“Education in and about chemistry is critical in addressing challenges such as global climate change, in providing sustainable sources of clean water, food and energy and in maintaining a wholesome environment for the well being of all people…” – UN International Year of Chemistry resolution

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Pre-requisites: CHEM 220/220L and CHEM 231/231L

Required Materials: Scientific calculator with logarithmic and exponential functions

Recommended Materials: A general chemistry textbook for reviewing basic chemical concepts

Course Description:
- This course will be divided into three main units that reflect the most pressing issues in modern environmental chemistry. We will cover:
  - Atmospheric Chemistry and Air Pollution
  - Climate Change and Energy
  - Water Chemistry, Pollution and Treatment
- As a sustainability-related course, students will be required to think broadly about environmental systems to include the social and economic factors that must also be considered.

Student Learning Outcomes:
- Students will demonstrate an understanding of the chemical processes that influence the environment (air, water, soil and climate).
- Students will apply fundamental chemical principles (acid-base chemistry, thermodynamics, kinetics, redox reactions and light-matter interactions) to understand the sources, transport, transformation and ultimate fate of various chemical species in the environment.
- Sustainability-related learning outcomes:
  - Students will identify policies and practices that have led to unsustainability. (QEP SLO 3)
  - Students will demonstrate the impact of production/consumption practices on environmental systems. (QEP SLO 5)
  - Students will design a solution to a sustainability problem, as it relates to the purification of drinking water. (QEP SLO 6)

Attendance/Participation: I expect you to attend all classes. If you must miss a class due to an illness or school sanctioned event, it is your responsibility to get the material you missed from another student. Regular participation by all students in this class is expected.

Homework: Homework assignments will be in the form of problem sets that will be assigned regularly and posted on OAKS. Assignments are due at the start of class on their due date, which will be provided on OAKS and stated in class. Late homework will not be accepted.
**Tests:** There will be three in-class tests, approximately every four weeks (tentative dates: **February 6, March 6 and April 12**). If you know in advance you will miss a test due to a religious observance or school sanctioned event, it is your responsibility to let me know immediately so arrangements can be made. If you miss a test unexpectedly, you must provide documentation in the form of an absence memo if you expect to make it up.

**Final Exam:** The final exam is cumulative and will cover lecture material from the entire semester. The final exam will be **Thursday, April 26, 12 – 3 pm.**

**Grading:**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Range</th>
<th>What each grade means</th>
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<tbody>
<tr>
<td>A</td>
<td>93.0 - 100</td>
<td>The student has achieved mastery of the material. Not only does the student demonstrate understanding of all aspects of the material to significant depth, but can reliably apply that understanding toward solving problems, both familiar and unfamiliar. What sets this student apart from others is the ability to solve problems that require synthesis of various ideas.</td>
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<tr>
<td>A-</td>
<td>90.0 – 92.9</td>
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<tr>
<td>B+</td>
<td>87.0 – 89.9</td>
<td>The student is very competent with the material. The student demonstrates understanding of most aspects of the material, but some gaps exist. He or she can routinely apply that understanding toward solving familiar problems, but will struggle slightly when solving unfamiliar problems. The student especially struggles to solve problems that require synthesis of various ideas.</td>
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<tr>
<td>B</td>
<td>83.0 – 86.9</td>
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<tr>
<td>B-</td>
<td>80.0 – 82.9</td>
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<tr>
<td>C+</td>
<td>77.0 – 79.9</td>
<td>The student is moderately competent with the majority of the material, but does not understand it to great depth. Thus, the student can solve routine problems that he or she has seen before, but definitely struggles to solve unfamiliar problems, especially ones that require synthesis of various ideas.</td>
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<tr>
<td>C</td>
<td>73.0 – 76.9</td>
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<tr>
<td>C-</td>
<td>70.0 – 72.9</td>
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<tr>
<td>D+</td>
<td>67.0 – 69.9</td>
<td>The student does not demonstrate significant command of the material, essentially because he or she does not understand it. He or she struggles to solve most problems, even familiar ones. Such a student relies primarily on rote memorization, and therefore is not able to solve problems that require synthesis of ideas.</td>
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<tr>
<td>D</td>
<td>63.0 – 66.9</td>
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<tr>
<td>D-</td>
<td>60.0 – 62.9</td>
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<tr>
<td>F</td>
<td>&lt; 59.9</td>
<td>The student shows essentially no command of the material and is unable to solve problems that are deemed straightforward. Such students rely essentially entirely on rote memorization, and therefore are not able to solve problems that require synthesis of ideas.</td>
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OAKS: OAKS will be used for announcements, quizzes, homework assignments, supplementary materials and handouts used in class. You are responsible for printing all necessary materials yourself if you would like a hard copy.

Office hours: My regularly scheduled office hours are in the table on the right. If you would like to meet with me and are unavailable at these times, please suggest some different times that work for you and we will be able to schedule a meeting that works in your schedule.

<table>
<thead>
<tr>
<th>Office hours (SSMB 310)</th>
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<tr>
<td><strong>Day</strong></td>
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<td>Wednesday</td>
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<td>Friday</td>
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Disability Services: If you are a student with a documented disability who will require accommodations in this course, please provide the proper documentation in the form of a Professor Notification Letter (PNL). Please come to speak with me during office hours about how I may best accommodate you in this course.

Academic Dishonesty: Lying, cheating, attempted cheating, and plagiarism are violations of the Honor Code of the College of Charleston (http://studentaffairs.cofc.edu/honor-system/studenthandbook/index.php). As it pertains to this course, examples of academic dishonesty would include copying another student’s work during an exam or collaborating with another student on an individual project. Working together on homework is not considered academic dishonesty in this course, but students should use their best judgment to ensure collaborations are mutual so both/all students benefit from homework as a learning tool.

Classroom Conduct and Group Work: We will regularly carry out exercises in small groups or as a class. Please always be respectful of your classmates, listen when others are speaking and refrain from doing anything not related to the class.

Electronic Device Policy: Using electronic devices for activities not related to class (e.g., texting) during lecture is rude to me and a distraction to your classmates. If you choose to use a laptop or tablet device during class, you should refrain from any social networking, games, etc. that are distracting to others. If your device becomes a distraction, you may be asked to put it away or move to the back of the classroom.

Important Dates

- Tuesday, January 16 – Last day to drop/add
- Tuesday, February 6 – Test 1 (Atmospheric Chemistry)
- Tuesday, March 6 – Test 2 (Climate and Energy)
- Tuesday, March 13 – Last day to withdraw with a grade of “W”
- Monday, March 19 – Friday, March 23 – Spring Break – no class
- Thursday, April 12 – Test 3 (Water)
- Thursday, April 26 – Final Exam (12 – 3 pm)
Lecture Schedule
Class time will be largely devoted to lectures on new material, discussions on assigned reading from the literature and doing group work. Students are encouraged to ask questions throughout the class period. If significant review of material from general chemistry is needed, students will be encouraged to review this material outside of class.

Lecture Outline
- Chemistry of the Stratosphere
  - Layers of the atmosphere
  - Ozone layer
  - The ozone holes
- Chemistry of the Troposphere
  - Gas concentration units
  - Chemical fate of trace gases
  - Hydroxyl radical reactions
  - Photochemical smog
  - VOC's, NO\textsubscript{x} and ground level ozone
  - Aerosols
  - Sulfur dioxide emissions
  - Sources and effects of acid rain
- Chemistry of Climate
  - Mechanism of the greenhouse effect
  - Sources and effects of major greenhouse gases and aerosols
- Energy Use
  - Fossil fuels
  - Biofuels
  - Renewable energy
  - Nuclear energy
- Chemistry of Natural Waters
  - Dissolved oxygen
  - Oxidation of organic material
  - pE/pH diagrams
  - Carbonate System
  - Ocean Acidification
- Pollution and Purification of Water
  - Drinking water purification
  - Waste water treatment
  - Toxic heavy metals
  - Organic pollutants