University of Colorado **Boulder**

COURSE SYLLABUS

Indoor Air Pollution

MCEN/EVEN 4141/5141 (3 credits)

Spring 2026

Instructor
Prof. Marina Vance
Email: Marina.Vance@colorado.edu
Office: SEEC S286A

Course assistants
Rileigh Robertson, Rileigh.Robertson@colorado.edu
Surya Goda, Surya.Goda@colorado.edu

Lecture: Tuesdays and Thursdays, 1:00 - 2:15 PM.

Locations:
Removed for distribution

Course schedule and list of topics

Office Hours:
Tuesdays and Thursdays, 2:15 - 3:00 PM, SEEC S286A and Zoom (same link)
Wednesdays, 12:00 - 1:00 PM, Zoom (same link)
Teams message prof. Vance to schedule a meeting.

Textbook: No required textbook, appropriate readings will be distributed for each topic.

Please refer to Canvas for course announcements, due dates, and all other course-related content and communication.

1. **COURSE DESCRIPTION (from course catalog)**

People spend most of their time indoors and levels of many pollutants are higher indoors than in outdoor air. This course describes the impact of indoor air pollutants on human health, including an introduction to key pollutants and their sources. Students will estimate emission factors, calculate generation / ventilation rates, quantify the impact of deposition and chemical reactions and explore relevant control technology. Current issues will also be addressed, including climate change, green building design, economic concerns and relevance to the developing world. Same as EVEN 5141, MCEN 4141, and EVEN 4141.

LEARNING OBJECTIVES

Upon successful completion of this course, you should be able to:

- Explain the importance of indoor air pollution in comparison to outdoor air pollution, including its sources, impacts on human health, and relevance to engineering design and environmental systems.
- Identify and quantify major indoor and outdoor sources of air pollutants.
- Develop and solve mass balance models to describe indoor pollutant dynamics.
- Evaluate building-related factors such as infiltration, natural and mechanical ventilation, and air exchange rates, and assess their influence on indoor air pollutant concentrations.
- Understand different strategies to reduce indoor air pollution
- Describe human health impacts associated with exposure to key indoor pollutants
- (Graduate students) Conduct and communicate independent research on an indoor air pollution topic.
- (Graduate students) Co-teach a lecture on a specific indoor air pollution topic

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COURSE TOPICS

This course is divided into seven units:

1. Indoor sources
    a. Intro and time activity patterns
    b. Outdoor sources of indoor air pollution
    c. Indoor sources of indoor air pollution
2. Reactor models applied to indoor environments
    a. Infiltration and indoor generation
    b. Transformations: Deposition velocity and chemical reactions
    c. Removal mechanisms
    d. Natural ventilation and air change rates
    e. Mechanical ventilation
3. Indoor air pollutants
    a. Indoor gaseous pollutants

    b. Indoor particulate matter
4. Health effects of indoor air pollutants
    a. Human exposure pathways
    b. Sick building syndrome
    c. Combustion byproducts: asthma
    d. Radon and its decay products: lung cancer
    e. Volatile organic compounds: odors, sick-building syndrome
    f. Semivolatile organic compounds: endocrine disruptors / cancer
    g. Bioaerosols: infectious disease transmission, allergy and asthma
5. Indoor air quality measurements
    a. Low-cost sensors
    b. Research-grade and offline techniques
6. Indoor air cleaning
    a. Filtration / Portable air cleaners
    b. Other techniques
7. Building-related factors
    a. Thermal comfort
    b. Climate effects on indoor environments
    c. Green building design principles
    d. Economic considerations and relevance to the developing world

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GRADING CRITERIA

Deliverable	**Assignment weight**	
	4000-level	**5000-level**
In-class quizzes	10%	10%
Homework	20%	15%
Midterm 1	15%	15%
Midterm 2	15%	15%
Midterm 3	15%	15%
Class lecture	5% extra credit	5%
Final project	20%	20%
Participation and professionalism	5%	5%
Total	105%	100%

The breakdown of the final grade is:

A	94.0 - 100
A-	90.0 - 94.0
B+	87.0 - 90.0
B	83.0 - 87.0
B-	80.0 - 83.0
C+	77.0 - 80.0
C	73.0 - 77.0
C-	70.0 - 73.0*
D+	67.0 - 70.0
D	63.0 - 67.0
D-	60.0 - 63.0
F	00.0 - 60.0

This is the default grading scheme for CU Boulder

Differences between undergraduate and graduate student grading and assignments

- All graduate students will be required to present an in-class lecture (this is optional for undergraduate students)
- All graduate students will have different/longer homework assignments and exams
- The expectations for the quality of the final project will be higher for graduate students

Homework

The purpose of the homework is to independently practice application of concepts learned in class to realistic engineering situations. The due date of each homework assignment throughout the course can be found in the schedule (although this may change slightly). Homework is to be submitted online via Canvas/Gradescope by the deadline listed in the course schedule. Homework solutions will be posted to Canvas after the homework grades are posted. Homework grades can be found on Canvas/Gradescope.

Each homework question specifies which students should complete it. If the question says [everyone], all students should complete it. If the question says [4000-level], only students taking the course at the 4000-level should complete it. If the question says [5000-level], only students taking the course at the 5000-level should complete it.

You should attempt the homework on your own since it can increase your understanding of the material by requiring independent and active examination of the class notes and textbook. If you are stuck on a problem you may work with others, however, each student must submit their own work for grading. You can receive help with homework by attending office hours.

Homework will be graded on a scale from 0-100. Problems that follow the guidelines below with a correct answer will receive full credit. Problems that are correct but do not follow the guidelines below will receive partial credit. Problems that are mostly correct and follow the guidelines below will receive partial credit.

In order to receive full credit on homework assignments you must follow the guidelines listed below. These guidelines will improve/reiterate organizational skills and facilitate homework grading:

- The assignment should be compiled into a single PDF and must be legible. Assignments that are not legible will receive a score of zero. Instructions for scanning assignments with your phone: Using Android and iPhone. Prof. Vance likes using the Adobe Scan app.
- Each problem should begin on a new page and the problem number must be indicated. Pages should be numbered. Both handwritten and typed work will be accepted. Write or type neatly and show all your work.
- When not explicitly stated, assume Normal Temperature and Pressure conditions, defined by NIST as 20 °C and 1 atm, and unit density (1 g/cm^3) for aerosol particles.
- Present your homework solution in a cohesive manner that describes your process. Include any important figures/results. Make your final answers explicit (e.g., box the final numeric answer) to help the grader.
- All homework must be submitted via Gradescope. Homework submitted via email or hardcopy will not be accepted.
- Turn the homework in on time. Homework up to 24 h late will suffer an automatic 10-point deduction. No submission >24 h late will be graded.
- The lowest homework grade will be dropped to accommodate personal difficulties.

In-class quizzes

Weekly quizzes will be distributed via Gradescope and will encompass a few short/conceptual questions. Quizzes will review content from previous lectures and will also cover the assigned reading for that lecture. The lowest 3 quiz grades will be dropped to accommodate missed classes.

Midterms

There will be three, non-cumulative midterms in this course. Exams will be taken during class time. Students with accommodations will be contacted by the professor to arrange an alternative time. This course will have no final exam.

Class lecture

The graduate students in this class will present a section of one lecture during the second half of the semester. The instructor will work with the graduate students to select and prepare for their presentation topic.

Final Project

The graduate and undergraduate students in this class will have one final project that will encompass a report including a literature review and a methodological section. Depending on the class size and composition, the final project may be individual or in small teams. A detailed description of the final project will be provided on Canvas.

Participation and Professionalism

Your professionalism grade depends on your in-classroom behavior (online or in-person), overall participation, responsiveness to messages, prompt and effective communication with the professor and colleagues, etc.

Minimum Out-of-Class Work Expectations

This is a 3-credit lecture-based course. Per Office of the Registrar, this results in a minimum expectation of 300 minutes (5 h) per week of out-of-class work. This is time you are expected to spend studying, completing homework assignments, and working on projects and reports.

GENERAL ADVICE

Tips for success

- Attend classes, take notes, actively participate in in-class examples and discussions.
- Read the course announcements.
- Attempt all homework assignments.

Lectures

- My lectures include a fair amount of group work and in-class exercises. Please come prepared to be active and engaged.
- You will be completing occasional, graded Canvas quizzes during lectures. Please ensure you have a method to access Canvas during class, with a laptop, iPad, or smartphone. You may also be required to research information online during lectures.
- I usually post incomplete lecture notes before each lecture. I then fill them in during lectures (hand-writing on an iPad) and re-post completed notes after each lecture.

Data analysis and plotting

Although the professor will use MATLAB for calculations and plotting, you are encouraged to use whatever data analysis software you are comfortable with and already using for your other work/research, such as Excel, MATLAB, Python, R, etc. You should use this class to further your experience in your data analysis software of choice. You are expected to produce well-constructed and well-formatted plots for this class, with clear axis labels, appropriate axis limits, line widths, datapoint sizes, and font sizes.

Use of generative AI tools

AI tools such as ChatGPT, Gemini, Copilot, and Claude are large language models (LLM). They are a type of AI designed to understand and generate human-like text, trained on massive datasets from the internet.

I encourage students to use generative artificial intelligence (AI) tools to aid in learning as long as the student is still in control of all content, avoiding plagiarism. The use of generative-AI to

write the answers for any assignment material or to solve any homework problem is strictly prohibited in this course.

General recommendations surrounding AI:

- Never feed personal information to AI tools.
- Never treat an AI tool as a virtual friend or companion.
- Never blindly trust the answers you get from an AI tool.

Specific recommendations surrounding AI for this course:

	OK	**Not OK**
Writing	Writing a paragraph of text yourself and then having an AI tool read the text and suggest grammar/flow improvements (proof-reading), and then reading the output carefully and applying some suggestions to the work yourself is ok.	Asking an AI tool to write a paragraph for you is not ok. Writing practice will make you a better engineer, professional, and thinker, which is one of the main reasons you are in school.
Coding	Asking an AI tool to debug broken MATLAB/Python/R code, then reviewing the output code to fully understand it, and applying it to your research is generally ok.	Asking an AI tool to create coursework code from scratch, to analyze or interpret your data, or to write up a discussion of your results is not ok.
Studying and solving problems	Asking an AI tool to answer general conceptual questions to help you learn, to create practice problems, or to drill you on content to help you prepare for an exam is an acceptable use of this tool.	Asking an AI tool to solve any homework, quiz, or exam questions is a serious honor code violation. The best practice is to solve these on your own and not rely on AI for assignments.

Regrading

The professor will handle all grading disputes. Any request for a grade change should be made within one week after the work is graded. You must write a comment on the Canvas assignment describing where and why you are disputing the grade. The entire submission will be subject to regrading, which can go up or down in score. Expect one week for each grade dispute evaluation.

Communication with the professor

The professor is very willing to assist with your academic needs outside of the classroom. Multiple professional obligations, however, make it necessary for me to schedule her availability. Please respect posted office hours and avoid disrupting meetings. To contact the professor, please send a Canvas message. Do not expect the professor to reply outside of business hours.

Missing classes and sick policy

Although you are expected to attend class in order to participate in in-classroom discussions, the professor is very understanding of emergencies, obligations, or sickness which may prevent you from attending class on occasion. If possible, please email the professor to notify that you will miss class. If you are feeling sick, the professor encourages you to stay home to recover more quickly and to protect your colleagues. All class notes are posted on Canvas.

CU BOULDER AND CU MECHANICAL ENGINEERING COURSE POLICIES

CU Community of Care Syllabus Statement

CU Boulder is committed to a community of care in which students are supported by faculty and staff throughout their college journey. You don't have to face academic challenges alone – CU and the college are here to help you learn and succeed in your coursework and campus life. Part of this community of care is your connection to faculty and staff across campus. Our college promotes and hopes you will connect with faculty or staff who may reach out during your educational journey at CU.

Classroom behavior

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the policies on classroom behavior. and the Student Code of Conduct.

Honor code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu); 303-492-5550). Students found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional

information regarding the Honor Code academic integrity policy can be found at the Honor Code Office website.

Accommodation for disabilities

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions. on the Disability Services website.

Preferred student names and pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.

Sexual misconduct, discrimination, harassment and/or related retaliation

The University of Colorado Boulder (CU Boulder) is committed to fostering an inclusive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, or protected-class discrimination or harassment by members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or cureport@colorado.edu. Information about the OIEC, university policies, anonymous reporting, and the campus resources can be found on the OIEC website.

Please know that faculty and graduate instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, dating and domestic violence, stalking, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.

Racist language, behavior, and discrimination

The ME department holds students, faculty, and staff accountable for racist comments and behavior, whether intentional or unintentional. We expect members of our community to take responsibility for understanding why some comments and actions may be racist and actively eliminating language and behaviors that perpetuate racial inequities. More information is available at An Antiracist CU.

Discrimination and harassment

Discriminatory and harassing behavior will not be tolerated in the Department of Mechanical Engineering. A safe and inclusive environment will be created and maintained by the students

and instructing faculty member. Students with concerns about discrimination or harassment actions should immediately contact the instructor, the Department Chair or their academic advisor, or the Office of Institutional Equity and Compliance.

Examples that may be considered harassment:

- A teaching assistant or instructor asking a student for a date.
- Displaying sexually explicit material in an academic setting (including laptop wallpaper).
- Persisting in asking a classmate for a date after being turned down.
- Using degrading terminology in referring to others, including peers.

Religious holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. You must make me aware of these conflicts in advance. See the campus policy regarding religious observances for full details.