

CH EN 5305/6305 – Air Pollution Control Engineering

Department of Chemical Engineering

University of Utah

Last Revised 2021 January 20

Semester	Spring 2021
Instructor	Geoff Silcox (geoff@chemeng.utah.edu) Room MEB 3290 C (801)581-8820 (office)
Meetings, assignments, quizzes, lecture notes, online discussion	<p>Lecture: TuTh 10:45AM-12:05PM. We will use the meetings on Tuesdays and Thursdays, via Zoom, for working together on examples, homework, answering questions, discussions, and quizzes. I will be providing recordings of my lectures in Canvas.</p> <p>Assignments, quizzes, lecture notes, video, and grades will be posted in Canvas. Homework and quizzes will be submitted in Canvas.</p> <p>We will be using Piazza for asking questions about the syllabus, homework, and quizzes. Rather than emailing questions to Jason or me, we encourage you to post your questions on Piazza. The signup link is https://piazza.com/utah/spring2021/chen53056305/home</p>
Office hours	TBA or make appointment
Website:	Canvas
Teaching assistant	Justin Thomas: justint.russ22@gmail.com Office hours: TBA
Prerequisites	MATH 2250, PHYS 2220, CH EN 2300, CH EN 2450, CH EN 2800 and major status in Chemical Engineering
Required text	<i>Air Pollution Control Engineering</i> , Noel de Nevers, 3 rd edition, Waveland Press, Inc., 2017. ISBN: 978-1-4786-2905-4.
Suggested references	<p><i>Fundamentals of Air Pollution Engineering</i>, Richard C. Flagan and John H. Seinfeld, Prentice Hall, 1988. Available online at http://resolver.caltech.edu/CaltechBOOK:1988.001.</p> <p><i>Introduction to Environmental Engineering and Science</i>, Gilbert M. Masters, 3rd ed., Prentice Hall, 2008.</p>

Course description	Air-pollution emission sources, behavior of pollutants in the atmosphere, theory, and practice of control of particulate and gaseous air pollutants at their sources.
Learning objectives	<p>By the end of this course you will be able to</p> <ol style="list-style-type: none"> 1. Describe the effects of air pollutants on health, property, and visibility. 2. Make calculations of pollutant concentrations or emission rates for comparison with the standards of the Clean Air Act. 3. Use material, energy, entropy, and momentum balances in air pollution measurement and control calculations. 4. Critically analyze emission and ambient sampling techniques including placement of monitors and isokinetic conditions in probes. 5. Use basic meteorology to predict the distribution and fate of air pollutants in the atmosphere. 6. Calculate the concentration and dispersion of air pollutants using box and Gaussian plume models. 7. Apply general ideas in air pollution control that allow you to design equipment, calculate efficiency, calculate penetration, perform material balances for complex reacting systems including combustion reactions, and estimate acid dew points. 8. Make calculations relating to the nature of particulate including settling velocity, drag force, particle size distribution, source, and fate in the atmosphere. 9. Estimate the fate of primary particulate in wall and dividing collection devices. 10. Choose a particle collector for a particular application. 11. Evaluate different options for control of volatile organic compounds, sulfur oxides, and nitrogen oxides. 12. Make recommendations to address the motor vehicle problem.

13. Summarize engineering solutions to problems associated with air toxics, indoor air pollution, and radon.
14. Graduate students: create and deliver an interesting, content-rich lecture that is related to air pollution control or characterization.

Special dates First day of class: Tuesday, 19 January
 Last day to add or drop: Friday, 29 January
 Last day to withdraw: Friday, 12 March
 Classes end: Tuesday, 27 April
 Reading Day: Wednesday, 28 April
 Final quiz: Friday, 30 April, 10:30 – 11:00

Grading UG: 30% homework, 70% quizzes.
 Grad: 30% homework, 10% lecture, 60% quizzes.

Final grades will be based on the following table. The table represents grade guarantees. The high score in the class will be used to scale all other scores. For example, if the high score is 95%, all scores will be divided by 0.95. I reserve the right to reevaluate the grades of students who show exceptional performance on the final. I may lower the grading scale and may choose a lower scaling factor than that based on the high score.

Percentage	Grade
92-100	A
89-92	A-
85-89	B+
80-85	B
75-80	B-
70-75	C+
65-70	C
60-65	C-
50-60	D
< 50	E

Homework Homework is due on Sundays by 11:59 pm and can be submitted in Canvas as a scanned pdf file or a Jupyter Notebook. Excel files may also be submitted. The solutions will be posted in Canvas. Late homework will not be accepted after the solutions have been posted. The neatness, organization, and completeness of your homework solutions will be evaluated in grading.

To receive full credit for your written solutions, you must write out all equations that you use, and you must state all values

substituted in those equations. You must show all your work to receive credit.

I encourage you to work with other students on the homework. You are required, however, to turn in individual, original solutions for grading. You should be able to solve all problems on your own. Copying the assignments of others will constitute plagiarism.

Quizzes

The eight quizzes will be open book, open notes, and open computer. Each quiz will be 30 minutes long. The first 7 quizzes will start on Thursdays at 11 am.

There is no final exam but Quiz 8 is during finals week at 10:30 am on Friday, April 30.

On all quizzes, you must show all your work to receive credit for a solution. That is you must write out the equations in symbolic form and provide all numerical values that you use.

Students with Disabilities

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability and Access, 162 Olpin Union Building, 801-581-5020. CDA will work with you and Prof. Silcox to make arrangements for accommodations.

All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.

Addressing Sexual Misconduct

Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

Counseling Center The Counseling Center (<http://counselingcenter.utah.edu/>) is located in Rm 426 of the Student Service Building. They are open Monday-Friday 8 am – 5 pm and can be reached at 801.581.6826. For after-hours emergencies, call 801.587.3000.

Campus Safety To report suspicious activity or to request a courtesy escort, call campus police at 801.585.COPS (801.585.2677). If you choose, you will receive emergency alerts and safety messages via text messaging and email. For more information, see safeu.utah.edu.

Graduate students Graduate students will be graded separately from undergraduates and may be called upon to address questions that the undergraduate section, 5305, is unable to answer. Graduate students will be required to present a 20-minute lecture to the class on a subject that is related to air pollution control or characterization.

Draft Schedule and Outline

Week	Tuesday	Thursday	Deadlines	Reading
Jan 19, 21	L01. Material balances and box models. IPAT eq., disaggregated growth rates.	L02. Concentration units. Effects of air pollution.	HW 1 due Jan 24 by 11:59pm	Ch 1, 2. Section 15.4.
Jan 26, 28	L03. Air pollution control and energy balances. Statistics and air pollution. Air pollution control laws. L04. Air pollution measurements. Emission factors.	Quiz 1	HW 2 due Jan 16 by 11:59 pm	Ch 3, 4. Problem 4.20.
Feb 2, 4	L05. Meteorology. L06, Pollutant Conc. Box Models	L07. Gaussian plume models: temperature inversions and line-source models.	HW 3 due Feb 7 by 11:59 pm	Ch 5, 6

Feb 9, 11	L07. Gaussian plume models continued.	Quiz 2	HW 4 due Feb 14 by 11:59 pm	Ch 6
Feb 16, 18	L08. General ideas in air pollution control. Efficiency, penetration, nines.	L09. Combustion, acid dew point.	HW 5 due Feb 21 by 11:59 pm.	Ch 7
Feb 23, 25	L10. Particle settling velocity using Stokes law.	Quiz 3	HW 6 due Feb 28 by 11:59 pm	Ch 8
Mar 2, 4	L11. Particle size distributions	L12. Control of primary particulates. Gravity settlers. Cyclone separators.	HW 7 due Mar 7 by 11:59 pm. Lecture abstract due Mar 7.	Ch 8, 9
Mar 9, 11	L13. Cyclones. Spreadsheet for cyclone Example 9.6. ESPs.	Quiz 4	HW 8 due Mar 14 by 11:59 pm.	Ch 9
Mar 16, 18	L14. Fabric filters. Depth filters.	L15. Scrubbers for particle capture. Scavenging of particles by rain.	HW 9 due Mar 21 by 11:59 pm.	Ch 9
Mar 23, 25	L16. VOCs and tank losses. Adsorption and absorption for control of VOCs.	Quiz 5	HW 10 due Mar 28 by 11:59 pm	Ch 10
Mar 30, Apr 1	L17. Absorption, cont. Control of VOCs by combustion.	L18. Control of sulfur oxides	HW11 due Apr 4 by 11:59 pm. Lecture outline due Mar 19.	Ch 10, 11
Apr 6, 8	L19. Control of nitrogen oxides.	Quiz 6	HW 12 due Apr 11 by 11:59 pm	Ch 12
Apr 13, 15	L20. More on NO _x . Motor vehicles.	L21. Air pollution and global climate: models of earth and earth surface	HW 13 due Apr 18 by 11:59 pm. Presentation due Apr 9.	Ch 12, 13, 14

		temperature. Effect of solar variability.		
Apr 20, 22	L22. CO, lead, air toxics. Indoor air pollution.	Quiz 7		Ch 15
Apr 27	L23. Atmospheric chemistry			Ch 14, Appendix D

Final Quiz 8 on Friday, Apr 30, 10:30-11:00.