

ME 405: Indoor Air Quality Engineering, Syllabus for Fall Semester 2024

John M. Cimbala, Penn State University. Latest update: 22 August 2024

- Lectures:** **Mon., Wed., and Fri. (as needed), 1:25-2:15 p.m., Room 260 Willard Building**
- Text:** **Recommended: *Indoor Air Quality Engineering*, R. J. Heinsohn and J. M. Cimbala, Marcel-Dekker, Inc., New York, 2003. FREE for PSU students at <http://www.crcnetbase.com/doi/book/10.1201/9780203911693>.**
- Prerequisite:** At least one undergraduate fluid mechanics course.
- Web Pages:** The main website for this course is on Penn State's Canvas site at <https://psu.instructure.com/>. Professor Cimbala also maintains a second website at <http://www.me.psu.edu/cimbala/me405> where he will post lecture videos, etc. in the event that Canvas is down. Use this website only if you have trouble connecting or finding something on Canvas. Students are expected to check Canvas regularly for lecture notes and videos, homework assignments, quizzes, and other information.
- Instructor:**
- **John M. Cimbala**, jmc6@psu.edu. Professor of Mechanical Engineering, 234 Reber Building, 814-863-2739, www.me.psu.edu/cimbala. ← Weekly schedule is posted on this website.
 - Office hours: **Wednesday 3:00-5:00 pm**. [Subject to change – will notify.]
- TA/Grader:** **Jean-Paul Edwards** jce5256@psu.edu – The TA/Grader will grade all homework assignments. See <https://www.me.psu.edu/cimbala/me405/TA/ta.pdf> for TA/Grader office hours, etc.

General Description and Course Outline:

This course is a technical elective for seniors and graduate students. It provides an introduction to environmental health and indoor air quality engineering. The first topics include the fundamentals of risk, ideal gas mixtures, and air pollution concentration, including relative humidity. Then models and diseases of the respiratory system are discussed and analyzed. Issues of indoor air quality other than air pollution, such as fire and explosion, noise, heat, and odors are also discussed. Emission factors are introduced along with methods of estimating emissions by evaporation, combustion, etc. A good deal of time is then spent on room ventilation, including sources, wall losses, recirculation, air cleaners, etc. The same methodology is extended to tunnel ventilation systems and hood/exhaust duct system design. The few last weeks of the semester deal with particulate air pollution, including equations of motion of particle trajectories in an air stream and particle removal systems (air pollution control systems, or APCs).

Lecture Schedule: A more detailed week-by-week breakdown is provided on the Canvas website.

Week #	Topics to be Covered [Note: We will follow this schedule as closely as possible, <i>subject to change</i>]
1	Hazard vs. Risk; HERP Index; Chemistry Review; Volume Flow Rate; Ideal Gas Mixtures; Bulk Molecular Weight
2	Concentrations; Relative Humidity; Respiratory System; Conditioned Inhalation; Toxicology
3	First-Order ODEs; Mass Body Burden; Exposure Levels
4	Vapor Explosions; Particle Explosions; Hearing and Noise; Heat Stress
5	Heat Stress; Odors; Emission Factors; Flux Chambers; Tank Filling
6	Diffusion; Reynolds Analogy; Evaporation Introduction; Evaporation and Wind; Evaporation Multicomponent
7	Confined Space; Evaporation Thermodynamics Cat. 1 and Cat. 2; General Ventilation; Simple Room
8	Unsteady Coefficients; Wall Adsorption; Measuring Wall Loss Coefficient; Air Cleaners
9	Infiltration; ERV Systems; Tees; Recirculation; Series and Parallel Cleaners
10	Clean Rooms; Mercury Professor; Mean Age; Room Ventilation Effectiveness; Degree Days
11	Tunnels: Introduction, Analysis; Local Ventilation; Hood Impact
12	Capture and Control Velocity; Canopy Hoods; Bulk Materials; Exhaust Duct Introduction; Major and Minor Losses
13	Fan Performance; Fan Example; Introduction to Particles; Particle Concentrations
14	Sphere Drag; Cunningham Correction Factor; Equations of Particle Motion; Terminal Settling Speed
15	Equivalent Diameters for Non-Spheres; Particle Settling in Moving Air, Containers, and Ducts; Grade Efficiency

Grading: All quizzes, exams, and homework assignments are *comprehensive*, making use of previous material.

Automatic late penalties are given in Canvas for late submissions of homework and quizzes.

Homework	21%	Highest 14 scores counted out of 15 total; due the next Wednesday each week at midnight
Lesson Quizzes	60%	Typically one quiz per lesson; due the next Wednesday each week at midnight; highest 60 scores counted out of expected 70 total (drop 10 lowest scores)
Final Exam	19%	3 hours online during finals week; 12:01 am December 16 to 11:59 pm December 18

Grading Scale: The following are minimum cutoffs for each grade:

• 90.00% = A	• 80.00% = B	• 70.00% = C
• 86.66% = A-	• 76.66% = B-	• 60.00% = D
• 83.33% = B+	• 73.33% = C+	• less than 60.00% = F

Grade Disputes: If a student feels that an exam or homework set was graded unfairly, or if there is an error in the grading, it should be brought to the attention of Professor Cimbala within one week after the graded material is handed back. Scores will *not* be reconsidered beyond one week after they are handed back, except under unusual circumstances.

Cheating Policy: Cheating is not tolerated in this course. You should refer to the Academic Integrity website at <http://www.engr.psu.edu/faculty-staff/academic-integrity.aspx> which explains what behaviors are in violation of academic integrity, and the review process for such violations. On the next page is a summary of the policy. Specifically for this course:

- **First offense:** Zero score for the item in question, and infraction reported to the College.
- **Second offense:** Failure of the course, and infraction reported to the College.

Course Objectives: Upon completion of this course, students should be able to:

1. Demonstrate an ability to analyze and compare risks associated with various activities and exposure to hazardous chemicals.
2. Demonstrate a working knowledge of the physiology and function of the respiratory system, including diseases of the lung.
3. Demonstrate an ability to estimate pollutant emission rates using emission factors and fundamental mass balance techniques.
4. Analyze practical problems that involve building, room, and tunnel ventilation requirements and systems.
5. Design local ventilation systems using standard guidelines from ACGIH and ASHRAE.
6. Predict the motion of particles in air, and analyze pollution control devices that remove particles from the air.
7. Demonstrate professionalism and respectful interaction with faculty and colleagues.

Academic Integrity Definition and Expectations: Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle.

Summary of Penn State's Academic Dishonesty Policy: The University defines academic integrity as the pursuit of scholarly activity in an open, honest and responsible manner. All students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts (refer to [Senate Policy 49-20](#)). Dishonesty of any kind will not be tolerated in this course. Dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. Students who are found to be dishonest will receive academic sanctions and will be reported to the University's Office of Student Conduct for possible further disciplinary sanctions (refer to [Senate Policy G-9](#)).

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Accommodating Disabilities and Disability Access Statement:

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Office for Disability Services (ODS) Web site provides contact information for every Penn State campus: <http://equity.psu.edu/student-disability-resources/disability-coordinator>. For further information, please visit the [Office for Disability Services Web site : http://equity.psu.edu/ods](http://equity.psu.edu/ods) .

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Student Disability Resources Web site provides [contact information for every Penn State campus](#): For further information, please visit the [Student Disability Resources Web site: http://equity.psu.edu/student-disability-resources](http://equity.psu.edu/student-disability-resources). In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation. See <http://equity.psu.edu/student-disability-resources/applying-for-services>. If the documentation supports your request for reasonable accommodations, your [campus's disability services office](#) will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

Counseling & Psychological Services (CAPS) Statement:

CAPS can help students resolve personal concerns that may interfere with their academic progress, social development, and satisfaction at Penn State. Some of the more common concerns include anxiety, depression, difficulties in relationships (friends, roommates, or family); sexual identity; lack of motivation or difficulty relaxing, concentrating or studying; eating disorders; sexual assault and sexual abuse recovery; and uncertainties about personal values and beliefs. You can contact CAPS by calling the Main CAPS number/Appointment Scheduling: 814-863-0395 (Please call between the hours of 8am and 5pm, Monday-Friday to schedule an appointment) or visit us at our office location, 5th Floor Student Health Center.

Sexual Assault and Relationship Violence Hotline:

A hotline has been established for victims and observers of sexual assault and relationship violence. Trained counselors on the hotline will help students access appropriate resources. Penn State students from any campus can call 1 (800) 560-1637 to access the 24 hour a day, seven day a week hotline.

Library Resources:

Many of Penn State's library resources can be utilized from a distance. Through the University Libraries website, you can

- access magazine, journal, and newspaper articles online using library databases;
- borrow materials and have them delivered to your doorstep...or even your desktop;
- get research help via e-mail, chat, or phone using the [Ask a Librarian service \(Links to an external site.\)](#)[Links to an external site.](#); and much more.

You must have an active Penn State Access Account to take full advantage of the University Libraries' resources and services. Once you have a Penn State account, you will automatically be registered with the library within 24–48 hours. If you would like to check that your registration has been completed, visit the [Libraries home page \(Links to an external site.\)](#)[Links to an external site.](#), click on **Library Accounts**, and then click on **My Library Account**.

Academic Integrity:

Academic integrity—scholarship free of fraud and deception—is an important educational objective of Penn State. Academic dishonesty can lead to a failing grade or referral to the [Office of Student Conduct \(Links to an external site.\)](#)[Links to an external site.](#) Academic dishonesty includes but is not limited to

- cheating,
- plagiarism,
- fabrication of information or citations,
- facilitating acts of academic dishonesty by others,
- unauthorized prior possession of examinations,
- submitting the work of another person or work previously used without informing the instructor and securing written approval, and
- tampering with the academic work of other students.

The University defines academic integrity as the pursuit of scholarly activity in an open, honest and responsible manner. All students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts (refer to Senate Policy 49-20). Dishonesty of any kind will not be tolerated in this course. Dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. Students who are found to be dishonest will receive academic sanctions and will be reported to the University's Office of Student Conduct for possible further disciplinary sanctions (refer to Senate Policy G-9).

How Academic Integrity Violations Are Handled:

In cases where academic integrity is questioned, the [Policy on Academic Integrity \(Links to an external site.\)](#)[Links to an external site.](#) indicates that procedure requires an instructor to notify a student of suspected dishonesty before filing a charge and recommended sanction with the college. Procedures allow a student to accept or contest a charge. If a student chooses to contest a charge, the case will then be managed by the respective college or campus Academic Integrity Committee. If a disciplinary sanction also is recommended, the case will be referred to the [Office of Student Conduct \(Links to an external site.\)](#)[Links to an external site.](#) All Penn State colleges abide by this Penn State policy, but review procedures may vary by college when academic dishonesty is suspected. Information about Penn State's academic integrity policy and college review procedures is included in the information that students receive upon enrolling in a course. To obtain that information in advance of enrolling in a course, please contact us by going to the [Contacts & Help page \(Links to an external site.\)](#)[Links to an external site.](#)

Additionally, World Campus students are expected to act with civility and personal integrity; respect other students' dignity, rights, and property; and help create and maintain an environment in which all can succeed through the fruits of their own efforts. An environment of academic integrity is requisite to respect for oneself and others, as well as a civil community.

For More Information on Academic Integrity at Penn State:

Please see the [Academic Integrity Chart \(Links to an external site.\)](#)[Links to an external site.](#) for specific college contact information or visit one of the following sites:

- Penn State Senate [Policy on Academic Integrity \(Links to an external site.\)](#)[Links to an external site.](#)
- [iStudy for Success! \(Links to an external site.\)](#)[Links to an external site.](#) (education module about plagiarism, copyright, and academic integrity)
- [Turnitin \(Links to an external site.\)](#)[Links to an external site.](#) (a web-based plagiarism detection and prevention system)