



King Saud University
College of Science
Vice Dean Academic Affairs
Study Plans



Chemistry Study Plan



Chemistry Department

2013-1434H



King Saud University
College of Science
Vice Dean Academic Affairs
Study Plans



Chemistry Study Plan

1 st Semester				
Course Code	Course Title	Pre-Req.	Co-Req.	Credits (Lect.- Exre.-Pract.)
CI 140	Learning, Thinking and Research Skills	-	-	3 (3+0+0)
CHS 150	Health and Fitness (2)	-	-	1 (1+0+0)
ENG 140	English Language (1) (E)	-	-	8 (8+0+0)
MATH 140	Introduction to Mathematics (E)	-	-	2 (1+1+0)
Total of Credit Hours				14

2 nd Semester				
Course Code	Course Title	Pre-Req.	Co-Req.	Credits (Lect.- Exre.-Pract.)
CT 140	Computer Skills (E)	-	-	3 (0+0+3)
MC 140	Communication Skills	-	-	2 (2+0+0)
ENG 150	English Language (2) (E)	ENG 140	-	8 (8+0+0)
MATH 150	Differential Calculus (E)	MATH 140	-	3 (2+1+0)
ENT 101	Entrepreneurship	-	-	1 (1+0+0)
Total of Credit Hours				17

3 rd Semester				
Course Code	Course Title	Pre-Req.	Co-Req.	Credits (Lect. Exre. -Pract.)
CHEM 101	General Chemistry (1)	-	-	4 (3+0+1)
CHEM 107	General Chemistry (2)	-	-	3 (3+0+0)
MATH 111	Integration Calculus	-	-	4 (3+1+0)
PHYS 102	General Physics (2)	MATH 150	-	4 (3+0+1)
Elective University requirement course			-	2 (2+0+0)
Total of Credit Hours				17

4 th Semester				
Course Code	Course Title	Pre-Req.	Co-Req.	Credits (Lect. Exre. - Pract.)
CHEM 222	CHEM. of Main Groups	CHEM 101	-	3 (3+0+0)
CHEM 231	Chemical thermodynamic		-	2 (2+0+0)
CHEM 240	Organic Chemistry (1)		-	2 (2+0+0)
CHEM 247	Iden. of Org. Comp.		-	2 (0+0+2)
CHEM 250	Vol. and Grav. Analysis		-	4 (3+0+1)
Optional course outside the specialization				3
Elective University requirement course			-	2 (2+0+0)
Total of Credit Hours				18

5 th Semester				
Course Code	Course Title	Pre-Req.	Co-Req.	Credits (Lect. Exre. -Pract.)
CHEM 321	CHEM. of Trans. Elements	CHEM 222	-	2 (2+0+0)
CHEM 331	Phases of Sub. and Soln.	CHEM 231	-	2 (2+0+0)
CHEM 337	Practical Phys. CHEM. (1)	CHEM 231	-	2 (0+0+2)
CHEM 340	Organic Chemistry (2)	CHEM 240	-	2 (2+0+0)
CHEM 351	Spectroscopic Methods	CHEM 250	-	2 (1+0+1)
Elective University requirement course			-	2 (2+0+0)
Optional course from the specialization			-	2
Optional course from the specialization			-	2
FREE optional course			-	2
Total of Credit Hours				18

6 th Semester				
Course Code	Course Title	Pre-Req.	Co-Req.	Credits (Lect. Exre. - Pract.)
CHEM 322	Quantum Chemistry (1)	CHEM 101 + MATH 111	-	2 (2+0+0)
CHEM 329	Inorganic Comp. Spectro.	CHEM 321	-	2 (2+0+0)
CHEM 332	Chemical Kinetics	CHEM 231	-	2 (2+0+0)
CHEM 341	Heterocyclic Org. CHEM.	CHEM 340	-	2 (2+0+0)
CHEM 342	Polymers and Petrochem.	CHEM 340	-	2 (2+0+0)
CHEM 352	Electoanalytical Methods	CHEM 250	-	2 (1+0+1)
Elective University requirement course			-	2 (2+0+0)
Optional course from the specialization			-	2
FREE optional course			-	2
Total of Credit Hours				18

7 th Semester				
Course Code	Course Title	Pre-Req.	Co-Req.	Credits (Lect. Exre. -Pract.)
CHEM 422	Chemistry of Solid State	CHEM 321	-	3 (2+0+1)
CHEM 435	Chemistry of Inter. Surf.	CHEM 231	-	2 (2+0+0)
CHEM 438	Practical Phys. CHEM. (2)	CHEM 331	-	2 (0+0+2)
CHEM 441	Org. Comp. Spect.	CHEM 341	-	2 (2+0+0)
CHEM 497	Training on chemical instrumentation	CHEM 351	-	2 (2+0+2)
Optional course from the specialization			-	2
Optional course from the specialization			-	2
FREE optional course			-	2
Total of Credit Hours				17

8 th Semester				
Course Code	Course Title	Pre-Req.	Co-Req.	Credits (Lect. Exre. - Pract.)
CHEM 424	Organometallic Chemistry	CHEM 321	-	2 (2+0+0)
CHEM 451	CHEMical Separation and Chromatographic Meth.	CHEM 351	-	2 (1+0+1)
CHEM 499	Research Project	-	-	3 (0+0+3)
Optional course from the specialization			-	2
Optional course from the specialization			-	2
Optional course outside the specialization			-	3
FREE optional course			-	2
Total of Credit Hours				17

(Lect - Exer. - Pract.) = (Lecture - Exercise - Practical)



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List of the Elective Courses of the University Requirements

(Student elects 8 credit hours)

Course Code	Course Title	Pre-requisite	Credits (Lect. – Exer. - Pract.)
IC 100	Studies in the Biography of the Prophet	-	2 (2+0+0)
IC 101	Introduction of Islamic Culture	-	2 (2+0+0)
IC 102	Islam and Building up the Society	-	2 (2+0+0)
IC 103	Economic System in Islam	-	2 (2+0+0)
IC 104	Political system in Islam	-	3 (2+0+1)
IC 105	Human Rights	-	3 (2+0+1)
IC 106	Islamic Jurisprudence	-	2 (2+0+0)
IC 107	Ethics of Occupation	-	2 (2+0+0)
IC 108	Contemporary Issues	-	2 (2+0+0)
IC 109	Woman and Her Developmental Role	-	2 (2+0+0)

List of the Elective Courses

Elective courses from the specialization (Student elects 16 credit hours)

Course code	Course title	Pre-requisite	Credits (Lect. – Exer. - Pract.)
Chem 326	Non-aqueous Chemistry	Chem 321	1 (1+0+0)
Chem 327	Lanthanides and Actinides		2 (2+0+0)
Chem 328	Quantum Chemistry (2)	Chem 322	2 (2+0+0)
Chem 330	Physical Chemistry of Polymers	Chem 231	2 (1+0+1)
Chem 333	Industrial Chemistry		2 (2+0+0)
Chem 334	Nuclear and Radiation Chemistry	Chem 104	2 (2+0+0)
Chem 338	Theoretical Chemistry	Chem 322	2 (2+0+1)
Chem 343	Organic Reaction Mechanism	Chem 340	2 (2+0+0)
Chem 347	Practical Applications of Organic Chemistry	Chem 247	2 (0+0+2)
Chem 423	Inorganic Reaction Mechanism	Chem 321	2 (2+0+0)
Chem 426	Bio-inorganic Chemistry		2 (2+0+0)
Chem 427	Industrial-inorganic Chemistry		3 (2+0+1)
Chem 429	Practical Inorganic Chemistry (2)	Chem 422	2 (0+0+2)
Chem 432	Corrosion	Chem 331	2 (1+0+1)
Chem 436	Surface Chemistry and Catalysis	Chem 332	2 (2+0+0)
Chem 442	Organic Industries	Chem 341 + Chem 342	2 (1+0+1)
Chem 445	Chemistry of Natural Products	Chem 341	2 (2+0+0)
Chem 447	Advanced Practical Organic Chemistry	Chem 347	2 (0+0+2)
Chem 452	Statistical Treatment of Chemical Data	Chem 351 +	2 (1+0+1)
Chem 453	Environmental Analysis	Chem 352	2 (1+0+1)
Chem 454	Medical and Industrial Analysis		2 (1+0+1)



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Elective courses from OUTSIDE the specialization (Student elects 6 credit hours)

Course Code	Course Title	Pre-requisite	Credits (Lect - Exer- Pract)
STAT 100	Introduction to Statistics	-	3 (2+1+0)
ZOOL 103	Principles of General Zoology	-	3 (2+0+1)
BOT 102	Botany	-	3 (2+0+1)
MBIO 140	Microbiology	-	3 (2+0+1)
GEO 101	Physical Geology	-	4 (3+0+1)
BCH 211	General Biochemistry (1)	-	3 (3+0+0)

List of service courses to Other Specialization and collages.

Course Code	Course Title	Credits (Lect. – Exer.- Pract.)	Department / College of
CHEM 101	General chemistry (1)	4 (3+0+1)	GEO – GPH – BOT – MBIO – BCH – Engineering- Agriculture
CHEM 103	General chemistry (1)	3 (3+0+0)	ZOOL – Computer Sciences
CHEM 104	General chemistry (1)	1 (0+0+1)	Computer Sciences
CHEM 108	Introduction to organic chemistry	4 (3+0+1)	Non specialist students - Agriculture
CHEM 251	Analytical chemistry	3 (2+0+1)	None -major
CHEM 253	Fundamental of analytical chemistry	2 (1+0+1)	None -major - Agriculture
CHEM 341	Heterocyclic Organic chemistry	2 (2+0+0)	None -major
CHEM 350	Instrumental Methods of Analysis	4 (2+0+2)	Engineering

Short Courses Description

I. Compulsory courses from the Specialization:

Course number and code: CHEM 101	Course title: General chemistry (1)
Effective hours: 4 (3+0+1) (Lect. – Exer. – Pract.)	
<p>Stoichiometry: SI units, chemical formulas, the mole, methods of expressing concentration, calculations based on chemical equations.</p> <p>Gases: Laws, kinetic theory, deviation and van der Waals equation.</p> <p>Thermo chemistry: Types of enthalpy changes, Hess Law and its applications,, first law of thermodynamics.</p> <p>Solutions: Type of solutions and laws related, colligative properties.</p> <p>Chemical Kinetics: Law of reaction rate, reaction order, factors affecting the reaction. <i>Chemical Equilibrium:</i> Reaction between K_c & K_p, Le Chatelier's principle and factor affecting equilibrium. Ionic equilibrium: Acid and base concepts, pH calculations of acid, base and buffer solutions.</p> <p>Eleven experiments including: Physical properties of mater, Hess's law, chemical kinetics, volumetric analysis.</p>	



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Course number and code: CHEM 107	Course title: General chemistry (1)
Effective hours: 3 (3+0+0) (Lect. – Exer. – Pract.)	
Principles of atomic structure Bohr's theory and de Broglie's hypothesis - Emission spectra of hydrogen atom and calculations - Quantum Numbers and electronic configurations of elements - Consequences of periodic table - Lewis structure	
Course number and code: CHEM 222	Course title: Chemistry of Main Group
Effective hours: 3 (3+0+0) (Lect. – Exer. – Pract.)	
Summary of modern atomic theory, Periodic Table, Periodicity effect, Group I element (Li-Cs), Group II element (Be-Ba)-Boron, Group III element (Al-Th)-Carbon, Group IV element (Si-Pb)-Nitrogen, Group V element (P-Bi)- Oxygen, Group VI element (S-Po)-Group VII element (F-St)-Group VIII element (Noble gases) .Ionic bond compounds –Covalent bond compounds-Chemical forces .	
Course number and code: CHEM 231	Course title: Chemical Thermodynamic
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Importance and terminologies, Work and Heat, Zeroth law, First law, Thermochemistry, The second and Third law, Free energy, partial molar quantities. Chemical potential. Mixing ideal and true solutions Chemical and physical equilibrium, Statistical thermodynamic. The practical part includes: Heat capacities, thermodynamic of electrochemical reactions Enthalpies measurements, calculating the equilibrium constants for some reactions, , distribution coefficients measurements, estimating the strength of hydrogen bonds.	
Course number and code: CHEM 240	Course title: Organic Chemistry (1)
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Introduction (Carbon Compounds, Chemical Bonds(ionic, Covalent), Atomic and Molecular orbitals, Hybridization, Polarity and Inductive effect), Alkanes, Cycloalkanes (Alkyl groups, IUPAC nomenclature, Physical properties, Sources off, Synthesis. Reactions(Combustion, Halgenation, Ring opening). Configuration, cyclohexanes, Alkenes and Alkynes (IUPAC nomenclature, Physical properties, Synthesis (Dehydrohalogenation, from vicinal dihalides, Dehydration of alcohols). Reactions(Acidity of terminal alkynes, Addition reactions(Reduction, Halogenation, Addition of HX – Markovnikov rule, Carbonium ions and their stability, Reaction mechanism), Addition in the presence of peroxides, Hydration, Halohydrin formation), Oxidation of Alkenes (KMnO ₄ , Peroxides and Ozonolysis), Conjugated Dienes (Allyl radical and stability, Allyl cation, 1,3-Butadiene-electron delocalization, Resonance and the Stability of conjugated dienes, 1,4-Addition and 1,4-Cycloaddition reactions of diene), Stereochemistry (Structural isomers and Stereoisomerism, Enantiomers, Diastereomers and Chirality, D and L, The R-S system, Resolution, Molecules with more than one chiral carbon, Reactions of chiral molecules: Inversion, Racemization), Aromatic Compound (Aromaic character, Hukel rule, Nomenclature, Electrophilic substitution reactions(Alkylation, Acylation, Halogenatio, Sulphonation, Nitration; reaction mechanism), Side chain halogenation and oxidation, Reactivity and Orientation in substituted benzene, Polynuclear aromatics).	



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Course number and code: CHEM 247	Course title: Identification of Organic Compounds
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Introduction, Safety, Lab. Equipments, Gas cylinders Solubility, Extraction, Distillation Physical constants: melting point, boiling point Chromatography: Paper (PC), Column (CC), Thin layer Chromatography(TLC) Functional groups: Alkane, Alkene, Aromatic, Organic halides, Hydroxy Comp., Nitro and amine compounds, Aldehydes and Ketones, Carbohydrate, Carboxylic acids and their derivatives. Elemental Analysis.	
Course number and code: CHEM 250	Course title: Volumetric and Gravimetric Analysis
Effective hours: 4 (3+0+1) (Lect. – Exer. – Pract.)	
Concentrations of solutions. Types of equilibrium. Factors affecting equilibrium constant. Precipitation equilibrium and the introduction to quantitative analysis. Acid-base titration. Titration curves. Indicators. Compleximetric titrations. Precipitation titrations. Redox and potentiometric titrations. Gravimetric analysis. Gravimetric calculations. Practical: Acid-base titrations - Precipitation titrations - Compleximetric titrations - Redox titrations. Some experiments in gravimetry.	
Course number and code: CHEM 321	Course title: Chemical of transition elements
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Definition of transition elements - Theories of bonding (Warner's theory, the effective atomic number, the valence bond theory, the crystal field theory, molecular orbital theory, ligand field theory) - Energy levels for the transition metal ions - The magnetic properties of the transition metal complexes - Role of transition metal ions in the biological system - Role of transition metal ions in catalysis	
Course number and code: CHEM 322	Course title: Quantum Chemistry (I)
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Historical background, revision of some mathematical preliminaries, Schrodinger equation and particle in a box, postulates of the quantum theory, applications, harmonic oscillator, angular momentum	
Course number and code: CHEM 329	Course title: Inorganic Compounds Steroscopy
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Introduction: characterization of electromagnetic radiation, quantization of energy, regions of spectrum, representation of spectrum, basic elements of practical spectroscopy, signal-to-noise, resolving power, width and intensity of spectral lines. Microwave spectroscopy: rotation of molecules, rotational spectra, diatomic molecules. Infra-red spectroscopy: vibrating diatomic molecule, diatomic vibrating rotator, vibration-rotation spectrum of carbon monoxide, breakdown of the Born-Oppenheimer approximation, interaction of rotations and vibrations. Electronic spectroscopy of atoms: structure of atoms, electronic angular momentum, multi-electron atoms, angular momentum of multi-electron atoms. Spin resonance spectroscopy: spin and applied field, nuclear magnetic spectroscopy, electron magnetic spectroscopy. Group Theory: Molecular symmetry and the symmetry, representation of groups, applications.	



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Course number and code: CHEM 331	Course title: Phases of Substances and Solutions
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Kinetic theory, forces between atoms, ions and molecules. Vapor pressure and enthalpy. Boiling and freezing. Solid phase and its structure. Phase equilibrium. Ideal and non-ideal solutions of non-electrolyte. Formation of colloidal dispersions, Colloid stability, association of colloids, macromolecules as colloids, emulsions. Colligative properties. Solvent and solute activities. Ion hydration. Born and Debye-Hückle models. Activity coefficient. Solubility and dissociation. Electrolytic conductance. Ionic mobility. Transport number. Diffusion, transport and Fick's laws.	
Course number and code: CHEM 332	Course title: Chemical Kinetics
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Reaction rate, concentration and time, rate expression, reaction order, half time, rate-concentration plot, experimental methods, kinetics of simple reactions with different orders, determination of rate and orders, reaction rate and temperature, Arrhenius equation, Activation energy calculation, Complex reaction and mechanism. Introduction to catalysis, solid-gas and solid-liquid heterogeneous catalysis, chemical kinetics of heterogeneous catalysis, types and preparation of catalysts, Major industrial reactions	
Course number and code: CHEM 337	Course title: Practical Physical Chemistry (1)
Effective hours: 2 (0+0+2) (Lect. – Exer. – Pract.)	
Ten experiments in Thermo-chemistry, thermodynamics and conductivity	
Course number and code: CHEM 340	Course title: Organic Chemistry (2)
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Organic halides (IUPAC nomenclature, Physical properties, Synthesis, Grignard reagents, Nucleophilic substitution S_N1 , S_N2 . $E1$, $E2$ mechanism). IUPAC nomenclature, Classification, Physical properties, Synthesis, Reactions of the following organic classes: Alcohols and Thiols; Ethers, Epoxides and Sulphides; Phenols, Aldehydes and Ketones; Carboxylic acids and Their Derivatives, Amines.	
Course number and code: CHEM 341	Course title: Heterocyclic Organic Chemistry
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Heterocycles , Nomenclature, Aromaticity, Five-membered heterocycles: Pyrroles, Indoles, Diazoles, Synthesis, Reactions, Cycloaddition Reactions, Six-membered heterocycles, Pyridine, quinoline, Basicity, Synthesis, Reactions. Heterocyclic compounds versus microbes, Antibiotics, antitumors and as Dyes. Biologically important Heterocycles, Uracils and Purins, Carbohydrates , Definition, Nomenclature, Classification, Monosaccharides: absolute configuration, cyclic structures, oxidation, reduction, osazones, ascorbic acid, amino sugars. Oligosaccharides and Polysaccharides, Cellulose technology, Amino acids, Proteins , Natural amino acids: Properties, Synthesis and Reactions, Synthesis of Peptides, Protein classification, Lipids , Classification, Waxes, Oils and Fats (Glycerides), Synthesis and Properties of Glycerides, Glycolipids.	
Course number and code: CHEM 342	Course title: Polymers and Petrochemicals
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Classification of polymers, Chemical and Physical properties, General methods for polymer synthesis, Condensation and Addition polymerization, Copolymerization, Polymer technology and application, Degradation and Stabilization of polymers. Petrochemicals from Natural gas, Benzene, Toluene and Xylene	



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Course number and code: CHEM 351	Course title: Spectroscopic Methods
Effective hours: 2 (1+0+1) (Lect. – Exer. – Pract.)	
Classification of polymers, Chemical and Physical properties, General methods for polymer synthesis, Condensation and Addition polymerization, Copolymerization, Polymer technology and application, Degradation and Stabilization of polymers. Petrochemicals from Natural gas, Benzene, Toluene and Xylene	
Course number and code: CHEM 352	Course title: Electrochemical Methods
Effective hours: 2 (1+0+1) (Lect. – Exer. – Pract.)	
Electrochemical cell. Cell potential and Nernst Equation. Calculation of the cell potential. Types of electrodes- reference electrodes and working electrodes. Junction potential. Potentiometry and potentiometric methods. Ion selective electrodes. Electrogravimetric methods. Coulometric methods. Voltammetric methods of analysis. Polarography and stripping voltammetry. Practical: Selected experiments covering different electroanalytical techniques.	
Course number and code: CHEM 422	Course title: Chemistry of Solid State
Effective hours: 3 (2+0+1) (Lect. – Exer. – Pract.)	
Types of solids, external structure of solids, introduction to point group symmetry, internal structure of solids, crystal systems and unit cell, lattice types, lattice plans and directions, basic crystallographic calculations, X-ray diffraction, crystal structure of elements and inorganic compounds, defects in solid, inorganic industries (Steel, cement, glass). Experiments: - Study of crystal structure using computer programs: Metals and alloys, Inorganic compounds, Molecular compounds. - Thermal analysis and its applications. - X-ray diffraction and its applications - Applications of SEM and TEM - Identification of solid materials: Manual method, Computer programs method. - Nano-synthesis and studies of : Alloy - MgO and Mg(OH) ₂ - Perovskite SrTiO ₃ - BaTiO ₃ - Spinel MgAl ₂ O ₄ - Glass	
Course number and code: CHEM 424	Course title: Organometallic Chemistry
Effective hours: 3 (2+0+1) (Lect. – Exer. – Pract.)	
Introduction (definition, classification and stability of organometallic compounds), classification, bonding and synthesis of main group organometallic compounds, organo-transition metal complexes, classification of ligands, EAN rule and its applications, nature of bonding in transition metal complexes, d and p-complexes, metal-carbon bond cleavage reactions, oxidative-addition reactions, applications in homogeneous and heterogeneous catalysis.	
Course number and code: CHEM 435	Course title: Chemistry of Interfacial Surfaces
Effective hours: 3 (2+0+1) (Lect. – Exer. – Pract.)	
Solid-liquid interfaces, electrochemical potential, electrochemical reactions and Nernst equation, liquid junction potential, electrode kinetics, rate of electrochemical reactions, diffusion, cyclic voltammetry and finally mechanism of electrochemical reactions. Solid-Liquid interface: Contact wetting angle, contact angle measurement, factors	



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Course number and code: CHEM 438	Course title: Practical Physical Chemistry (2)
Effective hours: 2 (0+0+2) (Lect. – Exer. – Pract.)	
Solid- Number of Experiments in physical chemistry. (Chemical kinetics, electrochemistry , catalysis and polymers.)	
Course number and code: CHEM 441	Course title: Organic Compounds Spectroscopy
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Introduction, Structural elucidation by Spectroscopic Methods; Ultraviolet (UV) and Visible, Infrared (IR), ^1H and ^{13}C Nuclear Magnetic Resonance and Mass Spectrometry; Application of these spectroscopic tools.	
Course number and code: CHEM 451	Course title: Chemical Separation and Chromatographic Methods
Effective hours: 2 (1+0+1) (Lect. – Exer. – Pract.)	
Principles and applications of solvent extraction. Ion exchange chromatography. Paper chromatography. Thin layer chromatography. Column chromatography. Liquid chromatography. High performance liquid chromatography. Gas liquid chromatography. Practical: Selected experiments on paper chromatography. Ion exchange chromatography. Column chromatography. High performance liquid chromatography and gas liquid chromatography.	
Course number and code: CHEM 497	Course title: Training on Chemical Instrumentation
Effective hours: 2 (0+0+2) (Lect. – Exer. – Pract.)	
Spectroscopy techniques, separation techniques, thermal analysis, electrochemical techniques, sorption techniques	
Course number and code: CHEM 499	Course title: Research Project
Effective hours: 3 (0+0+3) (Lect. – Exer. – Pract.)	
Spectroscopy techniques, separation techniques, thermal analysis, electrochemical techniques, sorption techniques	

II- Compulsory courses from OUTSIDE the Specialization:

Course number and code: PHYS 102	Course title: General Physics (2)
Effective hours: 4 (3+0+1) (Lect. – Exer. – Pract.)	
Vectors, Motion in straight line, Newton's Laws of motion, work, energy and momentum, simple harmonic motion, elasticity, mechanics of non-viscous fluids, flow of viscous fluids, surface tension, temperature, quantity of heat, work and heat.	
Course number and code: MATH 111	Course title: Integral calculus
Effective hours: 4 (3+1+0) (Lect. – Exer. – Pract.)	
Definition of definite integral and its properties, the anti-derivative, indefinite integral and the fundamental theorem of calculus. Change of variables. Integrals of natural and general exponential functions. Integrals of natural and general logarithmic functions. Derivatives and integrals of hyperbolic and inverse-hyperbolic functions. Techniques of integration: by parts, trigonometric substitutions, completing the square, integrals of rational functions, miscellaneous substitutions. Indeterminate forms, improper Integrals. Applications of integration: area, solids of revolution, arc length and surface of revolution, linear Motion, work, momentum and center of mass. Numerical integration. Polar coordinates, relation between polar and Cartesian coordinates, graphs of polar curves, area in polar coordinates. Parametric equations.	



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III- Elective courses from the Specialization:

Course number and code: CHEM 326	Course title: Non- aqueous Chemistry
Effective hours: (1+0+0) (Lect. – Exer. – Pract.)	
Study of physical and chemical properties of solvents, their effect on chemical reactions, methods of measuring strength of solvents, classification of solvents into: protonic, oxy, halide and oxy-halido solvents and detailed studies of them, molten salts and their applications in industry.	

Course number and code: CHEM 327	Course title: Lanthanides and Actinides
Effective hours: 1 (1+0+0) (Lect. – Exer. – Pract.)	
The Lanthanides: Electronic configuration, lanthanides complexes and their chemical reactions, methods of separation, industrial applications. The Actinides: The actinides postulate and its derivation, methods of preparation, actinide complexes.	

Course number and code: CHEM 328	Course title: Quantum Chemistry (2)
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Revsion of Chem 220, variation method, perturbation method, angular momentum of many electron atoms, Huckel molecular orbital method.	

Course number and code: CHEM 330	Course title: Physical Chemistry of Ploymers
Effective hours: 2 (1+0+1) (Lect. – Exer. – Pract.)	
Introduction, Definitions, classification of polymers, Polymerization and copolymerization techniques, Characterization and determination of Molecular weight, Configuration of polymers chains(structure and microstructure), Solubility of polymer and miscibility, Determination of thermal properties of polymers. Practical: <ul style="list-style-type: none">✓ Solubility and precipitation of polymers✓ Techniques of purification of monomers, catalysts and polymers✓ Polymerization of suitable monomer using free radical✓ Polymerization of suitable monomer using anionic or cationic polymerization✓ Polymerization of suitable monomers using polycondensation method✓ Copolymerization using free radicals and characterizations✓ Determination of molecular weight by viscosimetry✓ Grafting of polymer using free radical.✓ Determination of structure and microstructure of polymer using spectroscopic techniques	

Course number and code: CHEM 333	Course title: Industrial Chemistry
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Physical Processes in Chemical Industry, Mass and Energy Balance in Industrial Processes, Industrial Thermo-chemistry, Chemical Conversion Processing, Main Catalysts used in Chemical Industry, Industrial Applications of Electrochemical Cells and Electrolysis, Corrosion Phenomena and its Industrial Solutions.	



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Course number and code: CHEM 334	Course title: Nuclear & Radiation Chemistry
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
<p>Part One: Nuclear chemistry, Introduction, atomic nuclei, radioactive decay process, nuclear reaction, equations of radioactive decay and growth, interaction of radiation with matter, radiation detection and measurement, techniques in nuclear chemistry, radiochemical applications and beneficial used of isotopes, sources of nuclear bombarding particles, reactor safety and radiation protection and control.</p> <p>Part Two: Radiation chemistry, developments of radiation chemistry, reaction dosimetry, radiolysis of water and aqueous solution, radiolysis of organic systems radiolysis of gases, application of radiation chemistry .</p>	
Course number and code: CHEM 338	Course title: Theoretical Chemistry
Effective hours: 3(2+0+1) (Lect. – Exer. – Pract.)	
The theoretical aspects in molecular structures of diatomic and simple polyatomic molecules using approximation methods: semi-empirical methods represented by Huckel MO, ab initio methods, density functional methods. These approximation methods will be used to calculate some molecular properties like energy, force constants, bond lengths, bond angles and dihedral angles, normal modes of vibrations, I.R., Raman and NMR spectra.	
Course number and code: CHEM 343	Course title: Organic Reaction Mechanism
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Introduction, Thermodynamic and Activation energy - Physical and Chemical Methods to Follow a Reaction Mechanism, reaction kinetics, Isotope labeling, intermediate determination, stereochemistry, crossover experiments - Reactions: Acids and Bases, Nucleophilic Substitution, Elimination Reactions, Electrophilic Addition to a double bond, Nucleophilic Addition to a carbonyl group, Rearrangements and free radicals.	
Course number and code: CHEM 347	Course title: Practical Application of Organic Chemistry
Effective hours: 2 (0+0+2) (Lect. – Exer. – Pract.)	
Introduction, Safety, Lab. Equipments - Spectroscopy, IR - Identification of Unknown - Preparation of derivatives, Reports - Unknowns 1 – 5 - Identification of Mixture components, separation	
Course number and code: CHEM 423	Course title: Inorganic Reaction Mechanism
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Introduction to inorganic reaction mechanisms, soft and hard acids and bases, Nucleophilic substitution reactions at four-coordinate Site, Mechanism of Oxidation-Reduction reactions, Bio-inorganic Chemistry Includes: Non red-ox metallic enzymes, Oxygen carriers and the weight of oxygen proteins, Proteins of the hemoglobin , Nitrogen fixation and sulfur, iron proteins, Heavy metal ion storage, Metals and non-metals in medicine and biological system	



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Course number and code: CHEM 426	Course title: Bio-inorganic Chemistry
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
<ol style="list-style-type: none">1) The alkali metals and alkaline earth cations in biosystems.2) Non-redox metalloenzymes.3) Oxygen carriers and oxygen transport proteins, electron transfer and photosynthesis.4) Heme proteins and copper proteins in redox reactions, vitamin B12.5) Nitrogen fixation and iron-molybdenum-sulphur proteins.6) Metal ion transport and storage.7) Metals and non-metals in biology and medicine8) Physical methods.	
Course number and code: CHEM 427	Course title: Industrial inorganic Chemistry
Effective hours: 3 (2+0+1) (Lect. – Exer. – Pract.)	
<ol style="list-style-type: none">1 - Water<ol style="list-style-type: none">a- Slander of water quality.b- Fresh water treatment.c- Waste water treatment.d- Desalination of sea water.2 - Metallurgy<ol style="list-style-type: none">a- Ore dressing: sorting, magnetic separation, floatation.b- Pyrometallurgy: extraction of iron, lead, chromium, tin, antimony, etc.c- Hydrometallurgy: extraction of gold, silver, mercury, etc.d- Electrometallurgy: extraction of aluminum and sodium.e- Thermite: extraction of vanadium and chromium.3 - Ultra purification of metals Electrorefining, zone refining, chemicals refining, alloys.4 - Ceramics: composites. Processing of ceramics, applications of ceramics, superconducting ceramics.5 - Glass and quartz industry B₂O₃ glass (pyrex and kimax glass)6 - Cement industry7 - Extraction of elements for semiconductors Ultra pure silicon, gallium, phosphorous, arsenic.8 - Extraction of radioactive elements Ion exchange process, solvent extraction.9 - Sulfuric acid, Nitric acid, Hydrochloric acid industries.10- Inorganic fertilizers, Detergent and household cleaning stuffs	
Course number and code: CHEM 429	Course title: Practical inorganic Chemistry (2)
Effective hours: 2 (0+0+2) (Lect. – Exer. – Pract.)	
The electromagnetic radiation – preparation of samples for I.R. measurements – Preparation of some organometallic compounds and measuring their spectra – titration for non aqueous solutions – study of the spectra of complexes – study of the kinetics of isomeric transformation of inorganic compounds - study of the electronic structure and electronic spectra - study of U.V. spectra of some compounds and evaluating the absorption coefficient and concentration.	



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Course number and code: CHEM 432	Course title: Corrosion
Effective hours: 2 (1+0+1) (Lect. – Exer. – Pract.)	
Essential definitions and terminologies - Direct and indirect costs of corrosion - Classifications of corrosion (types of corrosion) - Methods of corrosion rate measurements - Thermodynamics and kinetics of corrosion - Factors affecting corrosion - Methods of corrosion control.	
Course number and code: CHEM 436	Course title: Surface Chemistry and Catalysis
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Surface and interfaces: Types of interfaces, Surface free energy, Surface tension. Solid-Gas interface: Physical adsorption, chemical adsorption, adsorption measurement methods, adsorption isotherms, adsorption applications. Homogeneous Catalysis: Acid & base catalysis, oxidation-reduction catalysis, chain reaction catalysis, coordination catalysis. Heterogeneous Catalysis: Solid-Gas heterogeneous catalysis, Solid-Liquid heterogeneous catalysis, main types of catalysts, preparations of heterogeneous catalysis, catalyst characterization	
Course number and code: CHEM 442	Course title: Organic Industries
Effective hours: 2 (1+0+1) (Lect. – Exer. – Pract.)	
Production and uses of Petroleum and basic Petrochemicals and Inorganic chemicals, Downstream industries, Pioneers in the field of Chemical and Downstream industries in the Kingdom of Saudi Arabia. Experiments include Preparation and Characterization of selected petrochemicals and non petrochemicals.	
Course number and code: CHEM 445	Course title: Chemistry of Natural Products
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
Introduction, Secondary metabolites, isolation, separation and structural elucidation Isoprenoids: Terpenes, classification, monoterpenes and sesquiterpenes. Steroids: Triterpenoids and Sterols, Cardinolides, Biosynthesis of Terpenoids and Steroids (Acetate Pathway). Alkaloids, Classification, Examples: Pyrrolidines, Piperidines, Isoquinolines, Quinolines, Indoles and Purines. Biosynthesis of Alkaloids (Amino acid Pathway). Alkaloids, Examples: Flavonoids, Anthraquinones, Coumarins, Xanthenes, and Polyketide Pathway.	
Course number and code: CHEM 447	Course title: Advanced Practical Organic Chemistry
Effective hours: 2 (0+0+2) (Lect. – Exer. – Pract.)	
Introduction, Safety, Lab. Equipments - Preparation and study of some organic compound, spectroscopy and yield (%). Example Preparations and Reactions: -Diels Alder Reaction. - Oxidation of side chain -Reaction of SN1 K SN2 , E1 - Nitration of Organic compounds -Reduction of Nitro compounds - Grignard Reaction -Perkin condensation, -Friedel Crafts alkylation, -Alder Condensation, -Esterification -Polymerization, -Polystyrene, -Baekalite -Isolation and Identification of Natural Products, using TLC and CC in purification of organic compounds	



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Course number and code: CHEM 452	Course title: Statistical Treatment of Chemical Data
Effective hours: 2 (1+0+1)	
Errors in chemical analysis. Statistical evaluation of analytical data. Expressions of analytical results. Clinical chemistry. Application of analytical chemistry in industry. Practical section: Selected experiments on applied instrumental analysis.	
Course number and code: CHEM 453	Course title: Environmental Analysis
Effective hours: 2 (1+0+1) (Lect. – Exer. – Pract.)	
Atmospheric composition, gaseous pollutants, water pollution, gaseous pollutants control, water pollutants, soil pollutants, medical pollutants, waste treatment and recycling. Practical section: Determination of metal (Mg, Cr, K, P, N) in plant sample, Hg in urine samples, Pb and Cd in paints...etc.	
Course number and code: CHEM 454	Course title: Medical and Industrial Analysis
Effective hours: 2 (1+0+1) (Lect. – Exer. – Pract.)	
Automated instruments. Process control in which analytical measurements are performed on chemical processes to produce information about the progress of the quality product which include continuous analyzers, discrete analyzers and other instruments used in automated process control. Clinical analysis. Common determinations such as immunoassay, electrophoresis, enzyme immunoassay of blood and biological fluids. Practical section: Selected experiments on the analysis of industrial and medical samples using instrumental analysis.	

IV- Elective courses from OUTSIDE Specialization:

Course number and code: STAT 100	Course title: Introduction to Statistics
Effective hours: 3 (2+1+0) (Lect. – Exer. – Pract.)	
Descriptive statistics - Measures of central tendency - Measures of dispersion - Basic probability concepts - Conditional probability, Expectation - Variance - Bayes law - Random variables - Probability distribution - Binomial distribution - Poisson distribution - Hyper geometric distribution - Normal distribution – Applications by Excel	
Course number and code: GEO 101	Course title: Physical Geology
Effective hours: 4 (3+0+1) (Lect. – Exer. – Pract.)	
Introduction to physical geology and minerals – volcanism and intrusive igneous rocks – weathering, soil, sediments and sedimentary rocks – metamorphism and metamorphic rocks – water courses and groundwater – glaciers and glaciations – deserts and coasts – geological structures – earthquakes – plate tectonics – mountain belts and continental growth – earth resources.	
Course number and code: BOT 102	Course title: General Botany
Effective hours: 3 (2+0+1) (Lect. – Exer. – Pract.)	
Plant and their importance. Chemical and fine structures of the plant cell. Metabolism. Anatomy. Plant tissues, Plant water relations. Heredity and its applications. Levels of structural organization and evolution in plants (structure, taxonomy, economical and biological importance). Plant morphological and anatomical adaptation to environment Environmental pollution.	



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Course number and code: ZOOL 103	Course title: Principles of General Zoology
Effective hours: 3 (2+0+1) (Lect. – Exer. – Pract.)	
Study of structure of animal cell. Tissues, General characters of animal Kingdom. Classification of animal Kingdom. Study of Protozoa with selected examples. General characters and classification of different phyla of animal Kingdom with selected examples. Introduction of physiology : Nutrition, digestion and metabolism, blood (structure and function)	
Course number and code: MBIO 140	Course title: Microbiology
Effective hours: 3 (2+0+1) (Lect. – Exer. – Pract.)	
Introduction – Principles of Microbiology – Historical Review of the pioneer Microbiologist – Development of Microbiology – Methods of Studying Microorganisms – Classification of Microorganisms – Chemistry of Microbial Cell - Structure of Microbial Cell – Microbial Genetic – Nutrition and Microbial Metabolism – Survey Of microorganisms and their habitats – Growth and Reproduction – Relationships with other Organisms – Antimicrobial Agents-Immunity – Biotechnology - Microorganisms in medicine – Microorganisms in Industries - Microorganisms and Pollution	
Course number and code: BCH 201	Course title: General Biochemistry (1)
Effective hours: 3 (3+0+) (Lect. – Exer. – Pract.)	
This is the first part of a general introductory biochemistry course. This part covers relevant chemical concepts (chemical bonds, functional groups, equilibrium, and energy), building blocks of cellular components, structure and properties of water, buffers, structure and properties of amino acids, peptide bond, protein structure, structural & functional classification of proteins, and introduction to enzymes and metabolism.	

V- Service Courses to Other Specialization and Colleges

Course number and code: CHEM 101	Course title: General chemistry (1)
Effective hours: 4 (3+0+1) (Lect. – Exer. – Pract.)	
Stoichiometry: SI units, chemical formulas, the mole, methods of expressing concentration, calculations based on chemical equations. Gases: Laws, kinetic theory, deviation and van der Waals equation. Thermo chemistry: Types of enthalpy changes, Hess Law and its applications,, first law of thermodynamics. Solutions: Type of solutions and laws related, colligative properties. Chemical Kinetics: Law of reaction rate, reaction order, factors affecting the reaction. <i>Chemical Equilibrium:</i> Reaction between K_c & K_p , Le Chatelier's principle and factor affecting equilibrium. Ionic equilibrium: Acid and base concepts, pH calculations of acid, base and buffer solutions. Eleven experiments including: Physical properties of mater, Hess's law, chemical kinetics, volumetric analysis.	
Course number and code: CHEM 103	Course title: General chemistry (1)
Effective hours: 3 (3+0+0) (Lect. – Exer. – Pract.)	
Stoichiometry: SI units, chemical formulas, the mole, methods of expressing concentration, calculations based on chemical equations. Gases: Laws, kinetic theory, deviation and van der Waals equation. Thermochemistry: Types of enthalpy changes, Hess Law and its applications,, first law of	



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thermodynamics.

Solutions: Type of solutions and laws related, colligative properties.

Chemical Kinetics: Law of reaction rate, reaction order, factors affecting the reaction. Chemical

Equilibrium: Reaction between K_c & K_p , Le Chatelier's principle and factor affecting equilibrium. Ionic equilibrium: Acid and base concepts, pH calculations of acid, base and buffer solutions

Course number and code: CHEM 104 | **Course title: Practical General chemistry (1)**

Effective hours: 1 (0+0+1) (Lect. – Exer. – Pract.)

Eleven experiments including: Physical properties of mater, Hess's law, chemical kinetics, volumetric analysis

Course number and code: CHEM 108 | **Course title: Introduction to organic chemistry**

Effective hours: 4 (3+0+1)

- Atomic structure and chemical bonding.
- Classification, nomenclature, physical properties, synthesis and reactions of the following organic classes: aliphatic and aromatic hydrocarbons, alcohols, ethers, phenols, aldehydes, ketones, carboxylic acid and derivatives, and Amines.
- Structures and properties of carbohydrates, fats and oils extraction, synthesis of alkenes and unsaturation test, alkyl halide nuclear substitution, reactions of alcohols, phenols, aldehydes, ketones, amines, carboxylic acids (and derivatives) and diazonium compounds, saponification, reactions of carbohydrates.

Course number and code: CHEM 251 | **Course title: Analytical chemistry**

Effective hours: 3 (2+0+1) (Lect. – Exer. – Pract.)

Theoretical Part:

Introduction to quantitative analysis, concentration units, chemical equilibria and its application on acid base reaction, precipitation, complexation and redox reactions. Solubility, factors affecting solubility, solubility products. Chemical Volumetric calculation on all reactions, acid-base titration precipitation titration, complex titration and redox titration.

Practical Part:

Qualitative and quantitative analysis, including identification of anions and cations. Volumetric analysis, e.g. Acid-base, precipitation, complexation and redox titration.

Course number and code: CHEM 253 | **Course title: Fundamental of analytical chemistry**

Effective hours: 2 (1+0+1) (Lect. – Exer. – Pract.)

Theoretical Part:

Introduction to quantitative analysis, concentration units, chemical equilibria and its application on acid base reaction. Solubility, factors affecting solubility, solubility products. Acid-base, precipitation, complexation and redox titrations.

Practical Part:

Qualitative analysis, including identification of anions and cations. Volumetric analysis, e.g. Acid base titration, precipitation titration, complexation titration and redox titration.



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Course number and code: CHEM 341	Course title: Heterocyclic Organic Chemistry
Effective hours: 2 (2+0+0) (Lect. – Exer. – Pract.)	
<p>Heterocycles, Nomenclature, Aromaticity, Five-membered heterocycles: Pyrroles, Indoles, Diazoles, Synthesis, Reactions, Cycloaddition Reactions, Six-membered heterocycles, Pyridine, quinoline, Basicity, Synthesis, Reactions. Heterocyclic compounds versus microbes, Antibiotics, antitumors and as Dyes. Biologically important Heterocycles, Uracils and Purins, Carbohydrates, Definition, Nomenclature, Classification, Monosaccharides: absolute configuration, cyclic structures, oxidation, reduction, osazones, ascorbic acid, amino sugars. Oligosaccharides and Polysaccharides, Cellulose technology, Amino acids, Proteins, Natural amino acids: Properties, Synthesis and Reactions, Synthesis of Peptides, Protein classification, Lipids, Classification, Waxes, Oils and Fats (Glycerides), Synthesis and Properties of Glycerides, Glycolipids.</p>	
Course number and code: CHEM 350	Course title: Instrumental Methods of Analysis
Effective hours: 4 (2+0+2) (Lect. – Exer. – Pract.)	
<p>Theoretical Part: Spectroscopic and electro-analytical methods. Practical Part: Some experiments for Spectroscopic and electro-analytical methods.</p>	

Important Note: The student must review the department concerned for decisions that taught outside the college (Compulsory and Elective).