Course information

ME425/525: Advanced Topics in Building Science
Indoor environmental quality for sustainable buildings
Portland State University, Department of Mechanical and Materials Engineering

4 credit hours
Meeting times: Monday, Wednesday 8:15 – 10:05 AM
Meeting Location: Engineering Building 510

Course reference numbers: 62272 (ME425), 62293 (ME525)

Course website: https://www.pdx.edu/green-building/ieq-2018

Instructor information

Elliott T. Gall, Ph.D., Assistant Professor, Mechanical and Materials Engineering
Office: Engineering Building Suite 301J
Phone: 503-725-2878
Email: gall@pdx.edu
Office Hours: Thursdays, 10-11 AM

Learning Objectives:

- Contextual understanding of indoor air quality: historical perspective, important constituents, human exposure
- Application of material-balance principles to the study of indoor environments
- Reactor models, steady-state and dynamic analyses of indoor air pollutants
- Transport and transformation of gas-phase indoor air pollutants
- Monitoring of indoor environments, including low-cost sensing
- Basics of air quality sensor design and principle of operation
- Importance of and approaches for calibration of sensors
- Indoor particulate matter pollution
- Health effects of environmental exposures
- Indoor air quality in developing countries

Suggested Textbooks:

Note that there is no required textbook for this course; reading and reference materials will be peer-reviewed research articles, or sections of reports from a variety of organizations. All required readings will be posted on the course website. Materials listed below are suggestions for further readings for interested students:

Climate Change, The Indoor Environment, and Health. Institute of Medicine of the National Academies. ISBN 978-0-309-20941-0 (free PDF version available online)

ASHRAE Fundamentals Handbook. ASHRAE, Inc. Atlanta, GA.

Modeling Indoor Air Pollution, Imperial College Press. Darrell W. Pepper and David Carrington.


Pre-requisites:
No required prerequisites. A familiarity with differential equations, and basic fluid mechanics and chemistry concepts is recommended.

Course policies:
Attendance: Regular attendance is highly recommended and expected. Attendance will not be taken or considered in grading.

Homework: Homework will be assigned in class, and due at the beginning of the lecture.

Homework submission: Homework must be submitted in hard copy (no digital submission will be considered or graded). Homework should clearly document the student’s work, any assumptions made, and identify the final answer.

Late homework: Any work not submitted by the start of lecture will be considered late. Late homework will be accepted with the following penalty:

<24 hours late: maximum of 80% of points of assignment may be received
24-48 hours late: maximum of 50% of points of assignment may be received
> 48 hours late: student will receive no credit for the assignment.

Exams: There will be two (2) exams in this course. The mid-term exam will be in-class. The final exam will be during finals week. Further details TBA.
## Course projects:

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Lecture Topic</th>
<th>Assignment</th>
<th>Project (525 only)</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Monday, April 2nd</td>
<td>Course overview and introduction, historical perspective, measurements units, conversion, building sci at PSU</td>
<td></td>
<td>Introduce project</td>
<td>[1]</td>
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<tr>
<td></td>
<td>Wed, April 4th</td>
<td>Mass-balance principles, 0-D models: Indoor sources, Outdoor Sources, Ventilation</td>
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<td>2</td>
<td>Monday, April 9th</td>
<td>Mass-balance principles continued: Air-cleaning</td>
<td>HW1 assigned</td>
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<td>[2]</td>
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<td></td>
<td>Wednesday, April 11th</td>
<td>Ventilation and Health: Role of CO2 in indoor environments, Measuring Ventilation</td>
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<td>3</td>
<td>Monday, April 16th</td>
<td>Ventilation and Health: Principles of CO2 measurement</td>
<td>HW2 assigned, HW1 Due</td>
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<td></td>
<td>Wednesday, April 18th</td>
<td>Ventilation and Health: Indoor spaces and disease transmission</td>
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<td>Project topic and justification due, must include 3 lit references</td>
<td>[4]</td>
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<tr>
<td>4</td>
<td>Monday, April 23rd</td>
<td>Ventilation and Health: Review of ventilation guidelines, AQ and green building guidelines</td>
<td>HW3 assigned, HW2 Due</td>
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<td></td>
<td>Wednesday, April 25th</td>
<td>Mass-balances: Heterogeneous and homogeneous chemistry; measurement of O3</td>
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<td>5</td>
<td>Monday, April 30th</td>
<td>Mass-balances: Sorption, coupled mass-balances, discretization</td>
<td>HW3 Due</td>
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<td>[6]</td>
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<tr>
<td>Week</td>
<td>Date</td>
<td>Event</td>
<td>Notes</td>
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<td>6</td>
<td>Wednesday, May 2nd</td>
<td>Guest Lecture, TBD. Mass-balances: Sorption/chemistry continued</td>
<td>Proposed project methodology due</td>
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<td>Monday, May 7th</td>
<td>midterm Exam</td>
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<td></td>
<td>Wednesday, May 9th</td>
<td>Mass balances: Modeling plug flow reactors (1-D models)</td>
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<td>7</td>
<td>Monday, May 14th</td>
<td>Derivation of continuity equation: Advection, diffusion, turbulence</td>
<td>HW4 Assigned</td>
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<td>Wednesday, May 16th</td>
<td>Particles in indoor air: Size distributions, filtration, measurement of PM</td>
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<td>8</td>
<td>Monday, May 21st</td>
<td>Particles in indoor air: Transport and fate of PM in indoor environments</td>
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<td></td>
<td>Wednesday, May 23rd</td>
<td>Modeling exposure in indoor environments</td>
<td>HW5 Assigned; HW4 Due</td>
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<td>9</td>
<td>PSU CLOSED Memorial Day</td>
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<td></td>
<td>Wednesday, May 30th</td>
<td>Measurement of VOCs</td>
<td>HW 5 Due</td>
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<td>10</td>
<td>Monday, June 4th</td>
<td>IAQ in developing countries</td>
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<td></td>
<td>Wednesday, June 6th</td>
<td>Project presentations</td>
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<td>Finals</td>
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<td>final exam</td>
<td>Project report due (4-6 page conference paper)</td>
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Readings:

PDFs of readings will be posted online


Grading policy:

Basis of grading in this course:

<table>
<thead>
<tr>
<th></th>
<th>ME425</th>
<th>ME525</th>
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<tbody>
<tr>
<td>Homework</td>
<td>30%</td>
<td>20%</td>
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<tr>
<td>Midterm exam</td>
<td>35%</td>
<td>25%</td>
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<tr>
<td>Final exam</td>
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<td>25%</td>
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<tr>
<td>Project</td>
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<td>30%</td>
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Letter grades will be assigned as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>93-100%</td>
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<td>A-</td>
<td>89-92%</td>
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<td>B+</td>
<td>86-88%</td>
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<td>B</td>
<td>82-85%</td>
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<td>D</td>
<td>64-66%</td>
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<td>D+</td>
<td>64-66%</td>
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<tr>
<td>D-</td>
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<td>D</td>
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<tr>
<td>D+</td>
<td>55-58%</td>
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<tr>
<td>E</td>
<td>&lt;55%</td>
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</tbody>
</table>
Suggested reference list:

[14] Shrestha, Maxwell, An Experimental Evaluation of HVAC-Grade Carbon-Dioxide Sensors - Part 3: Humidity, Temperature, and Pressure Sensitivity Tent Results., (n.d.). http://eds.b.ebscohost.com/abstract?site=eds&scope=site&jrn=00012505&AN=50842484\&h=REs7nn7tMpk%2frZeEWWUF06yKJJSRM%2bYPOQp1r3v0jakRmxwR5arE0bm6kMwvZNOKGB8zdChSLFORw5ZXBvHw%3d%3d&crl=c&resultLocal=ErrCrlNoResults&resultNs=Ehost&crlhashurl=login.aspx%3fdirect%3dtrue%26profile%3dhost%26scope%3dsite%26authype%3dcrawler%26jrn%3d00012505%26AN%3d50842484 (accessed March 24, 2017).


**Code of conduct:**

The PSU Student Conduct Code prohibits all forms of academic cheating, fraud, and dishonesty. Details can be found on the PSU web page for the code of student conduct, [http://www.pdx.edu/dos/codeofconduct](http://www.pdx.edu/dos/codeofconduct). Allegations of academic dishonesty may be addressed by the instructor, and/or may be referred to the Office of Student Affairs. 

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Affairs for action. Acts of academic dishonesty may result in a failing grade on the exam or assignment for which the dishonesty occurred, disciplinary probation, suspension or dismissal from the University. Questions about academic honesty may be directed to the Office of Student Affairs: [http://www.ess.pdx.edu/osa](http://www.ess.pdx.edu/osa).

Classroom Rules and Behavior Expectations:
The classroom is a professional space and professional conduct is expected. Please silence your cell phone and refrain from text messaging during class and exam times. Treat your fellow students and the instructor with respect and please use appropriate language at all times. Additional rules may be added at the instructor’s discretion.

Ethics and professionalism:
As future professional engineers you should plan to take the FE Exam (see the Oregon State Board of Examiners for Engineering and Land Surveying at [www.osbeels.org](http://www.osbeels.org)), and you should be familiar with the ASME Code of Ethics ([http://files.asme.org/ASMEORG/Governance/3675.pdf](http://files.asme.org/ASMEORG/Governance/3675.pdf)), which includes the following: Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:
1. Using their knowledge and skill for the enhancement of human welfare;
2. Being honest and impartial, and serving with fidelity their clients (including their employers) and the public; and
3. Striving to increase the competence and prestige of the engineering profession.

Campus Resources:
As a PSU student, you have numerous resources at your disposal. Please take advantage of them while you are here. A small sample is listed below:
- MME Website: [http://www.pdx.edu/mme](http://www.pdx.edu/mme)
- Career Center: [http://www.career.pdx.edu/](http://www.career.pdx.edu/)
- Center for Student Health & Counseling: [http://www.shac.pdx.edu/](http://www.shac.pdx.edu/)
- The Writing Center: [http://www.writingcenter.pdx.edu/](http://www.writingcenter.pdx.edu/)
PSU Disability Resource Center: 435 SMU - The PSU Disability Resource Center is available to help students with academic accommodations. If you are a student who has need for test-taking, note-taking or other assistance, please visit the DRC and notify the instructor at the beginning of the term.

Library and Literature Research:
Ubiquity of the Internet makes it very tempting to think that all necessary resources for a term project will be available in full text after typing in a few words at google.com. This is not the case. You will often need to go to the library, use library search tools and read physical books and articles contained in refereed/archival journals.

Be sure to make use of the Vikat library catalog accessed via the PSU library home page at [http://www.lib.pdx.edu/](http://www.lib.pdx.edu/). Also available on the library home page are Full Text Electronic Journals and a list of on-line Databases. Databases to try are EI
Compendex (http://www.ei.org/ev2/ev2.home), Web of Science, and Google Scholar. Access to these databases is free for PSU students, but you must be using a computer on campus or via a proxy over an Internet connection. To log on to the PSU proxy server use https://login.proxy.lib.pdx.edu/login.

**Campus Safety:**
Student safety is paramount. The Campus Public Safety Office is open 24 hours a day to assist with personal safety, crime prevention and security escort services. Call 503-725-4407 for more information.

For Campus emergencies call 503-725-4404.

**Title IX Reporting Obligations**
Portland State is committed to providing an environment free of all forms of prohibited discrimination and sexual harassment (sexual assault, domestic and dating violence, and gender or sex-based harassment and stalking). If you have experienced any form of gender or sex-based discrimination or sexual harassment, know that help and support are available. PSU has staff members trained to support survivors in navigating campus life, accessing health and counseling services, providing academic and on-housing accommodations, helping with legal protective orders, and more. Information about PSU’s support services on campus, including confidential services and reporting options, can be found on PSU's Sexual Misconduct Prevention and Response website at: http://www.pdx.edu/sexual-assault/get-help or you may call a confidential IPV Advocate at 503-725-5672. You may report any incident of discrimination or discriminatory harassment, including sexual harassment, to either the Office of Equity and Compliance or the Office of the Dean of Student Life.

Please be aware that all PSU faculty members and instructors are required to report information of an incident that may constitute prohibited discrimination, including sexual harassment and sexual violence. This means that if you tell me about a situation of sexual harassment or sexual violence that may have violated university policy or student code of conduct, I have to share the information with my supervisor, the University’s Title IX Coordinator or the Office of the Dean of Student Life. For more information about Title IX please complete the required student module Creating a Safe Campus in your D2L.

**Access and Inclusion for Students with Disabilities**
PSU values diversity and inclusion; we are committed to fostering mutual respect and full participation for all students. My goal is to create a learning environment that is equitable, useable, inclusive, and welcoming. If any aspects of instruction or course design result in barriers to your inclusion or learning, please notify me. The Disability
Resource Center (DRC) provides reasonable accommodations for students who encounter barriers in the learning environment.

If you have, or think you may have, a disability that may affect your work in this class and feel you need accommodations, contact the Disability Resource Center to schedule an appointment and initiate a conversation about reasonable accommodations. The DRC is located in 116 Smith Memorial Student Union, 503-725-4150, drc@pdx.edu, http://www.pdx.edu/drc

If you are approved by the DRC for test accommodations, it is your responsibility to schedule the exam with Testing Services. Your exam cannot start earlier than 1 hour before or no later than one hour after the scheduled exam time. Notify your instructor at least one week before each exam so they can have an exam at the Testing Center. Be sure to schedule your testing times at the very beginning of the term to ensure you can get a test time that meets the start requirements. Special proctored exams will not be offered.