

# Department of Chemistry

Chairperson:	Al-Ghoul, Mazen H.
Professors:	Haddadin, Makhlof J.; Sultan, Rabieh F.
Associate Professors:	Al-Ghoul, Mazen H.; Bouhadir, Kamal I.; Halaoui, Lara I.; Hasanayn, Faraj A.; Saliba, Najat I.
Assistant Professors:	El-Rassy, Houssam T.; Ghaddar, Tarek H.; Ghauch, Antoine, R.; Kaafarani, Bilal R.; Patra, Digambara
Lecturer:	<sup>P</sup> Fares, Fares
Instructors:	Deeb, Hana H.; Abi Rafii, Randa R.; Sadek, Samar A.; <sup>P</sup> Abi Saab, Manal; <sup>P</sup> Abramian, Lara; <sup>P</sup> Farah, Manal; <sup>P</sup> Hammoud, Chaza
Assistant Instructors:	Dakik, Rajaa; <sup>P</sup> El-Batlouni, Hazar; <sup>P</sup> El-Moustafa, Rasha; <sup>P</sup> Jaafar, Amer; Ramadan, Hiba

## Graduate Program

The department offers the MS degree in chemistry. Graduate students may specialize in analytical, inorganic, organic, or physical chemistry. Of the minimum 21 graduate course credits required for the MS degree, a minimum of six credits must be graduate courses in the special field of chemistry in which the student concentrates. At least six additional credits must be graduate courses in chemistry outside the student's field of specialization. CHEM 361 is a requirement for all graduate students.

The research interests of the chemistry faculty include the following: synthetic heterocyclic chemistry; synthesis of biomaterials for drug delivery; synthesis of carbocyclic DNA analogs; reactive intermediates; cage compounds; coordination and organometallic chemistry; supramolecular chemistry; photocatalysis; photoelectrochemistry of semiconductors; synthesis, assembly, and physical properties of nanostructured materials; surface chemistry; irreversible nonequilibrium thermodynamics and statistical mechanics; nonlinear dynamics in chemistry; generalized hydrodynamics; chemical waves; precipitate patterns; laboratory and field investigations of atmospheric chemistry processes; design and synthesis of novel photo-active dendrimers; self-assembled mono-layers (SAMs) of bioactive material and poly-peptides on metal surfaces; study of electronic structure of unsaturated transition metal complexes and their reactions; analytical monitoring of priority pollutants in soil and water; process analytical chemistry applied in waste treatment and recycling technologies; natural compounds for metal sequestration; calorimetric methods in life sciences; discotic liquid crystals; synthesis of electron-deficient materials for organic electronics and opto-electronics applications; organic light emitting diodes (OLEDs), organic field effect transistors (OFETs), and organic solar cells; molecular recognition; and, solid-state stacking of organic materials.

**CHEM 301**                      **Structure of Inorganic Compounds**                      **3.0; 3 cr.**  
Electronic absorption spectra of complex inorganic molecules; vibrational, NMR, NQR, EPR, and Mössbauer spectroscopy; physical methods of determination of the structure of inorganic molecules.  
*Annually.*

- CHEM 303 Chemistry of the Coordination Compounds 3.0; 3 cr.**  
Applications of Orgel and Tanabe-Sugano diagrams; factors affecting stability of coordination compounds; stereochemistry; trans-effect; stabilization of oxidation states; mechanisms of the reactions of coordination compounds; catalysis by coordination compounds. *Annually.*
- CHEM 304 Mechanisms of Inorganic Reactions 3.0; 3 cr.**  
Mechanisms of substitution reactions in octahedral and square planar metal complexes; mechanisms of oxidation-reduction, metal ion catalysis and photochemistry; application of symmetry rules to inorganic reactions; fluxional molecules. *Alternate years.*
- CHEM 311 Advanced Organic Chemistry 3.0; 3 cr.**  
Electronic interpretation of organic reactions; correlation of inductive, resonance, and steric effects with reactivity of molecules; chemistry of carbocations, carbanions, carbenes, carbenoids, and radicals as intermediates in characteristic organic reaction mechanisms. *Annually.*
- CHEM 313 Physical Organic Chemistry 3.0; 3 cr.**  
Organic reactions mechanisms, linear free energy relationships, solvent and reagent correlations, isotope effects, catalysis in weak and strong acid and base medium, organic photochemistry and pericyclic reactions. *Alternate years.*
- CHEM 314 Heterocyclic Chemistry 3.0; 3 cr.**  
A general survey of the synthesis and reactions of selected classes of heterocyclic compounds; spectroscopic properties and structural relationships. *Alternate years.*
- CHEM 315 Chemistry and Technology of High Polymers 3.0; 3 cr.**  
An introduction to the chemistry of high polymers; types, mechanisms, and kinetics of polymerization; structure, characterization, and properties of macromolecules; preparation, processing, and uses of the more common condensation and addition polymers used in plastics, elastomers, and fibers. *Alternate years.*
- CHEM 321 Quantum Chemistry 3.0; 3 cr.**  
Wave mechanics, solutions of time-independent Schrödinger equation, particle in a box, harmonic oscillator, angular momentum, H-atom, atomic orbitals, variational theorem, perturbation theory, polyelectronic atoms, Slater determinants, term symbols, Hückel MO theory, electronic wave functions, SCF and CI calculations. *Alternate years.*
- CHEM 322 Statistical Thermodynamics 3.0; 3 cr.**  
General statistical mechanics of independent particles; partition functions for atoms and molecules, and simple chemical equilibria; heat capacities of solids, configuration of polymers, ensembles, theory of imperfect gases and of mixtures, lattice statistics, irreversible processes. *Alternate years.*
- CHEM 323 Chemical Kinetics 3.0; 3 cr.**  
Rate analysis, modern experimental techniques, theories of chemical kinetics, selected topics in gas phase and solution kinetics, characterization of transition states by ab-initio methods. *Alternate years.*
- CHEM 324 Electrochemistry 3.0; 3 cr.**  
Fundamentals and applications of electrochemistry. Overview of electrode processes, potentials and thermodynamics of cells; kinetics of electrode reactions; Marcus microscopic theory for charge transfer; treatment of mass transfer by migration and diffusion; electrochemical techniques including potential step methods, potential sweep methods, and hydrodynamic methods; electrode reactions with coupled homogeneous chemical reactions; instrumentation. *Alternate years.*

- CHEM 331 Chemical Instrumentation for Environmental Analysis 3.0; 3 cr.**  
Qualitative and quantitative analytical methods; ultraviolet (UV) and infrared (IR) spectroscopy; atomic absorption (AA) and emission spectroscopy; introduction to chromatographic separations. Designed for the Interfaculty Graduate Environmental Sciences Program (IGESP). *Annually.*
- CHEM 332 Chemical Separations in Environmental Analysis 3.0; 3 cr.**  
Fundamentals of analytical separations; distribution methods in discrete stages; methods in continuous stages; chromatographic methods: GC, HPLC, SFC; non-chromatographic methods: electrophoresis, field-flow fractionation, size exclusion; recent innovations. Designed for the Interfaculty Graduate Environmental Sciences Program (IGESP). *Annually.*
- CHEM 351/352 Special Topics 3 cr.**  
May be repeated for credit with consent of the department.
- CHEM 361 Tutorial 3 cr.**  
A tutorial that should be taken during a student's second or third semester of graduate studies, but not during a summer session. Students taking CHEM 361 are required to submit written reports to their advisers and to present a seminar to the students and faculty of the department. CHEM 361 is required of all graduate students in the department.
- CHEM 395A/395B Comprehensive Exam 0 cr.**  
*Prerequisite: Consent of adviser*
- CHEM 399 MS Thesis 9 cr.**