

CEE/EAS 6790
Air Pollution Physics and Chemistry
Fall 2020 Syllabus
-Subject to Change-

Professors: A.G. (Ted) Russell
Office: 3210 Ford ES&T
Email: trussell@ce.gatech.edu
Ph: 404-894-3079

Professor: Rodney Weber
1246 Ford ES&T
Email: rweber@eas.gatech.edu
Ph 404-894-1750

Class Time: Tuesdays and Thursdays 2:00-3:15

Class Location: Ford ES&T L1125

Office Hours: TR and RW: Feel free to call or **email** to set up a time (drop in after we are on campus)

Objective. This course is a graduate level introduction to air pollutants, and in particular their atmospheric dynamics and impacts. The student, upon completion of this course should have a knowledge of which air pollutants are of concern, their source, fate, atmospheric transport and transformation and policies developed to help manage the problem. Topics include: air pollutants of interest, air pollution impacts, sources of air pollutants, atmospheric transport (including dispersion and deposition), atmospheric chemistry, aerosol dynamics, control strategy development and air pollution management.

Textbook:

Atmospheric Chemistry and Physics: from Air Pollution to Climate Change, J.H. Seinfeld and S. Pandis (S&P), Wiley Interscience, (most recent edition) D.J. Jacob (PU Press) *Introduction to Atmospheric Chemistry*.

Other useful texts include: Cooper and Alley, "Air Pollution Control: a Design Approach"; Finlayson-Pitts and Pitts, "Atmospheric Chemistry"; Pielke, "Mesoscale Meteorological Modeling"; Wark, Warner and Davis (WWD), "Air Pollution, Its Origin and Control". WWD is an up to date book that provides a lot of information, though with less detail than S&P. If we were not using S&P and Jacob, we would use WWD.

Website: access through **Canvas**.

Grading:	Midterm 1:	25%
	Midterm 2:	25%
	Final:	10%
	Homework:	40%

Homework: A few notes on the homework. First: **IT MUST BE NEAT AND EASILY UNDERSTOOD**. (You should take the use of all caps, bold and underlined as meaning that this is an important point and your grade in this class might be influenced adversely if you dismiss it.) Imagine that you are working in a consulting firm, and your homework is the final report to your client. If the client does not like what he gets for paying your company a few hundred dollars for each hour of your time, he will not use your firm again. You will be fired. This is bad news. The grader for this course and we will treat your homework as a final report to the client. It is our plan to hand out homework on Tuesday, and collect it the following week on Thursday, although this may not always be the case. If, for some reason, you can not hand in the homework on time, beforehand send the applicable professor an e-mail explaining why, and we can explore what can be done. Note, again the client does not want to be given some lame excuse as to why his project is not done as promised, and saying that another client needed his report will not hack it. You see, clients tend to think that their money is just as green as others.

There will be a homework assignment due and possibly an exam/quiz during the last week of class.

As far as the class goes, we welcome questions whenever, and if the exposition is not clear (including the writing on the board), feel free to ask for clarification. Also, we are quite willing to address side topics in environmental engineering and science related to atmospheric chemistry and physics and would not mind starting off the class each day with a short

question on some current issue of importance. We would suggest reading the book ahead of time so that we can get into some deeper discussions.

All: Homework and class readings (other than S&P) will be distributed using canvas.

Tests: Two midterms and one final are planned.

Homework policy, academic integrity, honor code: GIT has, and we follow, an honor code. In this class, you may work together on homework. We expect any member of the class to be able to replicate, by themselves, the homework they turn in as their own. You are not allowed to plagiarize. You are not allowed to work together, or copy someone else's work, on any in-class or take-home test. Doing so will result in an F. Also, each individual is to have read and agrees to follow the Institute Honor Code: www.honor.gatech.edu. In regards to plagiarism, which will not be tolerated, note the following definition:

Plagiarizing is defined by Webster's as "to steal and pass off (the ideas or words of another) as one's own: use (another's production) without crediting the source."

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit <http://www.catalog.gatech.edu/policies/honor-code/> or <http://www.catalog.gatech.edu/rules/18/>. Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for students with disabilities: If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or <http://disabilityservices.gatech.edu/>, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

How to succeed in this class: Both of the professors in this class are primarily interested in your learning the concepts, not the details (though the details help). As such, you should focus on being able to develop and explain a conceptual model of air pollution, which includes transport (physics) and transformation (chemistry). Every week or so, you should go back to the conceptual model and ask what pieces you now understand well, and what questions remain. Looking at the AMP website should lead you to ask, "can I explain the pollutant concentrations?" Doing the homework is important, as the test questions are derived from the homework. The outside (non-textbook) reading can very much help you understand what less technical audiences are concerned about, and how the issues surrounding air pollution are being explained. Ask questions. Discuss homework questions with your friends, but do not always work together. Do as much as you can on your own. Work with your friends on the tougher ones. Come to the professors before you spend too much time on any one assignment.

Student-Faculty Expectations Agreement: At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See <http://www.catalog.gatech.edu/rules/22/> for an articulation of some basic expectation that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

COVID: As all classes, this class is being modified in response to institutional changes in the semester, mode of class, class size limitations, student needs and the like. We expect that there will be changes during the term. Do feel free to contact us with concerns. Indeed, given the circumstances, some feedback on what is and is not working well would be good. Some things we can fix, others we can't.

Course Type Expectations: At the point this Syllabus was being written, the course is expected to be taught in a Hybrid format. However, all materials will be available online as well. Attendance will be monitored for contact tracing purposes, but is not required. Attendance is recommended as we do hope to have interactive discussions about air pollution issues, including how the corona virus may be transmitted as an aerosol.

More COVID-related material from the Institute:

The fall semester 2020 is especially challenging due to the Covid-19 pandemic and a growing awareness of racial inequities. The following information relates to specific services and guidelines for courses during this semester.

The most up-to-date information on Covid-19 is on the [TECH Moving Forward](#) website and in the [Academic Restart Frequently Asked Questions](#).

Expectations and Guidelines

Each of us has a responsibility to ourselves and our fellow Yellow Jackets to be mindful of our shared commitment.

- We are all required to wear a face covering while inside any campus facilities/buildings, including during in-person classes, and to adhere to social distancing of at least 6 feet. If an individual forgets to bring a face covering to class or into any indoor space, there will be a clearly marked supply of these in each building. If a student fails to follow Georgia Tech's policies on social distancing and face coverings, The approach to be taken is to initially be reminded of the policy and if necessary, asked to leave the class, meeting, or space. If the student still fails to follow the policy, they may be referred to the Office of the Dean of Students. See: [Information on the Institute's policy on face coverings](#).
- Students are expected to sit in assigned seats and to come to class only on days that are assigned to them.
- Papers, projects, tests, homework, and other assignments will only be accepted in electronic form unless the assignment is a physical artifact.

Additional information is available in the [Student Guidebook](#).

Instructor Illness or Exposure to Covid-19

During the fall 2020 semester, some faculty members may be required to quarantine due to exposure or isolate due to a Covid-19 diagnosis. Some disruption to classes or services is inevitable, but Georgia Tech is making every effort to ensure continuity of operations. As is the case in any semester, faculty may cancel a class if they have an illness or emergency situation and cover any missed material at their own discretion. If one of us needs to cancel a class, we should notify students as early as possible.

Student Illness or Exposure to Covid-19

During the semester, you may be required to quarantine or self-isolate to avoid the risk of infection to others.

Quarantine is the separation of those who have been exposed to someone with Covid-19 but who are not ill; isolation is the separation of those who have tested positive for Covid-19 or been diagnosed with Covid-19 by symptoms.

If you have not tested positive but are ill or have been exposed to someone who is ill, please follow the [Covid-19 Exposure Decision Tree](#) for reporting your illness.

During the quarantine or isolation period you may feel completely well, ill but able to work as usual, or too ill to work until you recover.

Remote courses and remote class sessions during hybrid courses. Unless you are too ill to work, you should be able to complete your remote work while in quarantine or isolation.

In-person courses and in-person class sessions during hybrid courses. When in isolation or quarantine you will be unable to attend in-person course sessions. You should still participate in the course remotely and make up class work when able.

If you are ill and unable to do course work this will be treated similarly to any student illness. The Dean of Students will have been contacted when you report your positive test or are told that it is necessary to quarantine and will notify your instructor that you may be unable to attend class events or finish your work as the result of a health issue. We will not be told the reason. We have been asked to be lenient and understanding when setting work deadlines or expecting students to finish work if you do fall ill, and so you should be able to catch up with any work that you miss while in quarantine or isolation.

CARE Center, Counseling Center, Stamps Health Services, and the Student Center

These uncertain times can be difficult, and many students may need help in dealing with stress and mental health. The **CARE Center** and the **Counseling Center**, and **Stamps Health Services** will offer both in-person and virtual appointments. Face-to-face appointments will require wearing a face covering and social distancing, with exceptions for medical examinations. Student Center services and operations are available on the **Student Center** website. For more information on these and other student services, contact the Vice President and Dean of Students or the **Division of Student Life**.

Accommodations for Students at Higher Risk for Severe Illness with Covid-19

Students may request an accommodation through the Office of Disability Services (ODS) due to 1) presence of a condition as defined by the Americans with Disabilities Act (ADA), or 2) identification as an individual of higher risk for Covid-19, as defined by the Centers for Disease Control (CDC). Registering with ODS is a 3-step process that includes completing an application, uploading documentation related to the accommodation request, and scheduling an appointment for an “intake meeting” (either in person or via phone or video conference) with a disability coordinator.

If you have been approved by ODS for an accommodation, we will work with you to understand your needs. If the accommodation request results in a fundamental alteration of the stated learning outcome of this course, ODS, academic advisors, and the school offering the course will work with you to find a suitable alternative that as far as possible preserves your progress toward graduation.

Course Homework/Assignments/Papers

All course assignments will be submitted electronically via Canvas.

Exam Proctoring

This course may use digital proctoring for some or all of the exams.

The following are required of students:

- Meeting the [Honorlock technical requirements](#).
- Students must have a broadband internet connection
- Students must have a webcam and microphone
- Students must have a secure private location to take an exam
- Students will be asked to provide a picture ID and take a picture of themselves via a webcam as part of the exam process
- Honorlock is not compatible with Linux OS, Virtual Machines, tablets, or smartphones
- Honorlock requires the installation of Google Chrome and the Honorlock Chrome extension

If any of these present a problem, please let us know.

Election Day

In order to increase the opportunities for students to vote on the national election day, Tuesday, November 3, we do not plan to schedule in-class assessment activities and will make available lecture recordings for students who are unable to attend regularly-scheduled classes that day.

Recordings of Class Sessions and Required Permissions

Due to Covid-19 concerns and the increased use of distance learning, our class sessions may be audio visually recorded for use by enrolled students. Class recordings, lectures, and other classroom presentations presented through video conferencing and other materials posted on Canvas are for the sole purpose of educating the students enrolled in the course. Students may not record or share recordings, including screen capturing, unless the instructor states so or individual permission is obtained. Exams and tests may require students to engage the video camera, but those recordings will not be shared with or disclosed to others without consent unless legally permitted. Additional information may be found [here](#).

In our class, participation is voluntary, and students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded.

CEE/EAS 6790 - Air Pollution Physics and Chemistry
Tentative Fall 2020 Schedule*

Class No	Date	Topic	Lecture	Instructor	Reading
1	8/18	Intro	Introduction,	AR/RW	S&P 1.1-1.7 ¹
2	8/20	Impacts	Pollutants of Interest Air pol. impacts	AR	EPA Reports ² COVID aerosol transmission papers ³
3	8/25	Sources	Pollutant sources	AR	EPA Reports ²
4	8/27	Trop O3	Chem Intro, Photolysis, Radicals	RW	DJ 9; S&P parts of 3&4
5	9/1	Trop O3	Intro, Photo stationary state, OH	RW	DJ 11; S&P 6.1, 6.2
6	9/3	Trop O3	CO, HCHO chem	RW	DJ 11; S&P 6.3, 6.4
7	9/8	Trop O3	CH ₄ , role of NO _x ,	RW	DJ 11; S&P 6.3, 6.4
8	9/10	Trop O3	NO _x Day/night, Trop O3 budget	RW	DJ 11; S&P 6.5, 6.6
9	9/15	Trop O3	Smog, high/low NO _x , isopleth	RW	DJ 12
10	9/17	Trop O3	Smog, VOC reactivity, summary	RW	DJ 12; S&P 6.3, 6.4
11	9/22	Strat O3	Intro, Chapman, radicals	RW	DJ 10; S&P 5.1- 5.4
12	9/24	Strat O3	O3 hole, CFCs, PSC	RW	DJ 10; S&P 5.8-5.9
13	9/29	Aerosols	Intro, ambient particles size distr.	RW	S&P 8.1-.3
14	10/1	Aerosols	Particle physics, processes	RW	S&P 9.1-.6
15	10/6	Aerosols	Thermo, particle water	RW	S&P 6.13.1, 7.1-.3, 10.3-.4
16	10/8	Aerosols	Aqueous phase chemistry	RW	S&P 7.4-.5
17	10/13	Test 1	Trop & Strat Chemistry	RW	
18	10/15	Meteoro	Air pollution meteorology	AR	S&P 16.2
19	10/20	Meteoro	Atmospheric stability	AR	S&P 16.2
20	10/22	Meteoro	Atmospheric stability	AR	S&P 18
21	10/27	Meteoro	Micrometeorology: turbulence.	AR	S&P 18
22	10/29	Meteoro	Micrometeorology: turbulence.	AR	S&P 18.10
23	11/3	Trans.	Pasquill Stability classes, etc.	AR	S&P 18
24	11/5	Trans.	Atmospheric diffusion	AR	S&P 18.9-13
25	11/10	AQM	Gaussian plume equation & model	AR	S&P 25, 26
26	11/12	AQM	Air Quality Models	AR	S&P 25, 26
27	11/17	Test 2	Test 2 will focus more on air pollution physics, but will include air pollution chemistry as well, i.e., it will be comprehensive		
28	11/19	AQM	Air Quality Models	AR	
29	11/24	AQM	Air Quality Management/ Regulations	AR	
	11/26		Thanksgiving		
	11/27-31		Reading days		
	12/1		Final		

*This schedule will be changed as the semester proceeds due to a variety of reasons and the instructors maintain the right to do so.

1. Readings are from Seinfeld and Pandis and will be augmented by additional material (e.g., Jacob)
2. EPA Reports are the Ozone and PM Integrated Science Assessments (ISAs) and the Section 812 Report.
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7250761/>, Zhang et al., (2020), others on Canvas website