Atmospheric Chemistry and Physics

ChE 379/384T (Unique # 14017/14047)

Spring 2018

Course Description: Seven million people die every year due to air pollution in indoor and outdoor environments. Reducing air pollutant levels requires a detailed understanding of their sources and of the chemical reactions and physical processes affecting their fate. This is the focus of this course. Main topics include tropospheric chemistry, and the microphysics, chemistry and thermodynamics of atmospheric nanoparticles. We will also discuss ongoing changes in atmospheric emissions (caused, for example, by the changing energy infrastructure) and recent advances in understanding air pollution and its health effects. The course is designed for undergraduate or graduate students interested in environmental engineering and/or energy technologies. Fundamentals and skills learned in this course are also applicable to other areas of engineering including nanomaterials.

Prerequisites: upper-level undergraduate or graduate standing

Lectures: Wed 1:00-4:00pm, CPE 2.222

Instructor: Dr. Lea Hildebrandt Ruiz lhr@che.utexas.edu
Office Hours: after class, CPE 3.470 or by appointment

Course website: on *CANVAS* http://canvas.utexas.edu

Required Text: "Atmospheric Chemistry and Physics: From Air Pollution to Climate Change (3rd edition)", John H. Seinfeld and Spyros N. Pandis, Wiley, 2016.
Additional readings will be posted to the course website.

Assessment:		
	Homework	25%
	Project Presentation	25%
	Exam 1	20%
	Exam 2	30%

Exam Dates: Exam 1: Wed Feb 21, 2018, 1-3 pm, CPE 2.222
Exam 2: Wed Apr 25, 2018, 1-4 pm, CPE 2.222

Make-up exams will only be given in extenuating circumstances. Please notify instructor as soon as possible.

Anticipated course grade cut-offs are A: 90 % –100 % , B: 80 % –89.9 %, C: 70 % –79.9 % Depending on class performance the minimum grade to receive a letter grade may be lowered slightly, it will not be raised. No +/- grading will be used.

Homework will be due on Wednesdays at 1.00 pm in CPE 2.222 or via email to the instructor.

Late homework will be accepted only until the time when solutions are posted. The penalty will be -20% per 24 hour period. This penalty is assessed after normal grading and is cumulative with any points lost (e.g. a homework that would normally receive 80% of total points would receive only 40% if handed in within 48 hours). Late homework must be submitted via e-mail to the instructor and TA.

Project presentations. Students will be ask to choose a manuscript (from a collection of suggested manuscripts posted on the course website) to present during one of the class periods. This will be an individual assignment for graduate students and a group assignment for undergraduate students. Send your top 4 choices of manuscripts to present to Dr. Hildebrandt Ruiz by 3pm on Friday January 19. Project assignments will be e-mailed by the end of January 19.
Students' in-class presentation should demonstrate understanding of the manuscript and should focus on educating other students on the subject and findings of the manuscript.

Knowledge, abilities and skills students should gain from this course

After taking this course, a student will be able to quantitatively describe the following:

- formation of tropospheric ozone
- motion of single particles
- condensational growth rates of single particles
- coagulation rates for particles of two sizes
- classical nucleation rates
- evolution of the particle size distribution due to condensation and coagulation
- oxidation of hydrocarbons and formation of secondary organic aerosol
- gas-aerosol partitioning of inorganic and organic species
- water uptake by non-ideal solutions
- light scattering by aerosol and cloud particles
- activation of aerosols into cloud droplets
- measurement techniques for atmospheric particles

Additionally, students will be able to relate the importance of these topics qualitatively to societal issues such as particulate matter air pollution and aerosol-climate interactions.

Tentative course schedule

***This syllabus represents my current plans and objectives. As we go through the semester, those plans may need to change. Such changes are not unusual and will be communicated clearly.*

Reading from the required text is indicated for each lecture or set of lectures. Additional reading may be assigned and will be posted to the course website. It is beneficial for you to read the material BEFORE the lecture so that you will have some idea of the lecture content and so that you will be better prepared to ask questions about the lecture.

#	Date	Topic	Reading
1	1/17	Introduction, chemical kinetics	1.3, 1.4, 1.6, 1.7, 1.8 Ch. 3
2	1/24	Gas-phase chemistry and ozone formation	6.1 - 6.9
3	1/31	Aerosol particles – intro and size distributions	Ch. 8
4	2/7	Dynamics of single aerosol particles	Ch. 9
5	2/14	Mass transfer to atmospheric particles Brownian motion and coagulation	Sect. 12.1 Sect. 13.3
6	2/21	**Exam 1**	
7	2/28	Nucleation and new particle formation	Friedlander pdfs, Ch. 11
8	3/7	Thermodynamics: Phase and Chemical Equilibrium	10.1, 10.3
9	3/21	Aerosol water uptake Inorganic Thermodynamics	10.2 10.4
10	3/28	VOC oxidation and SOA formation	6.10, 14.1
11	4/4	Organics: absorptive equilibrium partitioning	14.2, 14.4, 14.5
12	4/11	Introduction to optics, Mie theory and visibility Optics; Aerosol climate effect: direct forcing	Ch. 15 24.1
13	4/18	Köhler theory, Clouds / Aerosol indirect effect	17.1 - 17.5, Appendix 17
14	4/25	**Exam 2**	
15	5/2	Instrumentation	

Lecture format

This course is scheduled for one (long) class period per week. In general, the format of the class will be: lecture (by the instructor), followed by presentation of a related manuscript published in the peer-reviewed literature (by a student, see "project presentations" above), followed by another lecture (by the instructor).

Feedback

It is my goal to make this an excellent course and a positive experience for all of us. If you feel that the course is not meeting your expectations or you want to provide feedback on how the course is progressing for you, please contact me. If you would like to provide anonymous comments, please submit your feedback online at the Canvas course website. I will also be circulating an early course evaluation in early February. I will use your constructive comments as a way to improve the course where possible.

POLICIES

Homework: You must complete each problem by yourself in order to truly comprehend the material. It is acceptable to ask for advice from your classmates and the instructor, but you need to understand (i.e. be able to explain) everything you turn in as part of your homework assignment.

Electronics: If you choose to bring your cell phone, laptop or other personal electronic devices (PEDs) to class, please silence your PEDs before the start of lecture, and please do not use your phone during lecture as this will distract you and the students around you.

Academic Integrity

University of Texas Honor Code: The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community.

P**lagiarism** encompasses copying somebody else's work without giving credit. Homework or exams that are discovered to be copied will receive no credit and the students involved will be reported to Student Judicial Services.

Cheating encompasses such behaviors as copying another student's work, bringing materials into an exam that are not allowed, and a variety of other academically dishonest behaviors (a list of examples is included in the Appendix). As with plagiarism, students who are discovered to have cheated will receive no credit for an assignment or exam and will be reported to the Student Judicial Services.

Other University Notices and Policies

Use of E-mail for Official Correspondence to Students
All students should become familiar with the University's official e-mail student notification policy https://cio.utexas.edu/policies/university-electronic-mail-student-notification-policy.
It is the students' responsibility to keep the University informed as to changes in their. Students are expected to check e-mail on a frequent and regular basis in order to stay current with University-related communications, recognizing that certain communications may be time-critical.

Documented Disability Statement
Any student with a documented disability who requires academic accommodations should contact Services for Students with Disabilities (SSD) at (512) 471-6259 (voice) or 1-866-329-3986 (video phone). Please notify me as early in the semester as possible if you need disability-related accommodations - I will provide accommodations with an official accommodation letter from SSD.

Behavior Concerns Advice Line (BCAL)
If you are worried about someone who is acting differently, you may use the Behavior Concerns Advice Line to discuss by phone your concerns about another individual's behavior. This service is provided through a partnership among the Office of the Dean of Students, the Counseling and Mental Health Center (CMHC), the Employee Assistance Program (EAP), and The University of Texas Police Department (UTPD). Call 512-232-5050 or visit http://www.utexas.edu/safety/bcal.

APPENDIX: Examples of Cheating Behavior (a non-exhaustive list)

Exams

- Learning what is on an exam from someone who has already taken it
- Using a false excuse to delay taking an exam
- Copying from another student on an exam **with or without** their knowledge
- Helping someone else cheat on an exam
- Using unauthorized information: textbook, lecture notes, homework solutions, etc.
- Using unauthorized electronic devices to obtain information during an exam
- Using more time than allowed for an exam (take-home exam)
- Unauthorized communication during an exam
- Requesting a re-grade after modifying an exam

Homework

- Working with others on an assignment when not authorized
- Receiving unpermitted help from someone on an assignment
- Paraphrasing/copying material from a written/printed source without referencing it
- Paraphrasing/copying material from an internet source without referencing it
- Fabricating/falsifying a bibliography
- Turning in work **copied** from another
- Turning in work **done** by another
- Obtaining solutions from a database of previous years' assignments/exams
- Copying someone else's computer code when asked for individual work

Other work

- Fabricating or falsifying lab data
- Fabricating or falsifying research data