Department of Chemistry

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BS in Chemistry

Mission Statement

The Chemistry Department provides liberal arts and professional education in chemistry. The undergraduate program at the department is dedicated to teaching, scholarship, research and creative endeavors. Through this program, the department delivers a strong theoretical course of study and practical training in the chemical sciences to assure the success of its students in graduate schools, professional schools and employment. Undergraduate students are able to explain the essential facts, principles and theories across the four major areas of chemistry, i.e. analytical, organic, inorganic and physical. In addition, they are strongly encouraged to be engaged in research in these aforementioned areas. The program also plays a central role in the education of students of other majors, including students of Medicine, Health Sciences, Engineering, and Agriculture.

Students accepted as chemistry majors must maintain an average of 2.2 (or 70) or above in their first three terms in major courses in order to remain in the program. Students must complete the following minimum requirements: CHEM 201, CHEM 201L, CHEM 211, CHEM 212, CHEM 215, CHEM 216, CHEM 217, CHEM 218, CHEM 220, CHEM 225, CHEM 228, CHEM 229, and CHEM 230, at least two elective courses of the following five courses: CHEM 231, CHEM 232, CHEM 233, CHEM 234 and BIOL 220, in addition to MATH 201, MATH 202, and CMPS 209 or CMPS 200, PHYS 211 and PHYS 211L, 6 credits in the Social Sciences, and 12 credits in the Humanities. It is highly recommended that chemistry majors complete MATH 201 and MATH 202 before taking CHEM 217 and CHEM 218.

The 90-credit requirement for a BS degree in Chemistry is distributed as follows:

Degree Requirements

- Major courses: 40 credits in Chemistry courses (33 credits as required courses, 6 credits as elective courses, and 1 credit as a seminar course)
- Natural Sciences courses: 4 credits of Physics
- Quantitative Thought courses: 9 credits (6 credits in Math and 3 credits in CMPS)
- University General Education requirements that include 6 credits in English Communication Skills, 3 credits in Arabic Communication Skills, 12 credits in the Humanities including 6 credits of CVSP, and 6 credits in the Social Sciences
- Elective courses: 10 credits in free electives

Freshman students who intend to major in chemistry should complete the following minimum requirements: CHEM 101, CHEM 101L, CHEM 102, CHEM 102L, MATH 101 and MATH 102, PHYS 101 and PHYS 101L.

Students who intend to minor in chemistry should complete the following requirements:

- CHEM 201, one lab course from the following list (CHEM 201L, CHEM 203, CHEM 209 or CHEM 210) and a minimum of 12 credits from courses selected from at least three of the below four chemistry divisions:
  - Analytical: CHEM 215, CHEM 219, CHEM 234
  - Inorganic: CHEM 228, CHEM 229
  - Organic: CHEM 207, CHEM 208, CHEM 211, CHEM 212
  - Physical: CHEM 217, CHEM 218, PHYS 212, [CHEM 204 and MECH 310]
- Typical choice of minors for different majors:
  - Biology: CHEM 201, CHEM 201L/210, CHEM 211, CHEM 212, CHEM 215, CHEM 228 (16/17 credits)
  - Physics: CHEM 201, CHEM 201L/209/210, PHYS 212, CHEM 215/217, CHEM 208/211/212/228 (16/17 credits)
  - Geology: CHEM 201, CHEM 201L/209, CHEM 208, CHEM 215, CHEM 228, CHEM 229 (16/17 credits)
  - Chemical Engineering: CHEM 201, CHEM 201L/209, CHEM 207, CHEM 219, CHEM (204 and MECH 310) (16/17 credits)
- For a premedical chemistry student, the core premedical chemistry courses are: CHEM 101 + CHEM 101L (or equivalent), CHEM 201, CHEM 211, CHEM 212, and CHEM 225. The biology premedical courses are BIOL 101 (or equivalent) and BIOL 200 or BIOL 201. The physics requirements for a premedical chemistry student are PHYS 211 and PHYS 211L.
- The premedical chemistry core courses for non-chemistry major premedical students are: CHEM 101 + CHEM 101L (or equivalent), CHEM 201, CHEM 210, CHEM 211, and CHEM 212.

Course Descriptions

CHEM 101 General Chemistry I 3.0; 3 cr.
An introductory course that covers atomic structure, chemical reactions, stoichiometry, gas laws, thermochemistry, periodic relationships among the elements, chemical bonding, and other basic concepts. *Every term. (Prior to Fall term 2011-12, CHEM 101 was a 4-credit course with a laboratory component.)*

CHEM 101L General Chemistry Laboratory I 1.3; 1 cr.
A laboratory course to accompany CHEM 101. The experiments explore some of the fundamental concepts which deal with measurements, percent composition, chemical reactions, stoichiometry, volumetric analysis, gas laws, and calorimetry. *Pre- or corequisite CHEM 101. Every term.*

CHEM 102 General Chemistry II 3.0; 3 cr.
A course that covers solutions, chemical equilibrium, kinetics, acid-base and solubility equilibria, introductory thermodynamics and electrochemistry; surveys common groups in the periodic table; provides an introduction to organic chemistry and nuclear chemistry. *Prerequisite: CHEM 101. Every term. (Prior to Fall term 2011-12, CHEM 102 was a 4-credit course with laboratory component.)*

CHEM 102L General Chemistry Laboratory II 1.3; 1 cr.
A laboratory course to accompany CHEM 102. The experiments explore some of the fundamental concepts which deal with physical properties of solutions, chemical equilibrium, acids and bases, solubility equilibria, kinetics and electrochemistry. *Prerequisite: CHEM 101L. Pre- or corequisite: CHEM 102. Every term.*

CHEM 200 Basic Chemistry and Applications 3.0; 3 cr.
Introduces basic chemical principles and concepts and uses them to discuss selected contemporary applications and problems from the areas of materials, environmental, medicinal or biological chemistry. Introductory topics include the electronic structure of the atom, bonding and molecular geometry, stoichiometry, and reaction energies. Selection of modern applications in Chemistry. *Students cannot receive credit for both CHEM 200 and CHEM 201. Every term.*

CHEM 201 Chemical Principles 3.0; 3 cr.
A theoretical introduction to chemical principles, stressing atomic structure, bonding, stoichiometry, gases, solutions, acids and bases, solution equilibria. *Students cannot receive credit for both CHEM 200 and CHEM 201. Prerequisite: CHEM 101 and CHEM 101L or its equivalent. Every term.*

CHEM 201L Introduction to Chemical Analysis Laboratory 1.3; 1 cr.
Introduces students to chemical analysis in a series of preparatory laboratory experiments. Students acquire knowledge in handling basic tools and equipment, conduct wet chemistry experiments and quantify aqueous solutes using simple laboratory devices. *Students cannot receive credit for both CHEM 201L and CHEM 209 and for CHEM 201L and CHEM 210.*

CHEM 202 Introduction to Environmental Chemistry 3.0; 3 cr.
An introduction to the fundamentals of physical, inorganic, and organic chemistry, with applications to environmental problems. This course surveys atomic and molecular structure, solutions, equilibrium, acids and bases, oxidation-reduction, reaction kinetics with emphasis on mechanisms of organic free radical reactions, and basic radioactivity. *Students can receive credit for CHEM 201 and CHEM 202. Prerequisites: CHEM 101 and CHEM 101L or equivalent. Every term.*

CHEM 203 Introductory Chemical Techniques 1.3; 2 cr.
A laboratory course on the methods of quantitative analysis, physical chemistry measurements, and inorganic semi-micro qualitative analysis, with applications to environmental problems. *Not open to chemistry majors. Pre- or corequisite: CHEM 200, CHEM 201, or CHEM 202. Annually.*

CHEM 204 Physical Chemistry for Chemical Engineers 2.0; 2 cr.
An introduction to the basic principles of chemical kinetics, surface phenomena and colloids: reaction rates and mechanism; theories of reaction rates; catalysis; photochemistry; colloids; adsorption on surfaces; surface analytical techniques. *Not open to chemistry students. Prerequisites: CHEM 102 and CHEM 102L. Every summer.*

CHEM 205 Introductory Chemistry Laboratory 1.4; 2 cr.
A laboratory course on the methods of quantitative analysis, physical chemistry measurements, and inorganic semi-micro qualitative analysis. *Not open to chemistry majors. Pre- or corequisites: CHEM 200, CHEM 201, or CHEM 202. Every term.*

CHEM 206 Quantitative Analysis 3.4; 4 cr.
A course that covers gravimetric and volumetric techniques; acid/base, complex formation, and redox titrations; electrochemistry and an introduction to chromatography and spectrophotometric analysis. *This course is designed for biology majors. Not open to chemistry majors. Students cannot receive credit for both CHEM 206 and CHEM 215-216. Prerequisite: CHEM 201. Occasionally.*

CHEM 207 Survey of Organic Chemistry and Petrochemicals 3.3; 4 cr.
A survey of organic chemistry which mainly covers properties and reactions of aliphatic and aromatic hydrocarbons, functional groups, including alkyl halides, alcohols and ethers, aldehydes and ketones, carboxylic acids and derivatives. This course surveys polymers, petrochemicals and their general use in industry. The laboratory component covers the basic organic lab skills such as recrystallization, distillation, extraction, chromatography and some synthesis experiments. *Designed for chemical engineering students. Students cannot receive credits for both CHEM 208 and CHEM 207; CHEM 211 and CHEM 207. Prerequisite: CHEM 102 or equivalent. Annually.*

CHEM 208 Brief Survey of Organic Chemistry 3.0; 3 cr.
A brief survey designed for students majoring in agriculture or public health that covers the following topics: hydrocarbons, stereoisomerism, organo halogens, oxygen containing groups, carbonyl groups, carboxylic acids and their derivatives, amines, carbohydrates, and amino-acids. *Students cannot receive credit for both CHEM 208 and CHEM 211. Prerequisites: CHEM 101 and CHEM 101L; or CHEM 200 or equivalent. Every term.*

CHEM 209 Introductory Organic Laboratory 1.3; 2 cr.
A course of basic experiments in organic chemistry, including synthesis and techniques of separation and purification of organic compounds. *Students cannot receive credit for more than one course between CHEM 209 and CHEM 210. Pre- or corequisite: CHEM 208. Every term.*

CHEM 210 Organic Laboratory for Non-Majors 1.4; 2 cr.
Basic experimental techniques in organic analytical chemistry (melting and boiling point, chromatography, distillation, extraction, recrystallization), performing reactions in synthetic organic chemistry. *Students cannot receive credit for more than one course between CHEM 209 and CHEM 210. Pre- or corequisite: CHEM 212. Every term.*

CHEM 211 Organic Chemistry I 3.0; 3 cr.
An introduction to organic chemistry organized according to functional groups. This course covers synthesis, properties, and reactions of aliphatic and aromatic hydrocarbons and alkyl halides, with emphasis on mechanistic and stereochemical aspects of organic reactions. *Designed for chemistry majors and premedical study. Students cannot receive credit for both CHEM 208 and CHEM 211. Prerequisite: CHEM 201. Every term.*

CHEM 212 Organic Chemistry II 3.0; 3 cr.
A course that covers synthesis, properties, and reactions of organic functional groups, including alcohols and ethers, aldehydes and ketones, carboxylic acids and derivatives, amines, phenols, and aryl halides; chemistry of difunctional compounds and of molecules of biological importance, including carbohydrates, proteins, and nucleic acids; and organic structure determination by spectroscopic methods. Emphasis is placed on reaction mechanism and stereochemistry, as well as on the design of multi-step syntheses. *Designed for chemistry majors and premedical study. Prerequisite: CHEM 211. Every term.*

CHEM 215 Analytical Chemistry 3.0; 3 cr.
A course that covers fundamental analytical processes, including solution equilibria, titrations, electrochemical theory and applications, chromatography and spectrophotometric techniques. *Students cannot receive credit for both CHEM 215 and CHEM 206. Prerequisite: CHEM 201. Every term.*

CHEM 216 Analytical Chemistry Laboratory 1.4; 2 cr.
Experimental work in related areas of chemical analysis and instrumentation; acid/base titrations, pH measurements, complexometric analysis, electrochemical determination of electrode potentials and ion activities; ion-selective electrodes; spectrophotometric analysis. *Prerequisite: CHEM 201L. Pre- or corequisite: CHEM 215. Every term.*

CHEM 217 Thermodynamics and Chemical Dynamics 3.0; 3 cr.
A course that covers the basic principles of chemical thermodynamics and chemical dynamics; mathematical machinery of the laws of thermodynamics; heat, work and energy; first, second and third laws of thermodynamics; thermodynamics of chemical reactions, phase transformations and phase equilibria; thermodynamics of solutions; transport properties: diffusion, viscosity, ion transport, thermal conductivity; chemical kinetics and reaction mechanisms. *Pre- or corequisite: MATH 202. Annually.*

CHEM 218 Molecular Structure 3.0; 3 cr.
A course that covers failures of classical physics, quantum theory, Schrödinger equation, particle in a box, harmonic oscillator, rotational motion, hydrogen atom, atomic orbitals, spin, Pauli exclusion principle, complex atoms, term symbols, molecular structure, hybridization, Hückel theory, rotation, vibration, and electronic spectra. *Students cannot receive credit for both PHYS 212 and CHEM 218. Pre- or corequisite: MATH 202. Annually.*

CHEM 219 Analytical and Instrumental Chemistry for Chemical Engineers 3.0; 3 cr.
An introduction to chemical measurements and modern instrumental methods of chemical analysis: sample preparation; error analysis; chemical separations; chromatographic; spectroscopic; electrochemical, and surface analysis techniques. Not open to chemistry students. *Prerequisites: CHEM 102 and CHEM 102L. Annually.*

CHEM 220 Physical Chemistry Laboratory 1.6; 3 cr.
Experiments in thermodynamics, kinetics, electrochemistry, spectroscopy, and exercise in computational chemistry. *Prerequisites: CHEM 201L and CHEM 217. Pre- or corequisite: CHEM 218. Annually.*

CHEM 225 Organic Structure Determination 1.6; 3 cr.
Experiments in the techniques of purification, separation, and synthesis of derivatives of organic compounds; theory and practice in the analysis of organic compounds by infrared, ultraviolet-visible spectrophotometry, mass spectrometry, and nuclear magnetic resonance; identification of pure compounds and of components of mixtures of organic compounds by chemical and spectral methods. *Prerequisites: CHEM 201L and CHEM 212. Annually.*

CHEM 227 Technical Analysis 1.4; 3 cr.
Applications of chemical analysis to the analysis of natural and industrial products such as water, milk, textiles, liquors, oils, petroleum. Industrial techniques such as sample preparation and preconcentration. Separation and identification techniques: extraction, chromatography, and spectroscopy. *Prerequisite: CHEM 215. Alternate years.*

CHEM 228 Inorganic Chemistry 3.0; 3 cr.
A course that covers atomic structure, molecular structure (VBT, MOT), molecular shape (VSEPR), symmetry and group theory, the structure of solids (metals, ionic), acids and bases (Brønsted, Lewis, HSAB, solvents). *Prerequisite: CHEM 201. Annually.*

CHEM 229 Coordination Compounds 3.0; 3 cr.
A course that covers d-metal complexes (structures and symmetries, bonding and electronic structure, reactions of complexes); electronic spectra of complexes; reaction mechanisms of d-block complexes (ligand substitution reactions in square-planar and octahedral complexes, redox reactions, photochemical reactions). *Prerequisite: CHEM 228. Annually.*

CHEM 230 Senior Seminar 1.0; 1 cr.
A literature search of a specific topic in chemistry. A written report and oral presentation in a seminar form. *Prerequisite: Senior standing. Every term.*

CHEM 231 Organic Synthesis 1.4; 3 cr.
Experiments in multistep synthesis of organic compounds, with an emphasis on methods used for synthesis and isolation, and characterization of intermediates and products. *Prerequisite: CHEM 201L. Pre- or corequisite: CHEM 212. Annually.*

CHEM 232 Inorganic Synthesis 1.4; 3 cr.
Experiments in synthesis, separation, purification, and characterization of inorganic main-group and transition metal compounds by IR, UV-Vis, NMR, and ESR spectroscopy. *Prerequisite CHEM 201L. Pre or co-requisite CHEM 229. Annually.*

CHEM 233 Topics in Physical Chemistry 3.0; 3 cr.
A course that covers a selection of topics in thermodynamics, advanced kinetics, and techniques in physical analysis; thermodynamics of phase transformation; theoretical and experimental aspects of rates of reactions; rate laws of complex reactions, catalysis, adsorption isotherms, spectroscopic techniques (e.g., laser spectroscopy, NMR, EPR); surface analysis and imaging techniques; X-ray crystallography. *Prerequisite: CHEM 217. Pre- or corequisite: CHEM 218. Annually.*

CHEM 234 Instrumental Analytical Chemistry 3.0; 3 cr.
A course that provides students with a solid knowledge in the chemistry of separation and identification. It introduces chemistry students to many analytical techniques and instruments that are widely used in different laboratories in the fields of chemistry, chemical engineering, environmental health, biochemistry, forensic science, toxicology, industrial hygiene, medicine, pharmacology, pharmacy, geology, agriculture, and other industrial applications. It includes chemometry and detailed description of sample preparation techniques; electroanalytical techniques (potentiometry, electrogravimetry, coulometry and voltammetry); spectroscopic methods (components of optical instruments, optical atomic spectrometry, atomic absorption and atomic fluorescence spectrometry, atomic emission spectrometry, molecular luminescence spectrometry); separation methods (liquid, gas, supercritical-fluid, chiral and capillary electrophoresis chromatography) and related hyphenated (coupled) techniques (GC/MS, HPLC/APCI-APPI-ESI/MS). *Prerequisite: CHEM 215. Pre- or corequisite: CHEM 216. Annually.*

CHEM 295 Special Topics in Chemistry 3.0; 3 cr.
Prerequisite: Senior standing in Chemistry. Alternate years.

CHEM 299 Independent Study 3.0; 3 cr.
Independent chemical research carried out under the direction of a faculty member, including presentation of the results in the form of a senior thesis. *Offered to senior students in good standing, by arrangement with the project director. Every term.*

34 + 6 Credits in Chemistry

Modes of Analysis	English and Arabic (9)	Humanities (12)	Social Sciences	Natural Sciences (44-47)	Quantitative Thought (9)
Lecture courses (57–63)	• Required Arabic course (3) • Required English courses: 203(3), 204(3)	• Required credits in the humanities: 12 credits including 6 credits from CVSP	• 6 credits required[1]	• Chemistry courses (24–30) • Core: CHEM 201(3), 211(3), 212(3), 215(3), 217(3), 218(3), 228(3), 229(3) • Electives[2]: CHEM 233(3), CHEM 234(3), BIOL 220(3) • Science courses (12): PHYS 211(3)	• Math and Computer Science courses: MATH 201(3), MATH 202(3), CMPS 209 or 200(3)
Seminar (1)				• CHEM 230(1)	
Laboratory (13–19)				• Chemistry courses (9–15) • Core: CHEM 201L(1), CHEM 216(2), 220(3), 225(3) • Electives[2]: CHEM 231(3), 232(3) • Science courses (1): PHYS 211L	• Computer Science (3): • CMPS 209 or 200(3)[3]
Research Project (0 or 3)				• CHEM 299(3)[4]	

1) The number of free elective credits totals 10. Students can fulfill the economics and social sciences requirements in the various modes of analysis from these credits.
2) Students take, in addition to the 33 credits of core chemistry courses and the seminar course CHEM 230, 6 credits of the following elective courses of chemistry or biochemistry: CHEM 231, CHEM 232, CHEM 233, CHEM 234 , BIOL 220.
3) CMPS 209 is counted only once in the science credits above (53-56). It is, however, included and counted in both lecture and lab modes of analysis.
4) Not a requirement; could be taken as part of the 10 credits.