

ENVE4106/ASCE4106/BLDG5104 – Winter 2025

INDOOR ENVIRONMENTAL QUALITY

Department of Civil and Environmental Engineering / Building Engineering Program

Teaching Team

Instructor: Dr. Cara Lozinsky, PhD, P.Eng.

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(emails are monitored Monday – Friday, 8:00am – 5:00pm)

Office: ME 2374 (office hours by appointment)

TA(s): Information will be posted on Brightspace

Course Description and Requirements

1) Course Activities

Activity	Day	Time	Location
Lecture	Tuesdays	2:35 – 5:25pm	
Lab/Tutorial Section 1	Thursdays (even weeks)	8:35 – 11:25am	
Lab/Tutorial Section 2	Fridays (even weeks)	11:35am – 2:35pm	

Lab/tutorial sessions will take place every other week, starting the week of January 13, and will be run by the teaching assistants. Lab/tutorial sessions will include a combination of hands-on learning activities, independent work periods/office hours, technical tours, and presentation of example problems. Refer to the Course Schedule for more detail. Content covered in the lab/tutorial sessions will be testable.

2) Course Description

This course examines a wide variety of factors affecting indoor environmental quality (IEQ), its impact on people, how to measure it, how to analyze it, and how to improve it. IEQ is comprised of indoor air quality (IAQ), thermal comfort (TC), visual comfort (VC), and acoustic comfort (AC). Each of these four major elements of IEQ consists of three lessons: 1) concepts, 2) measuring and modelling, and 3) application. By the end of the course, students should have knowledge of IEQ issues, metrics, measurement techniques, modelling, solutions, and approaches to design. Guest lectures and technical tours may be used to supplement the regular lectures.

3) Precluded Courses

- ACSE/ENVE4106 Students: N/A
- BLDG5104 Students: prior completion of either ACSE4106 or ENVE4106

4) Prerequisites and Recommended Knowledge

- ACSE/ENVE4106 Students: fourth-year status in one of the following programs: B.Eng. Architectural Conservation and Sustainability, B.Eng. Environmental Engineering, B.A.S. concentration in Conservation and Sustainability
- BLDG5104 Students: enrolled in the Building Engineering Program (M.Eng., M.A.Sc., or Ph.D.)

5) Learning Outcomes

After taking the course, students should be able to:

- Identify major sources of adverse IEQ conditions, know their causes, and suggest methods for mitigation
- Perform psychrometric calculations and read/use a psychrometric chart
- Describe the major functions of heating, ventilation, and air conditioning (HVAC) equipment and systems and perform basic related calculations
- Create and apply an IEQ testing plan
- Understand IEQ modelling methodologies
- Identify and apply appropriate modelling methodologies depending on the problem characteristics
- Model IEQ under steady-state and dynamic conditions using custom models
- Model IEQ in simple buildings using several different software packages
- Understand basic comfort (thermal, visual, acoustic) criteria and models and be able to perform basic related calculations
- Be familiar with the high-level societal implications of IEQ and state-of-the-art IEQ-related technologies and controls

6) Graduate Attributes

The Canadian Engineering Accreditation Board (CEAB) requires graduates of undergraduate engineering programs to possess 12 attributes. Courses in all four years of our programs evaluate students' progress towards acquiring these attributes. Aggregate data (typically, the data collected in all sections of a course during an academic year) is used for accreditation purposes and to guide improvements to our programs. Some of the assessments used to measure GAs may also contribute to final grades; however, the GA measurements for individual students are not used to determine the student's year-to-year progression through the program or eligibility to graduate. This following list provides the GAs that will be measured in this course, along with the Learning Outcomes that are intended to develop abilities related to these attributes.

GA - Indicator	Assessment Tool
2.1 Problem Definition	Assignments 1 – 4, Final Exam
2.2 Approach to the Problem	
2.3 Use of Assumptions	
2.4 Interpreting Solutions/Validity of Results	

For information on GAs and continual curriculum improvement, visit the [Accreditation section of Engineers Canada website](#).

7) Accreditation Units

Math	Natural Science	Complementary Studies	Engineering Science	Engineering Design
-	-	-	50%	50%

8) Textbook(s)/Learning Materials and Their Costs

Students are not required to purchase textbooks or other learning materials for this course. All mandatory learning materials are freely available via the Carleton Library online subscriptions (link below)

Prices listed below represent the current purchase price for each reference text, for your information only.

Mandatory Reference Materials (free for download via Carleton University Techstreet subscription: [Techstreet Enterprise](#) | [MacOdrum Library](#)):

- 1) *ASHRAE Standard 55: Thermal Environmental Conditions for Human Occupancy (2023 Edition)*
(\$167 USD purchase price)
- 2) *ASHRAE Standard 62.1: Ventilation and Acceptable Indoor Air Quality (2022 Edition)*
(\$140 USD purchase price)
- 3) *ASHRAE Standard 62.2: Ventilation and Acceptable Indoor Air Quality in Residential Buildings (2022 Edition)*
(\$140 USD purchase price)

Optional Reference Materials (not essential, available online or in hard copy through MacOdrum Library):

- 1) *Sustainable Facades: Design Methods for High-Performance Building Envelopes* by Ajla Aksamija
(E-Book: \$75.99 USD, Hard Copy: \$98.95 USD purchase price)
- 2) *Human Factors in Lighting, 3rd Edition* by Peter Boyce
(E-Book, Paperback: \$84 USD, Hard Copy: \$192 USD purchase price)
- 3) *Daylighting Performance and Design, 2nd Edition* by Gregg Ander
(Hard Copy: \$134.95 USD purchase price)
- 4) *The Indoor Environment Handbook* by Philomena Bluyssen (especially Ch. 3)
(E-Book, Paperback: \$49.59 USD, Hard Copy: \$112 USD purchase price)
- 5) *Architectural Acoustics* by David Egan (Ch. 1, 2, 3, 4)
(Paperback: \$84.95 CAD purchase price)
- 6) *Lighting Engineering – Applied Calculations* by R.H. Simons (Ch. 1, 2, 3, 14)
(E-Book, Paperback: \$44.79 USD, Hard Copy: \$152 USD purchase price)

Lecture Notes

Powerpoint lecture slides will be posted on Brightspace at least one day prior to the lecture. The lecture slides are meant to supplement the lecture and do not represent the full course content. Some sections of the lecture slides will be left blank and will be filled in during the lecture. The filled-in lecture slides will **not** be provided. Please be prepared to fill in your notes by hand, tablet, computer, or any other approach that works best for you.

Lectures will not be recorded by the instructor. Students do not have permission to record the lectures on their own, unless it is part of their approved academic accommodation plan.

9) Topics and Tentative Plan (*subject to change)

	Week No.	Lecture Topics*	Supplementary Reference Materials	Assignments due at 11:59pm (on Brightspace)	Lab/Tutorial*	
Indoor Air Quality	1. Jan. 7	<ul style="list-style-type: none"> Course scope, schedule, syllabus Background of IEQ Indoor air quality background <ul style="list-style-type: none"> Types of contaminants Psychrometrics and properties of air 				
	2. Jan. 14	<ul style="list-style-type: none"> Mass balances in buildings Airflow and indoor air quality calculations and modelling Inverse modelling of IAQ 			Lab (CB5301): air-handling unit activity; IAQ example problems	
	3. Jan. 21	<ul style="list-style-type: none"> Ventilation and air cleaning 	ASHRAE Std. 62.1, 62.2			
	4. Jan. 28	<ul style="list-style-type: none"> IAQ standards Design for IAQ 	ASHRAE Std. 62.1, 62.2		Assignment 1 work period	
Thermal Comfort	5. Feb. 4	<ul style="list-style-type: none"> Thermal comfort background Human-building heat exchange MRT Human energy balance Fanger model Monitoring and measuring thermal comfort 	ASHRAE Std. 55	Assignment 1 Due		
	6. Feb. 11	<ul style="list-style-type: none"> Adaptive comfort model Thermal comfort metrics Comfort from draughts and solar radiation Thermal comfort software tools 	ASHRAE Std. 55		Thermal comfort example problems and Assignment 2 work period	
	Reading Week (Feb. 17 – 21)					
	7. Feb. 25	<ul style="list-style-type: none"> Thermal comfort standards Design for thermal comfort 	ASHRAE Std. 55	Assignment 2 Due		
Visual Comfort	8. Mar. 4	<ul style="list-style-type: none"> Intro to visual comfort Properties of electromagnetic radiation Eye physiology Basic lighting units and calculations 			Visual comfort activity; visual comfort example problems	
	9. Mar. 11	<ul style="list-style-type: none"> Visual comfort calculations and modelling Glare metrics 				
	10. Mar. 18	<ul style="list-style-type: none"> Lighting design Design for visual comfort Daylighting/lighting systems 			Assignment 3 work period	
Acoustic Comfort	11. Mar. 25	<ul style="list-style-type: none"> Introduction to hearing and acoustics Physics of sound Health and wellbeing impacts of acoustics and noise 		Assignment 3 Due		
	12. Apr. 1	<ul style="list-style-type: none"> Calculations and modelling for building acoustics Design strategies and case studies for acoustics 			Acoustic comfort activity, example problems, and work period	
	13. Apr. 8	Course review		Assignment 4 Due		
Final Exam Period (April 11 – 26): final exam will be scheduled during the final exam period (date, time, and room as per official exam schedule)						

10) Evaluation and Marking Scheme

Evaluation Activity	Description	Value
Assignments	One assignment for each of the four IEQ topics, spaced evenly throughout the semester. Refer to Brightspace for due dates.	4 x 12.5% = 50%
Final Exam	Cumulative exam, scheduled during the University Final Exam Period Students must receive at least 50% on the final exam to pass the course	50%

11) Policies

a) Final Examination

i) **Final exams are for evaluation purpose and will not be returned to students.**

ii) Deferred Final Examinations: Students who are unable to write the final examination because of extenuating circumstances, as defined in the [Academic Consideration Policy](#), may apply for accommodation by contacting the Registrar's office. Consult the [Section 4.3 of the University Calendar](#).

b) Exam Format

The final exam will be an in-person, individual, closed book exam on all course content including material and concepts covered in lectures, guest lectures, assignments, and lab activities.

c) Assignment Format

Unless otherwise stated, assignments are to be completed individually. Evidence of partial or full direct copying will be treated as plagiarism in accordance with Carleton University's Academic Integrity Policy.

d) Assignment Late Submission Policy

Assignments are due at 11:59pm on Brightspace on the date listed on the Course Schedule. If you cannot meet a deadline, please make arrangements with the instructor **before** the deadline.

Late submissions will be accepted after the due date, with a 10% deduction per day (or partial day), up to a maximum of five days. After five days, assignments will receive a mark of zero.

e) Deferred Term Work and Self-Declaration

Students who claim extenuating circumstances defined in the [Academic Consideration Policy](#), as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases. This must occur no later than three (3) days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. Consult [Section 4.4 of the University Calendar](#).

11) Academic Dates

Students should be aware of the academic dates (e.g. last day for academic withdrawal) posted on the Registrar's office web site <https://carleton.ca/registrar/registration/dates/academic-dates/>

Academic Integrity and Plagiarism

- a) Please consult the Faculty of Engineering and Design information page about the Academic Integrity policy and our procedures: <https://carleton.ca/engineering-design/current-students/fed-academic-integrity>. Violations of the Academic Integrity Policy will result in the assignment of a penalty such as reduced grades, the assignment of an F in a course, a suspension or, expulsion.
- b) One of the main objectives of the Academic Integrity Policy is to ensure that **the work you submit is your own**. As a result, it is important to write your own solutions when studying and preparing with other students and to avoid plagiarism in your submissions. *The University Academic Integrity Policy defines plagiarism as “presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one’s own.”* This includes reproducing or paraphrasing portions of someone else’s published or unpublished material, regardless of the source, and presenting these as one’s own without proper citation or reference to the original source.

Examples of violations of the policy include, but are not limited to:

- Any submission prepared in whole or in part, by someone else;
- Using another’s data or research findings without appropriate acknowledgement;
- Submitting a computer program developed in whole or in part by someone else, with or without modifications, as one’s own; and
- Failing to acknowledge sources of information through the use of proper citations when using another’s work and/or failing to use quotations marks.
- Using content generated by artificial intelligence (IA) tool.

Copyright

The materials (including the course outline, slides, posted notes, videos, labs, projects, assignments, quizzes, exams, and solutions) created for this course are intended for personal use only. They may not be reproduced, redistributed, or transmitted in any form or by any means—electronic, mechanical, photocopying, recording, or otherwise—without written permission from the author(s), both during and after the semester.

Learning and Working Environment

The University and all members of the University community share responsibility for ensuring that the University’s educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the [Department of Equity and Inclusive Communities](mailto:equity@carleton.ca) at equity@carleton.ca

We will strive to create an environment of mutual respect for all through equity, diversity, and inclusion within this course. The space which we work in will be safe for everyone. Please be considerate of everyone’s personal beliefs, choices, and opinions.

Academic Accommodations

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic

medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at **613-520-6608** or pmc@carleton.ca.

You should request your academic accommodations in the [Ventus Student Portal](#), for each course at the beginning of every term. For in-term tests or midterms, please request accommodations at least two (2) weeks before the first test or midterm. Please consult the [PMC website](#) for the deadline to request accommodations for the formally-scheduled exam (if applicable).

Accommodation for Student Activities: Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the [Senate Policy on Accommodation for Student Activities \(PDF\)](#).

Pregnancy Obligation: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF\)](#).

Religious Obligation: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF\)](#).

Survivors of Sexual Violence: As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit the [Sexual Violence Prevention & Survivor Support](#).

Engineering Academic Advising

[The Engineering Academic Support Service](#) assists undergraduate engineering students with course selection, registration, and learning support from first-year through to graduation.

Academic Advisors Contact can be found here: <https://carleton.ca/engineering-design/current-students/undergrad-academic-support/undergraduate-advisors/>.