

**AMERICAN UNIVERSITY OF BEIRUT**  
**FACULTY OF ARTS AND SCIENCES**  
**DEPARTMENT OF CHEMISTRY**

**CHEM 202**  
**Introduction to Environmental Chemistry (3 cr.)**  
Spring 2017-2018

**Course Instructor:** Houssam El-Rassy, PhD, Associate Professor  
**Office:** Chemistry Bldg., Room 520  
**E-mail:** Houssam.Rassy@aub.edu.lb  
**Phone Ext.:** 4051

**Office Hours:** TBA

**General Lectures:** T-Th 9:30 – 10:20 am (CHSC Auditorium)  
**Recitation:** Section 1: M 9:00 – 9:50 am (PHYS 329) – CRN 20785  
Section 2: F 1:00 – 1:50 pm (BIOL SLH) – CRN 20786  
Section 3: F 10:00 – 10:50 am (CHEM 001) – CRN 20787  
Section 4: F 12:00 – 12:50 pm (CHEM 101) – CRN 20788

### Course Description

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 semester. (AUB Undergraduate Catalogue 2017-2018, p. 179)

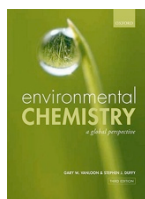
### Learning Outcomes

Upon completion of this course, the student will demonstrate a working knowledge of the concepts covered in each section of this course, such as:

1. Use the atomic structure arguments to describe the orbitals, the electronic structure of atoms and the periodicity of the elements.
2. Apply the simple bonding theory to Lewis dot, resonance, formal charge, and polarity.
3. Differentiate between the various bonds in molecular and ionic compounds.
4. Apply the Valence Shell Electron Pair Repulsion model to predict the geometry of molecules.
5. Solve problems involving the principles of chemical kinetics.
6. Apply the fundamentals of chemical equilibria to systems involving proton-transfer reactions.
7. Explain the major differences between the successive layers of the earth's atmosphere.
8. Describe and explain the major photochemical reactions taking place in the stratosphere.
9. The ozone layer and the photochemical reactions leading to the ozone depletion.
10. The chemistry in the troposphere and the formation of smog.
11. The greenhouse effect and the global warming.
12. The water pollution by heavy toxic metals and their bio-geochemical cycles.
13. Explain the phenomena behind the formation of acid rain.
14. Identify the various types of biological and chemical water pollutants and explain their effects.
15. Describe the water and sewage treatment process and explain the rationale after each step.

## Resource Available to Students

Textbook: Gary W. vanLoon and Stephen J. Duffy, Environmental Chemistry: A Global Perspective, 3<sup>rd</sup> Edition, Oxford University Press, 2010



PowerPoint Slides      Lectures slides will be available to students through Moodle.

## Course Policy, Exams and Grading

Students must be considerate of their classmates and abstain from disruptive behavior during the lecture period. This includes talking and whispering, while the instructor is addressing the class.

Students are expected to attend all classes and participate in class discussion. Students who do not attend the classes will be dropped out of the course. Students are expected to enter the classroom on time. Attendance will be taken at random intervals.

Students must sit for all exams. The grading scheme for this course will be as following:

Midterm:	50%
Final Exam:	50%

Unless a valid excuse is presented (AUBMC family medicine or AUBMC medical report), the student will take a zero on missed Exams. No make-ups for missed Midterm. If the excuse is accepted, the grade distribution will become 100% for the final exam.

Non-graphing non-programmable calculators are indispensable during the quizzes and final exam. Programmable calculators are not allowed in the exam room. The student must take a quiz without calculator if he/she doesn't bring an appropriate calculator. Students are not allowed to use their mobile phones or any other alternative as calculators during the quizzes and exams. Mobile phones are not allowed in classrooms and exam rooms.

Students must respect the Student Code of Conduct. Any violation of this Student Code of Conduct, either academic or non-academic misconduct, will be reported to the appropriate level where the student risks being subject to disciplinary action in accordance with the Student Code of Conduct. <http://www.aub.edu.lb/pnp/generaluniversitypolicies/Documents/StudentCodeConduct/StudentCodeConduct.pdf>

AUB strives to make learning experiences accessible for all. If you anticipate or experience academic barriers due to a disability (such as ADHD, learning difficulties, mental health conditions, chronic or temporary medical conditions), please do not hesitate to inform the Accessible Education Office. In order to ensure that you receive the support you need and to facilitate a smooth accommodations process, you must register with the Accessible Education Office (AEO) as soon as possible: [accessibility@aub.edu.lb](mailto:accessibility@aub.edu.lb); +961-1-350000, x3246; West Hall, 314.

AUB is committed to facilitating a campus free of all forms of discrimination including sex/gender-based harassment prohibited by Title IX. The University's non-discrimination policy applies to, and protects, all students, faculty, and staff. If you think you have experienced discrimination or harassment, including sexual misconduct, we encourage you to tell someone promptly. If you speak to a faculty or staff member about an issue such as harassment, sexual violence, or discrimination, the information will be kept as private as possible, however, faculty and designated staff are required to bring it to the attention of the University's Title IX Coordinator. Faculty can refer you to fully

confidential resources, and you can find information and contacts at [www.aub.edu.lb/titleix](http://www.aub.edu.lb/titleix) . To report an incident, contact the University's Title IX Coordinator Trudi Hodges at 01-350000 ext. 2514, or [titleix@aub.edu.lb](mailto:titleix@aub.edu.lb) . An anonymous report may be submitted online via EthicsPoint at [www.aub.ethicspoint.com](http://www.aub.ethicspoint.com)

## Course Outline

- 1. Introduction to Environmental Chemistry / Syllabus**  
Earth history; Beginnings of life; Atmosphere; Cycles; Air pollution; Ozone; Smog; Greenhouse effect; Water pollution; Water treatment.
- 2. Chemical Kinetics**  
Rate of a chemical reaction; Effect of concentration on reaction rates; Rate law; Zero-order reactions; First-order reactions; Second-order reactions; Theoretical models for chemical kinetics; The effect of temperature on reaction rates; Reaction mechanisms; Catalysis.
- 3. The Earth's Atmosphere (Chapter 2)**  
The Atmosphere; Functions of the atmosphere; Layers of the atmosphere; Temperatures and regions; Reactions and calculations in atmospheric chemistry.
- 4. Stratospheric Chemistry – Ozone (Chapter 3)**  
Concerns about stratospheric ozone; Energy transition; UV absorption and photochemistry; Stratospheric ozone formation; Catalytic decomposition of ozone; Chlorofluorocarbons; The ozone hole; Polar Stratospheric Clouds.
- 5. Tropospheric Chemistry – Smog (Chapter 4)**  
Classical smog; Photochemical smog; The photochemistry of smog; Reactions of hydrocarbons in the troposphere; Exhaust gases from engines; Ozone production from engine emissions.
- 6. Tropospheric Chemistry - Precipitation (Chapter 5)**  
Composition of rain; Atmospheric production of nitric and sulfuric acids; Acidifying agents; Rain, snow and smog chemistry; Control of anthropogenic emissions.
- 7. Aerosols and Chemistry of Urban and Indoor Atmospheres (Chapters 6&7)**  
Sources and concentrations of aerosols; aerosols lifetime; Air pollution for particulate emissions; Pollutants in urban atmosphere; Indoor quality and common indoor air contaminants.
- 8. The Chemistry of Global Climate (Chapter 8)**  
Energy balance; Global warming; Greenhouse effect; Sources and sinks of greenhouse gases.
- 9. Distribution of Species in Aquatic Systems (Chapter 10)**  
Phosphate species; Cadmium complexes; Chromium in tannery wastes.
- 10. Gases in Water (Chapter 11)**  
Henry's law; Oxygen in natural and sea waters; Gases reacting with water; Alkalinity and pH.
- 11. Metals in the Hydrosphere (Chapter 13)**  
Toxic metals; Biogeochemical cycle of metal species; Mercury cycle; Mercury, lead and cadmium pollution.
- 12. Water Pollution and Waste-Water Treatment (Chapter 16)**  
Sources and types of water pollution; Oxygen-consuming agents; Plant nutrients and Eutrophication; Water and sewage treatment.