Academic Programs Booklet

College of Science

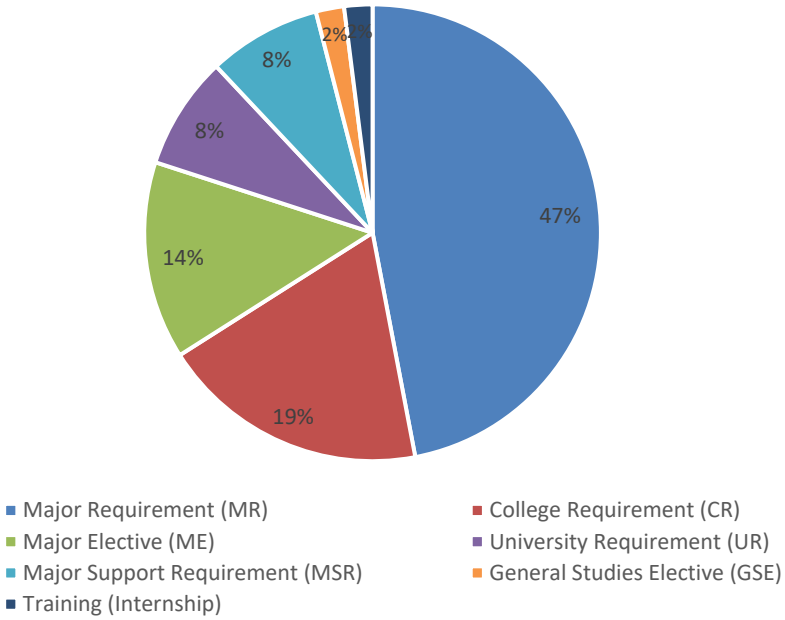
2025

Prepared By: VP For Academic Programs and Graduate Studies Office

College of Science

Bachelor of Science in Chemistry (2025)

Program Components



Course Type	CRD
University Requirement (UR)	**11**
College Requirement (CR)	**26**
Major Support Requirement (MSR)	**11**
Major Requirement (MR)	**64**
Major Elective (ME)[1]	**18**
General Studies Elective (GSE)[2]	**3**
Training (Internship) Yes	**3**
Total Credit (CRD)	**136**

Teaching Language: English

[1] Student must select **six** Major Elective courses (ME) from ME Lists.
[2] Student must select **one** General Studies Elective (GSE) from Humanities and Social Science.
Note:

- GSE Courses - Humanities and Social Science Component: Any course from the following:
  Humanities: Fine Arts, History, American Studies, Classics, Communications, English, (Foreign Language) French, Music, Philosophy, Theatre, Literature (Arabic), Religion (comparative).
  Social Science: Anthropology, Economics, Education, Geography, History, Psychology, Sociology, Women's Studies, Political Science.

Detailed Study Plan

Year 1 - Semester 1

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ARAB 110	Arabic Language Skills	3	0	3	UR	-----	No
ITCS 106	Computer Programming I	3	2	4	CR	-----	No
ENGL 125	English for Science I	3	0	3	CR	-----	No
MATHS 131	Calculus I	4	0	4	CR	-----	No
CHEMY 101	General Chemistry I	3	2	4	CR	-----	Yes

Year 1 - Semester 2

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
PHYCS 101	General Physics I	3	2	4	CR	-----	No
ENGL 126	English for Science II	3	0	3	CR	ENGL 125	No
CHEMY 102	General Chemistry II	3	2	4	MR	CHEMY 101	Yes
MATHS 132	Calculus II	4	0	4	MSR	MATHS 131	No
BIOLS 102	General Biology I	3	2	4	CR	-----	No

Year 2 - Semester 3

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
HRLC 107	Human Rights	2	0	2	UR	-----	No
PHYCS 102	General Physics II	3	2	4	MSR	PHYCS 101	No
CHEMY 103	Safety and Hazardous Chemicals	2	0	2	MR	-----	Yes
CHEMY 222	Organic Chemistry I	3	2	4	MR	CHEMY 102	Yes
CHEMY 242	Inorganic Chemistry I	3	2	4	MR	CHEMY 102	Yes
ENGL 226	Scientific Report Writing	3	0	3	MSR	ENGL 126	No

Year 2 - Semester 4

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 212	Analytical Chemistry I	3	2	4	MR	CHEMY 102	Yes
CHEMY 233	Physical Chemistry I	3	2	4	MR	CHEMY 102	Yes
CHEMY 341	Inorganic Chemistry II	3	0	3	MR	CHEMY 242	Yes
CHEMY 321	Organic Chemistry II	3	0	3	MR	CHEMY 222	Yes
ISLM 101	Islamic Culture	3	0	3	UR	-----	No

Year 3 - Semester 5

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 311	Analytical Chemistry II	3	0	3	MR	CHEMY 212	Yes
CHEMY 331	Physical Chemistry II	3	0	3	MR	CHEMY 233	Yes
CHEMY 322	Practical Organic Chemistry	0	6	3	MR	CHEMY 321	Yes
CHEMY 323	Organic Spectroscopy	3	0	3	MR	CHEMY 321	Yes
CHEMY 342	Practical Inorganic Chemistry	0	6	3	MR	CHEMY 341	Yes

Year 3 - Semester 6

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 312	Practical Analytical Chemistry	0	6	3	MR	CHEMY 311	Yes
CHEMY 332	Practical Physical Chemistry	0	6	3	MR	CHEMY 331	Yes
CHEMY 421	Organic Chemistry III	3	0	3	MR	CHEMY 321	Yes
CHEMY 4xx	Major Elective 1	3	0	3	ME	As per ME list 1	Yes
CHEMY 4xx	Major Elective 2	3	0	3	ME	As per ME list 1	Yes

Training Requirement

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 397	Internship	0	6	3	MR-Training	Completion of 75 credits	Yes

Year 4 - Semester 7

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 432	Physical Chemistry III	3	0	3	MR	CHEMY 331	Yes
CHEMY 411	Analytical Chemistry III	3	0	3	MR	CHEMY 311	Yes
CHEMY 4xx	Major Elective 3	3	0	3	ME list 1	As per ME list 1	Yes
CHEMY 4xx	Major Elective 4	2	2	3	ME list 2	As per ME list 2	Yes
CHEMY 499	Senior Research Project	0	6	3	MR	Completion of 90 credits	Yes

Year 4 - Semester 8

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 444	Inorganic Chemistry III	3	0	3	MR	CHEMY 341	Yes
CHEMY 4xx	Major Elective 5	2	2	3	ME list 2	As per ME list2	Yes
CHEMY 4xx	Major Elective 6	2	2	3	ME list 2	As per ME list 2	Yes
GSE xxx	General Studies Elective	3	0	3	GSE	As per GSE list	No
HIST 122	Modern History of Bahrain and Citizenship	3	0	3	UR	-----	No

Major Elective Courses List 1

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 414	Quality Assurance in Laboratories	3	0	3	ME	CHEMY 311	Yes
CHEMY 425	Mechanisms in Organic Chemistry	3	0	3	ME	CHEMY 321	Yes
CHEMY 427	Advanced Organic Chemistry	3	0	3	ME	CHEMY 321	Yes
CHEMY 423	Selected Topics in Heterocyclic Chemistry	3	0	3	ME	CHEMY 321	Yes
CHEMY 436	Surface Chemistry and Catalysis	3	0	3	ME	CHEMY 331	Yes
CHEMY 437	Applied Electrochemistry	3	0	3	ME	CHEMY 331	Yes
CHEMY 441	Applications of Group Theory to Inorganic Chemistry	3	0	3	ME	CHEMY 341	Yes
CHEMY 443	Inorganic Reaction Mechanisms	3	0	3	ME	CHEMY 341	Yes
CHEMY 454	Chemical Waste Management	3	0	3	ME	CHEMY 311 and 321	Yes
CHEMY 456	Nanotechnology and Nanosensors	3	0	3	ME	CHEMY 311	Yes
CHEMY 457	Computational Chemistry	3	0	3	ME	CHEMY 331 & 321	Yes
CHEMY 461	Photochemistry	3	0	3	ME	CHEMY 331	Yes

Major Elective Courses List 2

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 424	Natural Products	2	2	3	ME	CHEMY 321	Yes
CHEMY 429	Food Chemistry	2	2	3	ME	CHEMY 321 and 312	Yes
CHEMY 442	Bio-inorganic Chemistry	2	2	3	ME	CHEMY 341	Yes
CHEMY 451	Industrial Chemistry	2	2	3	ME	CHEMY 341 and 321	Yes
CHEMY 455	Polymer Chemistry and Applications	2	2	3	ME	CHEMY 321	Yes
CHEMY 458	Environmental Chemistry	2	2	3	ME	CHEMY 312 and 321	Yes
CHEMY 459	Principles and Applications of Green Chemistry	2	2	3	ME	CHEMY 321	Yes
CHEMY 460	Chemistry of Nanomaterials	2	2	3	ME	CHEMY 341	Yes

General Studies Elective Courses List

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ARAB 141	Modern Arabic Lit.	3	0	3	GSE	-----	No
ARAB 242	Arabic Poetry In The Renaissance Period	3	0	3	GSE	-----	No
ART 133	Fundamentals of Music and Its Appreciation	3	0	3	GSE	-----	No
ART 141	Drawing and Painting	2	1	3	GSE	-----	No
ART 221	Traditional Music of Bahrain and Its Application	3	0	3	GSE	-----	No
CHL 101	Introduction to Chinese Language	3	0	3	GSE	-----	No
CHL 102	Basic Chinese Language	3	0	3	GSE	CHL 101	No
EDAR 126	Playing on Piano and Org 1	3	0	3	GSE	-----	No
EDPS 144	Psychology of Learning and Memory	3	0	3	GSE	-----	No
EDTC 100	Teaching and Learning Technology	3	0	3	GSE	-----	No
ENGL 130	Introduction to Literature	3	0	3	GSE	-----	No
FREN 101	French I	3	0	3	GSE	-----	No
FREN 142	French II	3	0	3	GSE	FREN 141	No
GERM 101	Introduction to German	3	0	3	GSE	-----	No
HISTO 212	Contemporary History of The Arab World	3	0	3	GSE	-----	No
HISTO 281	Landmarks of Islamic Civilisation	3	0	3	GSE	-----	No
ISLM 114	Quranic Sciences	3	0	3	GSE	-----	No
ISLM 136	Biography of The Prophet	3	0	3	GSE	-----	No
ISLM 141	Introduction to Shari'A	3	0	3	GSE	-----	No
ISLM 252	Islamic Doctrine	3	0	3	GSE	-----	No
JAPN 101	Japanese Level I	3	0	3	GSE	-----	No
JAPN 102	Japanese Level II	3	0	3	GSE	JAPN 101	No

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
KL 101	Korean Language I	3	0	3	GSE	-----	No
KL 102	Korean Language II	3	0	3	GSE	KL 101	No
LAW 101	Introduction to Legal Studies	3	0	3	GSE	-----	No
LAW 102	History of Law	3	0	3	GSE	-----	No
LAW 106	Constitutional Law I	3	0	3	GSE	-----	No
PHEDE 214	Principles of Educational Statistics	3	0	3	GSE	-----	No
PSYC 103	Introduction to Psychology	3	0	3	GSE	-----	No
PSYC 120	Psychology of Marriage	3	0	3	GSE	-----	No
PSYC 211	Educational Psychology	3	0	3	GSE	-----	No
PSYC 281	Thinking Skills	3	0	3	GSE	-----	No
SOCIO 161	Introduction to Sociology	3	0	3	GSE	-----	No
SOCIO 181	Introduction to Anthropology	3	0	3	GSE	-----	No
SOCIO 191	Citizenship, Identity and Globalization	3	0	3	GSE	-----	No
SOCIO 224	Sociology of Health	3	0	3	GSE	-----	No
SOCIO 226	Sociology of Arabian Gulf	3	0	3	GSE	-----	No
TL 101	Turkish Language	3	0	3	GSE	-----	No
SPAN 101	Spanish I	3	0	3	GSE	-----	No
GSE XXX	Other electives	X	X	3	GSE	Department Approval	No

Course Description

Course Code: CHEMY 102 **Course Title:** General Chemistry II
Molecular orbitals of homonuclear diatomic molecules; thermochemistry: calorimetry, enthalpy, thermochemical equations, heats of formation; chemical kinetics: rate and concentration, concentration and time, activation energy, rate and temperature, catalysis; chemical equilibria: gaseous and aqueous equilibria, the equilibrium constant and the factors affecting an equilibrium system, solubility equilibrium; acids and bases: pH of acidic and basic solutions, hydrolysis of salts; acid-base neutralization: buffers, acid-base titration curves, indicators; entropy and Gibb's energy; introduction to electrochemistry: balancing redox equations, galvanic cells, standard cell potentials; organic Chemistry: IUPAC nomenclature of aliphatic and aromatic hydrocarbons, common functional groups. Related practical work.

Course Code: CHEMY 103 **Course Title:** Safety and Hazardous Chemicals
General laboratory safety practices and management; laboratory safety equipment; safety pictograms; NFPA diamond; first aid and emergency procedures; artificial respiration methods; personal protective equipment (PPE); hazardous chemicals: (flammable, corrosive, carcinogenic, mutagenic, and teratogenic) and health; self-reactive substances and mixtures; radioactive materials, material safety data sheet (MSDS), safety information and checklist.

Course Code: CHEMY 212 **Course Title:** Analytical Chemistry I
Treatment of analytical data; errors, accuracy, and precision of chemical analysis; standardization and calibration; introduction to volumetric analysis: acid-base titrations, titration curves of polyprotic acids and bases, titration curves for mixtures of acids and bases; acid-base titrations in nonaqueous solvents; applications of neutralization titrations; precipitation titration; complexation titrations; oxidation/reduction titrations and applications; gravimetric methods of analysis. Related practical work.

Course Code: CHEMY 222 **Course Title:** Organic Chemistry I
The nature of organic compounds (structure and bonding); alkanes and cycloalkanes; isomerism; conformational analysis; alkenes and alkynes (structure, reactivity, addition reactions, and synthesis); Conjugated dienes; stereochemistry (chirality, enantiomers); properties and reactions of alkyl halides: nucleophilic substitution and elimination reactions (S_{N1}, S_{N2}, E_1, and E_2). Related practical work.

Course Code: CHEMY 233 **Course Title:** Physical Chemistry I
Properties of gases; first, second and third laws of chemical thermodynamics; state functions and exact differentials; adiabatic changes; Helmholtz and Gibbs energies; prediction of spontaneity of physical and chemical processes; phase diagrams of pure substances, phase transitions and boundaries; thermodynamic description and properties of simple mixtures; phase diagrams of binary systems; activities of nonelectrolyte and electrolyte solutions. Related practical work.

Course Code: CHEMY 242 **Course Title:** Inorganic Chemistry I
A comparative and systematic study of the physical and chemical properties of groups 1,2 and 13-18 elements: occurrence, abundances, extraction, periodic trends, solubility, stability, main reactions and uses, hydrolysis of common compounds; heteroatomic molecular orbital theory; intermolecular forces; energetic of ionic bond formation; inorganic thermodynamics (Born-Haber cycle); acids and bases: reactions and properties (HSAB). Related practical work.

Course Code: CHEMY 311 **Course Title:** Analytical Chemistry II
Analytical sampling; introduction to spectrochemical methods of analysis; instruments for optical spectroscopy; molecular absorption spectroscopy; molecular fluorescence spectroscopy; applications of molecular spectroscopy; atomic spectroscopy; introduction to analytical separations techniques; chromatography; instrumentations and applications for gas chromatography (GC); high-performance liquid chromatography (HPLC).

Course Code: CHEMY 312 **Course Title:** Practical Analytical Chemistry
Fundamental basis of instrumental analysis; detection limits; sampling methods; processing of experimental data; chromatographic applications; electrochemical, spectral, and thermal methods in quantitative and qualitative chemical analyses.

Course Code: CHEMY 321 **Course Title:** Organic Chemistry II
Spectroscopic identification of organic compounds (UV, IR, and NMR); benzene and aromaticity; electrophilic aromatic substitution reactions; alcohols, phenols, and thiols; ethers; epoxides and sulfides; aldehydes and ketones; carboxylic acids and derivatives; carbonyl α-substitution reactions; carbonyl condensation reactions (Aldol and Claisen); amines and amides.

Course Code: CHEMY 322 **Course Title:** Practical Organic Chemistry
Application of different laboratory techniques to synthesize, purify, identify, and characterize organic compounds; utilization of TLC, column chromatography, and some spectroscopic techniques; acid-base extraction, distillation, and isolation methods; advanced preparations of some multistep syntheses and performing organic reactions of the following general types: substitution, addition, elimination, cyclization, oxidation, reduction and alkylation; electrophilic aromatic substitution; Fischer esterification; photosynthesis reactions**;** reduction of carbonyl compounds; and aldol condensation.

Course Code: CHEMY 323 **Course Title:** Organic Spectroscopy
Element analysis techniques: N-rule, Index of Hydrogen Deficiency value (IHD) calculation, Rule of thirteen ; UV-Vis spectroscopy; infrared spectroscopy (IR): calculation of frequency/wavenumber; NMR principle and instrumentation, ^{1}H NMR spectra chemical shift; counting of protons; spin-spin coupling; splitting patterns; spin-spin splitting, ^{13}C NMR spectra (shift, intensity of peaks, de-coupling, DEPT spectra); Mass Spectrometry: Ionization methods, fundamental fragmentation patterns and rearrangements; the use of molecular spectroscopy for the identification and elucidation of organic structures.

Course Code: CHEMY 331 **Course Title:** Physical Chemistry II
Chemical equilibrium: the equilibrium constant in terms of activities, the response of equilibria to conditions; galvanic electrochemical cells; molecular interactions: electric properties of molecules, interactions between molecules; kinetic model of gases; motions in liquid: conductivities of electrolyte and nonelectrolytes solutions, mobilities of ions; chemical kinetics: integrated rate laws, Arrhenius equation, reaction mechanism (equilibrium, consecutive, parallel, and unimolecular reactions), collision and transition-state theories.

Course Code: CHEMY 332 **Course Title:** Practical Physical Chemistry
Techniques in physical chemistry and quantitative studies illustrated through experiments on dipole moment, solubility product constant and mean ionic activity coefficient, conductance of electrolytes, transport phenomena, heat of solution with calorimetry, reaction kinetics, surface chemistry and surface tension, activation energy, homogenous and heterogenous catalysis, and equilibrium constant by distribution.

Course Code: CHEMY 334 **Course Title:** Photochemistry
Quantum nature of matter and light; light absorption and electronically excited states; physical deactivation of excited states; radiative processes and intramolecular radiation less transitions of excited states; intermolecular physical processes of excited states; photochemical reactions and their important applications; laser chemistry. Related practical work.

Course Code: CHEMY 341 **Course Title:** Inorganic Chemistry II
The d-block transition metals; coordination chemistry: Werner's theory, types of ligands, nomenclature, geometrical structure, isomerism; bonding theories for coordination compounds (valence bond, crystal field; molecular orbital, and ligand field theories); stability of coordination compounds; labile and inert complexes; electronic spectra of transition metal complexes; mechanism of substitution reaction in octahedral complexes; applications of coordination compounds.

Course Code: CHEMY 342 **Course Title:** Practical Inorganic Chemistry
Synthesis and isolation of coordination complexes containing a wide range of transition metal ions; analysis of the complexes using different analytical techniques; thermodynamics and kinetic studies of complexes, chemical reactivity; Jahn-teller distortion, linkage isomerism, and resolution of optical isomers.

Course Code: CHEMY 397 **Course Title:** Internship

A continuous period of training spent in the industry working in any field of chemistry. On completion of the course, the student is required to submit a formal written report of his/her work followed by a technical presentation.

Course Code: CHEMY 411 **Course Title:** Analytical Chemistry III

Electroanalytical methods of chemical analysis (potentiometry, electrogravimetry, coulometry, and voltammetry), miscellaneous separation methods (supercritical fluid separations, capillary electrophoresis, capillary array), mass spectrometry, X-ray diffraction (XRD) spectroscopy; X-ray fluorescence (XRF) spectroscopy; thermal analysis (TGA, DSC, DTA); nuclear magnetic resonance (NMR).

Course Code: CHEMY 414 **Course Title:** Quality Assurance in Laboratories

Quality in terms of processes. quality control: statistical quality control, Statistical Process Control; Total Quality Management; monitoring sources of variation: piece, piece-to-piece, time-to-time; constructing control charts: center line, spec limits, control limits, sample size; costs associated with quality: prevention costs, appraisal costs, costs of failure; quality systems: ISO 9000, Supplier Certification, ISO 17025, and ISO 14000.

Course Code: CHEMY 421 **Course Title**: Organic Chemistry III

The chemistry of biomolecules: carbohydrates; amino acids; peptides and proteins; enzymes; lipids, and nucleic acids; Krebs cycle and oxidative phosphorylation; organic chemistry of metabolic pathways; heterocyclic compounds: nomenclature, properties, and biological importance.

Course Code: CHEMY 423 **Course Title:** Selected Topics in Heterocyclic Chemistry

Heterocyclic chemistry: nomenclature, synthetic methods, chemical properties, natural occurrence, and biological importance; aromaticity of heterocyclic compounds; heterocyclic analogues of cyclopentadiene; heterocyclic analogues of benzene; heterocyclic analogues of naphthalene; fused ring systems involving five- and six-membered rings.

Course Code: CHEMY 424 **Course Title:** Natural Products

Natural products chemistry: definition, classification: terpenoids, steroids, alkaloids, and non-alkaloids nitrogen compounds; extraction, isolation, and identification methods; natural products of biological importance; natural products in the flora of Bahrain; marine plants and pigments; applications in medicine. Related practical work.

Course Code: CHEMY 425 **Course Title:** Mechanisms in Organic Chemistry

Selective reactions and protection; rearrangements; Radical reactions: radical formation, reactivity, stability, and reactions; synthesis and reactions of carbenes; organo-main group chemistry: sulfur, boron, silicon, and tin; organometallic chemistry: transition metals in organic chemistry; Palladium (0) catalyst in organic reaction, Heck reaction, Stille, Suzuki, Sonogashira coupling reactions; mechanism of peptide coupling reagents.

Course Code: CHEMY 426 **Course Title:** Food Chemistry

Food chemical composition; food minor components (minerals, vitamins, colors, flavor, additives, preservatives, trace elements); food palatability, food appearance, odor, flavor, nutritional value, storage, and foods spoilage; food adulteration; principles and methods of food processing; interactions of food components; food standards and regulation, quality control and assurance. Related practical work.

Course Code: CHEMY 427 **Course Title:** Advanced Organic Chemistry

Pericyclic reactions; reactive intermediate: generation, structure, stability, and reactivity; retrosynthetic analysis and multi-step syntheses of some important organic compounds; less common functional groups; organic reactions and mechanisms; asymmetric synthesis, selectivity, catalysis, protecting group.

Course Code: CHEMY 432 **Course Title:** Physical Chemistry III

Quantum mechanics: origins, wavefunctions, Schrödinger equation, operators and observables; the quantum theory of motion: translational, vibrations, rotational; atomic structure: structure of hydrogenic atoms, atomic orbitals and their energies, many-electron atoms; molecular orbital theory: hydrogen molecule-ion, molecular orbitals of homonuclear and heteronuclear diatomic molecules, molecular orbitals of polyatomic molecules using Hückel approximation; spectroscopy: molecular rotations and vibrations, electronic transitions.

Course Code: CHEMY 436 **Course Title:** Surface Chemistry and Catalysis

Chain and branching reactions; homogenous, heterogeneous and enzyme catalysts; adsorption isotherms and their various theories, Langmuir, Freundlich, BET; adsorption and its applications (such as precipitation titrations, chromatographic methods, Froth flotation, and noble gas separation); various surface evaluation techniques; colloidal systems: suspensions, emulsions, self-assembly systems, surfactants, and micelles; interfacial phenomena: surface tension and wetting; intermolecular forces for colloidal solution stability.

Course Code: CHEMY 437 **Course Title:** Applied Electrochemistry

Electrode potential and their applications; electrolytic cells and their applications, structure and characterization of pH, ion selective, and gas sensing electrodes; kinetics of electrode reactions; current-voltage characteristics of charge transfer reactions; electrochemical energy storage in hydrogen and batteries; fuel cells; conductivity and its applications; electrochemical sensors; corrosion.

Course Code: CHEMY 441 **Course Title:** Applications of Group Theory to Inorganic Chemistry

A semi-mathematical approach to group theory is developed through the stages of recognition of symmetry elements and operations, evaluation of binary products; properties of groups and group elements; systematic determination of point-group symmetries; generation of reducible and irreducible representations; and the construction and uses of point group character tables. Group theoretical treatment is applied to the symmetry of atomic orbitals; fundamental vibration stretching frequencies; hybridization schemes for atomic orbitals; crystal field splitting patterns, symmetry allowed electronic transitions, and molecular orbitals in transition metal complexes.

Course Code: CHEMY 442 **Course Title:** Bio-Inorganic Chemistry

The role of some metal ions in biology and medicine; the importance of metal ions in biological systems, particularly in redox metalloenzymes; The importance of various metalloproteins in dioxygen transport, and electron transfer; Metal ions used for communication, transport, and storage; The importance, structure and reaction mechanism of zinc based non-redox metalloenzymes; The role of metalloproteins in oxygen management and transport; The use of metals in chemotherapy for the development of new metal-based drugs and their interaction with different biomolecules. Related Practical work.

Course Code: CHEMY 443 **Course Title**: Inorganic Reaction Mechanisms

Determination of mechanism, classification of reactions, substitutions, reactions-general considerations; substitution reactions of octahedral complexes; Substitution reactions of four-coordinated square planar and tetrahedral complexes; stereo chemical change in octahedral complexes; oxidation and reduction reactions, redox addition, elimination, and substitution; metal ion catalysis; photochemical reactions.

Course Code: CHEMY 444 **Course Title:** Inorganic Chemistry III

The f-block metals (lanthanoids and actinoids); f-orbitals, oxidation states, atomic and ionic size and the lanthanoid contraction, spectroscopic and magnetic properties, sources, separation, purification, and their compounds; Introduction to organometallic chemistry; types of ligands π^1- π^7; EAN rules; pi-complexes; M-C multiple bonds; β-H elimination, M-M bonds, physical methods of measurements; important applications.

Course Code: CHEMY 451 **Course Title:** Industrial Chemistry

Chemical manufacture processes; synthesis of adhesives, pigments, dyes, food additives, detergents, insecticides, pesticides, herbicides, organic fertilizers, polymers, and pharmaceutical products; petrochemical production processes (petroleum refinery and gasoline manufacture, petroleum cracking and reforming; manufacture of some inorganic chemicals: alloys, cement, glass, ceramics, inorganic fertilizers; aluminum smelting technology: production and applications. Related practical work.

Course Code: CHEMY 454 **Course Title:** Chemical Waste Management

Hazardous chemicals waste management, hazardous chemical waste laws and regulations; chemical waste reduction at source; transport risk assessment; collection methods and characterization; recycling of chemical waste; physicochemical and biological treatment; disposal techniques; different techniques for removal of chemical

pollutants (organic and inorganic); Part of the course will depend on regular scientific visits of the students to industrial fields.

Course Code: CHEMY 455 **Course Title:** Polymer Chemistry and Applications
Polymers: nomenclature; classification, structure, and molecular weight; polymerization techniques: step growth polymerization, chain polymerization and ring-opening polymerization; copolymerization composition; polymer properties: solubility, crystallinity, morphology, thermal and mechanical properties; polymer degradation and stability; modern applications of polymers. Related practical work.

Course Code: CHEMY 456 **Course Title:** Nanotechnology and Nanosensors
Overview of nanotechnology; nanosensors, nanodevices for clinical diagnostics and drug delivery, biowarfare agent detection, nanoarrays, nanodevices, nanoanalytical devices and systems, nanosensors with biological molecules; different applications of nanosensors.

Course Code: CHEMY 457 **Course Title:** Computational Chemistry
Overview of various computational tools; applications of computational methods in different fields of chemistry, geometry optimization and conformational analysis, spectroscopic analysis (UV, IR, Raman, NMR), electronic parameters and properties study, reaction mechanism, applications of computational chemistry in material chemistry (non-linear optical properties, sensor properties, energy materials, energy storage materials etc.); interaction energy studies particularly in drug activity and drug delivery, challenges and outcomes, importance of benchmark studies for evaluation of accurate cost-effective methods, their applications in various disciplines, quantitative structure activity relationship (QASR).

Course Code: CHEMY 458 **Course Title:** Environmental Chemistry
Environmental chemistry; chemical processes impacting in the earth's atmosphere, water, and soil; basics of atmospheric chemistry (tropospheric chemistry, stratospheric chemistry); outdoor and indoor air pollution, greenhouse gases and global climate change; chemistry of natural waters and trace metal cycling; the sources, transport, and fate of persistent organic pollutants (POPs) in the environment; pharmaceuticals and their metabolites. Related practical work.

Course Code: CHEMY 459 **Course Title:** Principles and Applications of Green Chemistry
Green chemistry principles; solving some environmental problems regarding industrial waste generation; the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances; controlling environmental pollution in atmosphere from management point of view and Life Cycle Assessment (LCA) and its application will also be dealt with as a case study. Related practical work.

Course Code: CHEMY 460 **Course Title:** Chemistry of Nanomaterials
Nanostructured materials; nanomaterials fabrication techniques; self-assembly; synthesis of nanomaterials; size and shape dependent properties; polymeric nanoparticles; functionalization of nanoparticles; nanomaterials characterization techniques; environmental and biomedical applications of nanomaterials. Related practical work.

Course Code: CHEMY 461 **Course Title:** Photochemistry
Quantum nature of matter and light; light absorption and electronically excited states; physical deactivation of excited states; radiative processes and intramolecular radiation less transitions of excited states; intermolecular physical processes of excited states; photochemical reactions and their important applications; laser chemistry.

Course Code: CHEMY 499 **Course Title:** Senior Research Project
Undergraduate research project in experimental or theoretical chemistry under the supervision of a departmental staff member. Introduction to chemical literature, use of research engines and literature search procedure and research ethics. An oral presentation with the submission of a written thesis is compulsory.

Major Support Requirements Courses Descriptions

Course Code: MATHS 132 **Course Title:** Calculus II

Applications of definite integrals, L'Hopital's rule, integration techniques, infinite series, Taylor and Maclaurin series, parametric equations and polar coordinates

Course Code: ENGL 226 **Course Title:** Scientific Report Writing

This course aims to enable students in the College of Science to write professional and academic reports (between 2000-3000 words) related to their areas of specialization and intended work. It also deals with vocabulary and language structures essential for producing a full-length formal research report.

Course Code: PHYCS 102 **Course Title:** General Physics II

Electric charges and fields; Coulomb's and Gauss's laws; electric potential; capacitors and dielectrics; direct current circuits; Kirchoff's rules; magnetic field and flux; ampere's law; induced emf; Lenz's law; mutual and self-inductance; AC circuits; RLC circuit.

University Requirements Courses Descriptions

Course Code: ARAB 110 **Course Title:** Arabic Language Skills
This course focuses on basic Arabic skills including form, function, and meaning. It also helps the student to appreciate and understand structures and approach them from a critical point of view, through various genres in literature.

Course Code: HIST 122 **Course Title:** Modern History of Bahrain and Citizenship
Spatial identity of Bahrain: Brief history of Bahrain until the 18th century; the historical roots of the formation of the national identity of Bahrain since the 18th century; the modern state and evolution of constitutional life in Bahrain; the Arabic and Islamic dimensions of the identity of Bahrain; the core values of Bahrain's society and citizenship rights (legal, political, civil and economic); duties; responsibilities and community participation; economic change and development in Bahrain; Bahrain's Gulf, Arab and international relations.

Course Code: HRLC 107 **Course Title:** Human Rights
This course deals with the principles of human rights in terms of the definition of human rights, scope, sources with a focus on the International Bill of Human Rights; The Charter of the United Nations; Universal Declaration of Human Rights; The International Covenant on Economics, Social and Culture rights; Convention against Torture and other Cruel, Inhuman or Degrading Treatment or Punishment; Mechanics and the Constitutional Protection of Rights and Public Freedoms in Kingdom of Bahrain.

Course Code: ISLM 101 **Course Title:** Islamic Culture
An introduction to the general outline and principles of Islamic culture, its general characteristics, its relationships with other cultures, general principles of Islam in beliefs, worship, legislation and ethics.

College Requirement Courses Descriptions

Course Code: CHEMY 101 **Course Title:** General Chemistry I
Atomic structure; formulas and names of chemical molecules; Avogadro's number and the mole; stoichiometry of chemical reactions; acid-base and redox reactions, solutions, concentration units, and colligative properties; gases and gas laws; electronic structure and the electron configuration; periodic properties and chemical bonding: ionic and covalent; Lewis structures and formal charge; molecular geometry and hybridization. Related practical work.

Course Code: BIOLS 102 **Course Title:** General Biology I
Properties of life; atoms, molecules and chemical bonds; biomolecules; cell structure and function; bioenergetics (intermediary metabolism); cell reproduction; Mendelian genetics; structure of DNA; RNA and protein synthesis; molecular genetics.

Course Code: PHYCS 101 **Course Title:** General Physics I
Units and measurements; brief review of vectors; Newton's laws of motion; projectile motion; work and energy; impulse and momentum; rotational dynamics; equilibrium of a rigid body; periodic motion.

Course Code: MATHS 131 **Course Title:** Calculus I
Limits, Derivatives of Algebraic and Transcendental Functions, Related Rates, the Mean Value Theorem, Graphing Techniques, Optimization, Integrals, and the Fundamental Theorem of Calculus.

Course Code: ITCS 106 **Course Title:** Computer Programming I
This course introduces problem solving and fundamental programming concepts and techniques implemented by a high-level programming language. Topics include primitive and compound data types, syntax, semantics, expressions, assignment, input, output, conditional and iterative control structures, and functions.

Course Code: ENGL 125 **Course Title:** English for Science I (SCI)
This is the first of two integrated language courses designed specifically for science majors. Special attention is given to scientific vocabulary and the unique features of technical writing. The course includes an extensive reading programme via a self-access lab.

Course Code: ENGL 126 **Course Title:** English for Science II (SCI)
English for Science is the second of two integrated language courses designed specifically for science majors. Special attention is given to scientific vocabulary and the unique features of technical writing.