233	Organic Chemistry Laboratory (1)	<p>2 Credit Hours (1 lecture + 3 practical hours)</p> <p>This course includes basic techniques used in identification, purification and separation of organic compounds: Melting point determination, boiling point determination, distillation, crystallization, extraction, steam distillation, chromatography, basic organic reactions as elimination, addition, substitution and oxidation-reduction and their use in preparation of simple organic compounds, and testing of some classes of organic compounds.</p>
0306234	Organic Chemistry Laboratory (2)	<p>2 Credit Hours (1 lecture + 3 practical hours)</p> <p>This course includes the following experiments: Functional-group identification in compounds, identification of the compounds using spectroscopic methods, aromatic substitution, reactions of alcohols and phenols, synthesis of ethers, Grignard reaction, Reactions of carboxylic acids and their derivatives, reactions of amines, condensation reactions.</p>
0306235	Organic Chemistry for Non-Chemistry Students	<p>3 Credit Hours</p> <p>This course includes the main topics of organic chemistry, in addition to the main functional groups of organic compounds: It covers bonding in organic chemistry, isomers and stereochemistry, hydrocarbons, and aromatic compounds, alkyl halides, alcohols, phenols, ethers, aldehydes, ketones, carboxylic acids &amp; derivatives, amines, an introduction to biomolecules, carbohydrates, lipids, amino acids, peptides and nucleic acids.</p>
0306236	Laboratory of Organic Chemistry for Non-Chemistry Students	<p>1 Credit Hours</p> <p>This course includes the basic techniques used in the identification, purification and separation of organic compounds: Melting point determination, boiling point determination, distillation, crystallization, extraction, steam distillation, and chromatography, in addition to identifying some basic organic reactions such as substitution, dehydration, oxidation and reduction reactions. , and its use in preparing simple organic compounds, and testing some classes of organic compounds.</p>

0306241	Physical Chemistry (1)	<p>3 Credit Hours</p> <p>This course includes the following topics:  ideal and real gases, kinetic theory of gases, thermodynamic laws and their application to substances and mixtures, thermodynamic functions and their dependence on pressure, volume, and temperature, thermochemistry, spontaneity of chemical reactions and physical processes, chemical equilibrium, phase equilibria and phase diagrams of pure substances and phase rule, thermodynamics of mixing including partial molar quantities, Raoult's and Henry's laws and colligative properties, phase diagrams of simple mixtures and lever rule.</p>
0306311	Instrumental Methods of Analysis (1)	<p>3 Credit Hours</p> <p>This course includes studying the principles of the different methods used, instrumentation, and applications of each method. Topics covered include principles of spectroscopic methods, atomic absorption and atomic emission spectroscopy, UV-visible absorption spectroscopy, IR spectroscopy, emission spectroscopy, fluorescence spectroscopy, Mass spectrometry, and liquid chromatography and gas chromatography.</p>
0306313	Laboratory of Instrumental Analysis	<p>2 Credit Hours (1 lecture + 3 practical hours)</p> <p>This course includes experiments that cover atomic absorption and atomic emission spectroscopy, molecular absorption spectroscopy, UV-visible spectroscopy, IR spectroscopy, fluorescence and chemiluminescence, separations using gas chromatography, ion-exchange chromatography, high performance liquid chromatography, and electrochemical methods such as ion-selective electrodes.</p>
0306321	Inorganic Chemistry (2)	<p>3 Credit Hours</p> <p>This course includes acids and bases, hard-soft acids and bases. Molecular Symmetry, point groups, character tables, molecular orbitals. Acids, bases, hard and soft interactions. d-block metal chemistry, metals, ligands, Structures of coordination compounds, chelate effect, isomers. Bonding theories in coordination compounds: valence bond theory, crystal field theory, molecular orbital theory- ligand field theory. Term symbol, UV-visible spectra of coordination compounds - Tanabe-sugano diagrams and Orgel diagram, Reaction types in coordination chemistry and reaction mechanisms.</p>

0306322	Inorganic Chemistry Laboratory	<p>3Credit Hours (1 lecture + 6 practical hours)</p> <p>This course includes an extended review of coordination chemistry and studying metal complexes using IR and UV-Vis spectroscopy, electrical conductance, polarimetry, and magnetic susceptibility.</p> <p>Moreover, it includes the following experiments:</p> <p>Synthesis and characterization of <math>\text{Cr}(\text{acac})_3</math> as well as the nitration and bromination reactions of <math>\text{Cr}(\text{acac})_3</math>. Synthesis and characterization of Chromium(II) acetate hydrate, Chromium oxalate hydrate (cis- and trans- isomers), Ferrocene, Copper phthalocyanine, Nickle pyridine, and Schiff base complexes of copper, nickel, and manganese.</p> <p>The course also includes the synthesis of <math>[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2</math> as well as the kinetics of its hydrolysis and measuring its electrical conductivity, the synthesis of <math>\text{Co}(\text{en})_3^{+3}</math> and the optical resolution of the enantiomers, analysis of ammonia solutions, and finally measuring the magnetic susceptibility of metal complexes.</p>
0306331	Organic Chemistry (3)	<p>3 Credit Hours</p> <p>This course includes the study of <math>\beta</math>-dicarbonyl reactions and preparations, aliphatic and aromatic amines, the study of organic compounds of biological importance: carbohydrates, amino acids, peptides, proteins, lipids, heterocyclic compounds and nucleic acids, molecular orbitals and their controlled reactions.</p>
0306341	Physical Chemistry (2)	<p>3 Credit Hours</p> <p>This course includes the following topics:</p> <p>Chemical kinetics: general laws, reaction mechanisms, Arrhenius equation, Transition-state theory, activation energy, collision theory, heterogeneous reactions, catalyzed reactions, rate laws of complex reactions and the use of Quasi-Steady State Approximation (QSSA), rate laws of reaction mechanisms.</p> <p>Electrochemistry: Debye-Hückel limiting law, equilibrium in electrochemical cells, cell potential, Nernst equation and its applications.</p> <p>Surface chemistry: Adsorption including Langmuir and BET isotherms; Surface tension including laplace equation and its application in capillary action, condensation, colloids, and surfactants.</p> <p>Transport properties including viscosity, diffusion and Fick's laws, electrical conductance, ion transport, transport numbers, applications of electrical conductance.</p>

0306342	Physical Chemistry Laboratory	<p>3 Credit Hours (1 lecture + 6 practical hours)</p> <p>This course includes the following experiments:  Heat of combustion using bomb calorimetry , Acid dissociation constant of methyl red, Temperature Dependence of EMF of Ni/Cu galvanic cell, Phase-diagram of Phenol-water partially miscible system, Kinetics of Saponification of Ethyl acetate using conductivity method, Chemical Kinetics: Hydrolysis of Sucrose , Kinetics of <math>\text{S}_2\text{O}_8^{2-}</math> - <math>\text{I}^-</math> Reaction by the Titration Clock Reaction Method, Conductivity of Weak Electrolytes; determination of the acid dissociation constant of acetic acid solution, Conductivity of Strong Electrolytes: verification of the Debye-Huckel-Onsager equation , Surface Chemistry: Adsorption of acetic acid on charcoal, Surface tension of solutions, Determination of Critical Micelle Concentration of sodium lauryl sulphate.</p>
0306352	Polymer chemistry 1	<p>2 Credit Hours</p> <p>This course includes: a historical introduction, general concepts, types and classifications of polymers, introduction to the nomenclature of polymers, reactions leading to polymerization: polymerization by condensation and polymerization by free radicals, Ionic polymerization, and ring-opening polymerization. Polymerization methods: polymerization in mass, polymerization in solution (emulsion polymerization and suspension polymerization), polymerization reactions.</p>
0306391	Computer Applications in Chemistry	<p>3 Credit Hours</p> <p>This course includes:  Using Excel to analyze the results of laboratory experiments and draw curves, as well as building logical sentences to make simple mathematical programs using Excel program functions, drawing 2D, 3D compounds using available drawing programs such as Chems sketch and Chemdraw, ready-made programs used in chemical calculations, virtual laboratories. Chemical databases and how to use them, effective search on the web.</p>
0306411	Analytical Chemistry (2)	<p>3 Credit Hours</p> <p>This course includes basic concepts in chemical separation, electrical and thermal methods of analysis: preparation of samples for analysis and extraction methods, basic principles of chromatography and electroanalytical methods such as potentiometry, Coulometry and voltammetry. It also includes some thermal analysis methods such as thermogravimetric analysis.</p>

0306412	Instrumental Methods of Analysis (2)	<p>3 Credit Hours</p> <p>This course includes: Plasma emission spectroscopy, fluorescence, phosphorescence and chemiluminescence, spectroscopic methods for measuring turbidity and opacity, applications of absorption spectroscopy, gas chromatography and high-performance liquid chromatography, neutron activation and X-rays.</p>
0306413	Environmental Chemistry	<p>3 Credit Hours</p> <p>This course includes the basics of environmental chemistry and covers the topics: The natural cycles of some essential elements, nature of pollutants and their conversions. Pollutants' effects on mankind, water, soil, and air and methods of control water pollution and treatment. Organic and inorganic air pollutants, chemical smoke (smog), acid rain, greenhouse gases and elevation of earth's temperature (Global warming), Ozone layer depletion, soil chemistry and soil pollutants, harmful liquid and solid wastes: nature, sources, reactions, and treatment, chemical toxicology and the effect of pollutants on living organisms.</p>
0306414	Electrochemistry	<p>3 Credit Hours</p> <p>This course is intended to teach general electrochemical concepts and the application of electrochemical methods. Topics to be discussed include: Electrode processes, thermodynamics and potential, electron, mass transfer, conductivity, liquid and solid electrolytes, solid and liquid ionic conductors, the electrochemical double layer, and overpotentials.</p> <p>Electrochemical measurement methods and instruments to be covered: Potentiostatic and galvanostatic experiments, coulometry, voltammetry, chronoamperometry, chronopotentiometry, electrochemical syntheses of solid materials, and solid state electrochemistry; principles of electrochemical devices including batteries, supercapacitors, fuel cells, and electrochemical sensors.</p>



0306421	Inorganic Chemistry (3)	<p>3 Credit Hours</p> <p>This course focuses on organometallic chemistry. It includes the following topics:</p> <p>The 18-electron rule. Organometallic Compounds of s- and p- block elements. Organometallic Compounds of d- block elements: Carbonyl complexes. Nitrogen compounds and nitrosyl compounds. Unsaturated hydrocarbon complexes (cyclic and acyclic). Carbene and carbyne complexes. Bonding between metal – ligand. Synthesis of organometallic complexes for d-block elements. Metallocene complexes such as ferrocene. Fischer and Schrock carbene and carbene complexes. Introduction about spectroscopy of Organometallic Complexes. Reactions of organometallic compounds. Catalysis, which includes: Wilkinson catalyst, Oxo process, Monsanto and Tennessee–Eastman processes as well as Ziegler Natta catalysts and zeolites.</p>
0306423	Descriptive chemistry of the Elements	<p>3 Credit Hours</p> <p>d-block metals, f-block metals, s-and-p- block metals, semimetals, carbon, silicon, boron, phosphorous, clusters.</p>
0306431	Spectroscopy of Organic Compounds	<p>3 Credit Hours</p> <p>This course includes infrared spectroscopy, ultraviolet spectroscopy, nuclear magnetic resonance spectroscopy, mass spectrometry, and spectrometric identification of organic compounds.</p>
0306432	Systematic identification of organic compounds	<p>3 Credit Hours</p> <p>This course includes the Multistep synthesis: Classification tests for functional groups, identification of unknown organic compounds by physical, chemical and spectroscopic techniques, and by the preparation of derivatives. The course also includes a series of lectures related to the theoretical aspects of the experimental part.</p>
0306434	Chemistry of heterocyclic compounds	<p>3 Credit Hours</p> <p>This course includes identifying heterocyclic compounds, (containing at least one atom other than carbon such as nitrogen, oxygen, or sulfur), both saturated and unsaturated in terms of nomenclature, preparation, and reactions. In addition to the aromatic heterocyclic compounds; rings of interest are furan, pyrrole, pyridine, quinoline, isoquinoline, and indole. In addition, the course addresses the polycyclic aromatic heterocyclic rings: naming, preparation, and reactions.</p>

0306441	Physical Chemistry (3)	<p>3 Credit Hours</p> <p>This course includes the following topics: Simple Harmonic Motion, Bohr atomic theory and foundation of Quantum Mechanics and uncertainty principle, Schrodinger wave mechanics and quantum mechanical postulates, Quantum Mechanics of some simple systems: Free particle; Particle in a box; Harmonic Oscillator, Quantum mechanics of hydrogen-like atoms and orbital quantum numbers, The Chemical Bond: The Hydrogen Molecular-Ion, <math>\text{H}_2^+</math> ; The Hydrogen Molecule: Valence-Bond method and MO method; Valence-Bond theory for complex molecules; Molecular Orbitals of Diatomic Molecules, Foundations of chemical spectroscopy: Beer-Lambert's law, Atomic spectra and term symbols, Pure Rotational spectra of molecules, Vibrational-Rotational spectra of molecules.</p>
0306442	Molecular Spectroscopy	<p>3 Credit Hours</p> <p>This course includes electromagnetic radiation: Wavelength, frequency, wave number and energy. Boltzmann distribution. Rotational spectroscopy of solid linear rotor. Vibrational spectroscopy of simple compounds. Raman and infrared spectroscopy. Nuclear magnetic resonance spectroscopy. Vibrational-Rotational Raman spectroscopy. Laser spectroscopy.</p>
0306452	Polymer chemistry (2)	<p>3 Credit Hours</p> <p>This course includes: The study of the physical, chemical, mechanical, electrical, optical and thermal properties of polymerized materials, the chemistry and technology of some polymers, the technology of polymerization (Rheology coefficient, manufacture of polymers by pressing, extrusion, blowing).</p>
0306461	Industrial Chemistry (1)	<p>3 Credit Hours</p> <p>This course includes the basic concepts of the chemical industries: Classification of chemical products. Some important inorganic feedstocks, Primary Inorganic Materials (Water ), Water treatment and Deionized Water, Raw material for industrial (Fossil fuels, gas, coal), Mass balance, Energy balance, Separation methods, nitrogen compounds and fertilizers, Potash, bromine, mono- and tri-super phosphate, ammonium phosphate, Inorganic acids, hydrochloric acid, nitric acid, sulfuric acid, phosphoric acid, Chlorine and sodium hydroxide, Gypsum, cement, Glass, Ceramics, minerals and metallurgy, Catalysts in Industry.</p>

0306462	Industrial Chemistry (2)	<p>3 Credit Hours</p> <p>This course includes the raw materials in organic industries. Oil and its derivatives. Crude oil purification and distillation. Separation of oil components. Intermediate chemical industries from oil and natural gas. Production of hydrogen and carbon monoxide gases. Organic industries based on synthesis gas: methyl alcohol, acetic acid. Organic industries based on ethylene. Other fuel sources such as fats, and oils.</p>
0306470	Seminar and research	<p>1 Credit Hour</p> <p>Subjected to the Department's approval.</p>
0306481	Biochemistry (1)	<p>3 Credit Hours</p> <p>Proteins, structure and function of proteins, hemoglobin and myoglobin, enzymes, kinetics of enzyme action, enzymatic mechanisms, nucleic acids, DNA replication, genes, transcription , protein synthesis, biotechnology, carbohydrates, introduction to metabolism, glycolysis, citric acid cycle, electron transport chain, photosynthesis, lipids and biologic membranes.</p>