

# Department of Chemistry

|                        |  |
|------------------------|--|
| Chairperson:           | Al-Ghoul, Mazen H.   |
| Professors:            | Al-Ghoul, Mazen H.; Haddadin, Makhlof J.; Halaoui, Lara I.; Sultan, Rabih F.                             |
| Associate Professors:  | Bouhadir, Kamal I.; Ghaddar, Tarek H.; Hasanayn, Faraj A.; Kaafarani, Bilal R.; Saliba, Najat I.         |
| Assistant Professors:  | El-Rassy, Houssam T.; Ghauch, Antoine, R.; Patra, Digambara G.   |
| Lecturer:              | <sup>P</sup> Moudallal, Hala   |
| Instructors:           | Abi Rafii, Randa R.; Deeb, Hana H.; <sup>P</sup> El-Batlouni, Hazar; EL-Harakeh, Mayssa; Sadek, Samar A. |
| Assistant Instructors: | Dakik, Rajaa; Jaafar, Amer; Ramadan, Hiba  |

## 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, and 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 70 or above in their first three semesters in major courses, in order to remain in the program. The student must complete the following minimum requirements: CHEM 201, 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 four courses: CHEM 231, CHEM 232, CHEM 233, and BIOL 220; in addition to MATH 201, MATH 202, and CMPS 209 or CMPS 200; PHYS 211 and PHYS 211L or PHYS 228 and PHYS 228L; 6 credits in the Social Sciences.

The 90-credit requirements for a BS degree in Chemistry are distributed as follows:

#### Major Requirements

- Major courses: 40 credits in Chemistry courses (33 credits as required courses; 6 credits as elective courses; 1 credit seminar course).



**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. *Pre- or co-requisite: CHEM 102 and Pre-requisite: CHEM 101L. Each semester.*

**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. Prerequisites: CHEM 101 and CHEM 101L or equivalent. Each semester.*

**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. Designed for students with a background in chemistry equivalent to CHEM 101 and CHEM 101L. *Students cannot receive credit for both CHEM 200 and CHEM 201. Each semester.*

**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. Each semester.*

**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 co-requisite: CHEM 200, 201, or 202. Annually.*

**Chemistry 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. *Pre-requisites: CHEM 102 and CHEM 102L. Not open to chemistry students. Each 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 co-requisites: CHEM 200, 201, or 202. Each semester.*

**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. Each semester.*

**Chemistry 207      Survey of Organic Chemistry and Petrochemicals      4.0; 4 cr.**  
A survey of organic chemistry which covers mainly spectroscopy, multi-step synthesis, properties and reactions of aliphatic and aromatic hydrocarbons, functional groups, including alkyl halides, alcohols and ethers, aldehydes and ketones, carboxylic acids and derivatives, amines, phenols and aryl halides. This course surveys polymers, petrochemicals and their general use in industry. Designed for chemical engineering students. *Students cannot receive credits for both CHEM 208 and CHEM 207; CHEM 211 and CHEM 207. Pre-requisites: CHEM 102 and CHEM 102L or equivalent. Each Summer.*

**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 102 and CHEM 102L or equivalent. Each semester.*

**CHEM 209            Introductory Organic Laboratory            1.4; 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 among CHEM 209 and CHEM 210. Pre- or co-requisite: CHEM 208. Each semester.*

**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 co-requisite: CHEM 212. Each semester.*

**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. Each semester.*

**CHEM 212            Organic Chemistry II            3.0; 3 cr.**

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. Each semester.*

**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. Annually.*

**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. *Pre- or co-requisite: CHEM 215. Annually.*

**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; thermodynamics of solutions; transport properties: diffusion, viscosity, ion transport, thermal conductivity; chemical kinetics; collision theory; activated complex theory. *Prerequisites: CHEM 201 and MATH 201. 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; and pre- or co-requisite: CHEM 218. Annually.*

**CHEM 295 Special Topics in Chemistry****3.0; 3 cr.**

*Prerequisite: senior standing in chemistry. Alternate Years.*

**CHEM 299 Independent Study****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. *Each semester.*

## 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)   | 1. Required Arabic course: 201A or any General Education Arabic communication skills (3)<br>2. Required English courses: 203(3), 204(3) | Required credits in the humanities: 12 credits including 6 credits from CVSP (see pp. 163-68) | 6 credits required <sup>1</sup> | 1. Chemistry courses (24-30)<br>Core: CHEM 201(3), 211(3), 212(3), 215(3), 217(3), 218(3), 228(3), 229(3) Electives <sup>2</sup> : CHEM 233(3), BIOL 220(3)<br>2. Science courses (12 cr.): 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)        |   |   |                                 | 1. Chemistry courses (9-15)<br>Core: CHEM 216(2), 220(3), 225(4) Electives <sup>2</sup> : CHEM 231(3), 232(3)<br>2. Science courses (1): PHYS 211L  | Computer Science (3): CMPS 209 or 200(3) <sup>3</sup>                           |
| Research project (0 or 3) |   |   |                                 | CHEM 299(3) <sup>4</sup>  |   |

<sup>1</sup> 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.

<sup>2</sup> Students take, in addition to the 33 credits of core chemistry courses and the seminar course (230) 6 credits of the following elective courses of chemistry or biochemistry: CHEM 231, CHEM 232, CHEM 233, BIOL 220.

<sup>3</sup> 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.

<sup>4</sup> Not a requirement, could be taken as part of the 10 credits