

**Atmospheric Chemistry**  
**CHEM 3410**  
**Spring Quarter, 2021 (CRN 4959)**

**Instructor:** Dr. J. Alex Huffman  
**Office:** Seeley G. Mudd, Room 180  
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**Contact Info:** Email – [alex.huffman@du.edu](mailto:alex.huffman@du.edu)  
**Office Hours:** In-person; times TBD

**Class Time:** MWF, 10:00 – 10:50 AM  
**Class Location:** Knudson Hall (CMK), Room 211

**Textbooks:** No textbook are required for purchase for this course.

We will make some use of the following textbook, which is available for free at the site linked below:

Daniel J. Jacob

*Introduction to Atmospheric Chemistry*

Published: 1999, Princeton University Press

ISBN-13: 978-0691001852

<http://acmg.seas.harvard.edu/people/faculty/djj/book/>

(For reference, a new hardback version is ~\$60 on Amazon)

We will also make use of the following books. If you plan to pursue deeper study in atmospheric chemistry, I highly suggest purchasing one or both of these common, exhaustive references:

Barbara J. Finlayson-Pitts and James N. Pitts

*Chemistry of the Upper and Lower Atmosphere*

Published: 2000, Elsevier Inc.

ISBN: 978-0-12-257060-5

John H. Seinfeld and Spyros N. Pandis

*Atmospheric Chemistry and Physics*

Published (3<sup>rd</sup> Ed): 2016, Wiley and Sons.

ISBN: 978-1-118-94740-1

## **COURSE DESCRIPTION**

This is a beginning course in atmospheric chemistry – an examination of the Earth's atmosphere as a chemical system. It is assumed that you have a sound knowledge of general chemistry and basic organic chemistry. Having taken other, upper-division chemistry or physics courses may be beneficial as well; however, concepts not built directly on previous core courses will be introduced and explained as appropriate.

The course will be taught at the upper division level, and is also cross-listed as a graduate chemistry course. Students enrolled in the course may be (bio)chemistry or environmental science majors from the sophomore undergraduate level all the way to the graduate level. As a result, material will be presented in a way to make the material accessible to all students from these backgrounds. Some areas of missing background material may require outside reading to fill in gaps. This will be assisted by the instructor to make sure there is a basic plan to get students up to speed if there are some holes in prerequisite knowledge. Most course material will be introduced and discussed explicitly through lectures. For other topics, however, you will be expected to read and learn independently from assigned readings. In some cases you will have the opportunity to guide your own learning on specific topics, i.e. in preparation for a presentation or report.

## LECTURE

The format of the class meetings will follow live, in-person lecture format on MWF. Under most circumstances, students will be expected to attend lectures in-person (i.e. a “normal” class). There may be situations that require a student or the instructor to miss for sanctioned reasons, in which case instruction by Zoom will be managed individually. This is will not be the standard case, and should be approved individually with the instructor. It is *not* anticipated that the course lectures will be recorded or offered in hybrid format.

The instructor will summarize new material and present illustrations and examples. For relevant sections of the course, you will be encouraged to practice problems after lectures. The instructor will NOT be able to identify and describe every detail you read in the text and any supplemental materials. You will be expected to finish and understand assigned readings even if I have not gone over that material in great detail. However, the instructor will emphasize important topics covered in the reading as well as problem solving strategies when appropriate. Please stop me at any time if you have questions.

## OFFICE HOURS

Following an office hours poll, I will post the weekly hours when I will be available in my office for questions or issues related, or unrelated, to the course. These hours may be changed, if necessary, during the quarter, but this will be announced.

## IMPORTANT DATES

March 27: Classes begin, Spring Quarter

May 29: Memorial Day (No class)

June 2: Last day of classes

June 5 (Monday): Final Exam

## COURSE OBJECTIVES

The course will be taught at an upper division level. This means that some material will be presented directly, but other material will require independent effort by students. The overarching objective of the course is to introduce students to the chemical composition of the atmospheric as well as key chemical and physical transformations and processes that take place in the natural and anthropogenically-influenced atmosphere. The focus of the course will be on the troposphere and stratosphere.

The broader objective of the course is to empower students to be literate in the most important topics about atmospheric chemistry in order to introduce basic vocabulary and ideas for students that may interact with atmospheric chemistry later in their educational or professional careers. It may be that students later follow paths of environmental policy or law, they may become involved in environmental chemical research, or could work in industrial or government settings where having either a deep or basic knowledge of these topics could be useful. The course is intended to be a starting point for this learning process. A separate objective of the course is to introduce students to ways atmospheric chemistry may provide an avenue for a career, e.g. through atmospheric monitoring, environmental consulting, or research. One or more field trips may be arranged to introduce students to resources and opportunities in the region.

Specific course objectives include the ability to understand and explain the:

- Major components and associated physical reasoning behind the physical and chemical structure of the atmosphere
- Key chemical species and associated reactions in the troposphere and stratosphere
- Key cycles of stratospheric ozone production and destruction, including anthropogenic influence
- Role greenhouse gases & aerosols play in the climate system, incl. sources, sinks, radiative forcing
- Key gas-phase pollutants in the troposphere, incl. basic sources, sinks, and chemical transformations
- Basic topics about key chemical species in the indoor air environment
- Key instruments uses for measurement of EPA-regulated atmospheric chemical species, including the fundamental principles of their operation

## **COURSE TOPICS**

Section I: Atmospheric composition, structure, and transport

Section II: Stratospheric ozone chemistry

Section III: Atmospheric chemistry of global environmental change

Section IV: Basics of atmospheric chemical reactions: kinetics, photochemistry, modeling

Section V: Tropospheric chemistry and air pollution

Section VI: Atmospheric aerosol and aerosol chemistry

Section VII: Indoor air chemistry

Section VIII: Atmospheric measurement instrumentation

Section IX: Presentation topics

Note that the list of topics is currently being kept modular and flexible and is not necessarily listed in the order we will approach them. Because the course is not a specific pre-requisite for other courses, we have the luxury of being able to do things that fit the unique interests of the course and this year's students. Interests by the class will be discussed in the first week in order to consider altering the plan to adapt. Additional details will be provided through lecture slides.

## **READING**

Readings will periodically be assigned. These will be mentioned in lecture and posted via Canvas. You are encouraged to complete the assigned reading prior to the class lecture and sometimes again after the lecture. In addition, you are also encouraged to attempt the example exercises throughout the text.

## **GRADED ASSIGNMENTS**

Periodic homework assignments will be required to be turned in for a grade. These may be comprised of problems taken from a book or may be more conceptual or literature-research driven in nature. Some assignments will be individual efforts and others will require group work. Homework problems will often be more difficult than exam questions in order to make you think.

The instructor will make clear whether individual assignments are to be turned in on-paper or electronically via Canvas upload. Unless otherwise stated, assume assignments will be submitted electronically. It is very important that all assignments are: (a) submitted as a single document per assignment in a standard document format (or stapled together, if submitted on-paper), (b) typed or easily readable, (c) oriented in the correct way to be easily read (all pages). Assignments submitted without proper organization or clarity may be returned and may be counted as late and/or receive an additional grade penalty.

## **PRESENTATIONS & REPORTS**

In addition to graded homework assignments, several reports will be required, as will be discussed. The topics for these reports will not be discussed at length during the lecture and represent an area of individual learning and effort by the student. Report assignments may require you to watch a recorded lecture, listen to a podcast, or read an article or another report in order to summarize and answer questions as will be given in the assignment. There will be at least one presentation required in the course. The grade for the presentation(s) will be assigned based on presented content as well as presentation style, format, and skill. These details will be discussed in advance of the first required presentation.

## **LATE WORK POLICY**

Unless otherwise stated or approved by the instructor, all assignments will be due at the beginning of class on the date due. A late penalty will be assessed according to the following break-down, with the percentage of the total assignment weight reduced as follows: 10% if turned in after 10:05 am, but before 10 pm on the due date; an additional 10% if by 10 am the next business day (M-F); an additional 20% for each following business day.

## **EXAMS**

Approximately two (2) exams will be given during the quarter: one mid-term and one final exam. The dates of these exams will be given well in advance. It is most likely that the final exam will be given during the university-prescribed final exam date, and it should be expected that **the final may not be dropped or taken early**.

Both exams will have an in-class, written component. One or both exams may have an oral exam component, which will be administered outside of class time based on a scheduled meeting with Prof. Huffman. The meeting will take place in

Prof. Huffman's office and will be video recorded for grading purposes. A copy of the recording may be requested within a few days, if desired. The exam points itemized below will be the sum of all of these exam components.

### **PARTICIPATION**

Unlike many chemistry courses, some of the topics we will discuss will encourage class discussion and participation. Up to 25 points (or 5%) of the course grade may be assigned for class participation. This may include participation on one or more field trips, to be discussed.

### **GRADES**

Your final grade will be earned according to your performance on a mix of requirements, as introduced above. The table below lists a tentative estimate of the final points break-down that will be used. Any changes will be announced in class. The total exam fraction of the grade will not exceed 50%, and may be lower. The final letter grade will be assigned based on the table of percentages listed here. I will not grade on a curve, but overall grade averages may be slightly increased if necessary in some cases.

| <b>Component</b>        | <b>Points</b> | <b>Percentage</b> |           |
|-------------------------|---------------|-------------------|-----------|
| Exams (~2)              | 250           | 50%               | ← or less |
| Presentations & Reports | 150           | 30%               |           |
| Homework                | 75            | 15%               |           |
| Participation           | 25            | 5%                |           |
|                         |               |                   |           |
| <i>Total (approx.)</i>  | 500           | 100%              |           |

| <b>Final Letter Grade</b> | <b>Minimum Percentage</b> |
|---------------------------|---------------------------|
| A                         | 94%                       |
| A -                       | 90%                       |
| B +                       | 87%                       |
| B                         | 84%                       |
| B -                       | 80%                       |
| C +                       | 77%                       |
| C                         | 74%                       |
| C -                       | 70%                       |
| D +                       | 67%                       |
| D                         | 64%                       |
| D -                       | 60%                       |
| F                         | <60%                      |

### **IN-PERSON ATTENDANCE POLICY**

As in any in-person course, attendance and participation are important for a mastery of the course material. However, I understand that life circumstances can prevent students from being able to attend every class. Therefore, I will allow three (3) excused absences for each students to use in order to manage personal emergencies, wellness, disability, child care, etc. I don't expect communication regarding your reason for missing class, as it may be personal in nature, but please let me know either before or within a lecture afterward.

### **LECTURE AND TESTING ACCOMMODATIONS**

Students with disabilities (i.e., physical, medical, mental, emotional, and learning) deserve to participate in all of the University of Denver's courses, programs, and activities. I will make every effort to accommodate students diagnosed with a learning disability. I will do this in complete confidence. I request that any student requiring these accommodations inform me the first week of class. For further information, please see the University Disability Services' website: <http://www.du.edu/disability/dsp/index.html>.

Please note your professors must have your Letter of Approved Accommodations in order to provide you with accommodations. Accommodations are not retroactive, e.g., after a test or due date. All requests to take quizzes, tests, midterms, and final exams at the DSP Testing Center must be made prior to the sign-up deadlines via the [Accommodate Student Portal](#).

## RELIGIOUS ACCOMMODATIONS

As part of its commitment to diversity and Inclusive Excellence, the University provides reasonable accommodations for students' sincerely held religious beliefs or practices unless the University determines that such an accommodation would fundamentally alter the curriculum or academic program. Students are expected to examine the course syllabus for potential conflicts with religious beliefs or practices, and submit the Religious Accommodation Request webform to seek accommodation. Students who have conflicts with the overall class or experience schedule, such as the time and date the class is offered, are encouraged to find an alternative section for the class. For full details, including request process, visit the [Religious and Spiritual Life](#) web page.

University policy grants students excused absences from class or other organized activities or observance of religious holy days, unless the accommodation would create an undue hardship. Faculty are asked to be responsive to requests when students contact them *in advance* to request such an excused absence. Students are responsible for completing assignments given during their absence, but should be given an opportunity to make up work missed because of religious observance.

## INCLUSIVE LEARNING ENVIRONMENTS

In this class, we will work together to develop a learning community that is inclusive and respectful. Our diversity may be reflected by differences in race, culture, age, religion, sexual orientation, socioeconomic background, and myriad other social identities and life experiences. The goal of inclusiveness, in a diverse community, encourages and appreciates expressions of different ideas, opinions, and beliefs, so that conversations and interactions that could potentially be divisive turn instead into opportunities for intellectual and personal enrichment.

A dedication to inclusiveness requires respecting what others say, their right to say it, and the thoughtful consideration of others' communication. Both speaking up and listening are valuable tools for furthering thoughtful, enlightening dialogue. Respecting one another's individual differences is critical in transforming a collection of diverse individuals into an inclusive, collaborative and excellent learning community. Our core commitment shapes our core expectation for behavior inside and outside of the classroom.

A critical part of building a learning environment that is inclusive of sexual orientation and gender identity is asking and correctly using someone's name and pronouns. You can add your pronouns in your Banner profile through MyDU so that we can refer to you using the correct pronouns. If your pronoun set is not available in Banner, please let me know so that I can use the correct pronouns for you. Preferred names and pronouns may change during the term, so feel free at any point to let me know that you would like to be addressed differently. As a community, we will strive to address each other with the names and pronouns identified in Canvas. If we make mistakes or are corrected, we will briefly apologize and correct ourselves. To learn more about personal pronouns and why they are important, please visit the "[Sexual Orientation and Gender Identity](#)" module on the Office of Teaching and Learning website. For student resources, please visit the "[Gender and Sexuality](#)" section on the DU Cultural Center's website.

## STUDENT ATHLETES

If you are a student-athlete, you should inform me of any class days to be missed due to DU sponsored varsity athletic events in which you are participating. Please provide me with an absence policy form by the end of the first week of class. You will need to make up any missed lectures, assignments, and/or exams.

## SUPPORTING YOUR ACADEMIC SUCCESS

The university has a large network of [student success and support resources](#) available to you, and I encourage you to take advantage of this network of support when you need it. As your professor, I want you to have the tools you need to succeed – therefore, if I notice that you are struggling or if I haven't seen or heard from you for a period of time, I may message you with suggestions for ways to connect to appropriate resources. I ask that you respond to this outreach, and any other outreach you receive from someone at DU, whether or not you plan to use the support – responding to outreach/offers of support is an important skill to build.

## MENTAL HEALTH & WELLNESS

As part of the University's Culture of Care & Support we provide campus resources to create access for you to maintain your safety, health, and well-being. We understand that as a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug concerns, depression, difficulty concentrating and/or lack of motivation. These stressful moments can impact academic performance or reduce your ability to engage. The University offers services to assist you with addressing these or ANY other concerns you may be experiencing. If you or someone you know are suffering from any challenges, you should reach out for support. You can

seek confidential mental health services available on campus in the Health & Counseling Center (HCC) and My Student Support System (My SSP). Another helpful campus office is Student Outreach & Support (SOS), where staff work with you to connect to all the appropriate campus resources (there are many!), develop a plan of action, and guide you in navigating challenging situations. If you are concerned about yourself and/or one of your peers you can send a SOS referral.

More information about HCC, MY SSP, and SOS can be found at:

[Health & Counseling Services](#)

[My SSP 24/7 confidential services for students](#) (Links to an external site.)

[Student Outreach & Support \(SOS\) and SOS Referrals](#)

### **ACADEMIC DISHONESTY & STUDENT SUPPORT**

While I advocate collaborative learning and teamwork, I also firmly believe that each individual should maintain the highest ethical standards in all of life's endeavors. As such, I support and will strictly enforce the Honor Code of the University of Denver.

All work submitted in this course must be your own and produced exclusively for this course. The use of sources (ideas, quotations, paraphrases) must be properly acknowledged and documented. For the consequences of violating the Academic Misconduct policy, refer to the University of Denver website on the Honor Code

(<https://studentaffairs.du.edu/student-rights-responsibilities/honor-code>)

### **RECORDING OR SHARING ANY COURSE MATERIALS OR CONTENT**

At the University of Denver, we protect the intellectual property of all our faculty, and safeguard the privacy of all our students in online learning environments. To this end, students may not record, reproduce, screenshot, photograph, or distribute any video, audio, or visual content from their online courses. Students who would like to record a portion of the course should receive approval from the instructor before doing so.

All material presented by the instructor in this course is meant for the use of the students in this course during this term. You may not upload any material from this course to any website or share it with anyone outside the course. Any effort by a student to share course material (lecture slides or recordings, homework assignments, exams, or anything else distributed for use by the students in the course) with any website or service that can be used to share educational material will represent a violation of the honor code. These sites and services could include, but are not limited to: Course Hero, Chegg, Quizlet, Studypool, Bartleby, Skooli, Wikipedia, Slideshare, Scribd, Facebook, TikTok or any other social media service. This violation will be documented and shared with the appropriate university authorities. At a minimum, the grade on the assignment will be a zero, and the student may be given a failing grade in the course.

I also understand that every student has unique personal and educational needs. I will do my best to help you learn or appropriately facilitate your ability to work through personal issues. Please see the Office of Student Life

(<http://www.du.edu/studentlife/ccs/index.html>), including the Pioneer Care program

(<http://www.du.edu/studentlife/care/>), for more detailed resources.