Indoor Environmental Quality (IEQ) – ACSE4106/ENVE4106/ENVE5104

Winter 2024, Lectures: Tuesdays, 8:35-11:25 in CB 3101
Tutorials and Labs: Even weeks, check your schedule for time/location (OR in CB5301, when announced in advance); tutorials/labs are all identical for a given week

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Office hours: By appointment

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. Lab/tutorial activities include technical tours, field studies, software use, and example problem solving.

Learning objectives
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 HVAC equipment and systems and perform basic related calculations
- Create and apply an IEQ testing plan
- Understand and apply IEQ modeling methodologies
- 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

Evaluation

Major assignments for each topic of IEQ (4 total, spaced at about 3-week intervals; refer to schedule on BrightSpace for up-to-date deadlines)	50% (12.5% each)
Final Exam - Covers entire term; exam will be scheduled during the exam period. **Students must receive at least 50% on the final exam to pass the course.**	50%

All forms of evaluation (assignments, exams) will be in SI units. However, it would be beneficial for students to be comfortable with basic conversions to IP units (e.g., CFM).

Course Materials
Course/exam material consists of freely available: textbook chapters, PowerPoint presentations, conference and journal papers, government reports, and building standards. The concepts discussed by guest lecturers are also testable on quizzes and the final exam.

Assignments
Four assignments will be given throughout the term. Assignments will be posted a minimum of two weeks before they are due. Refer to BrightSpace for deadlines. Assignments are to be submitted via BrightSpace before the beginning of the lecture or will be considered late. Graduate students (registered in ENVE5104) may be assigned alternate assignments (e.g., an extra question). Late assignments will be accepted but with a 20% per day mark reduction (i.e., zero after five days). Assignments are to be completed individually; evidence of partial or full direct copying will be treated as an academic violation and will be handled accordingly (i.e., reported to the Dean's office). Typically 5-10% of students have been caught copying in past years.

Final Exam
The final exam is during the designated exam period and will cover all material (see *Course Materials*) taught during the course. A reference page with diagrams and tables will be provided as part of the exam booklet.

IEQ Modelling Software (freely available for download on Windows-based PCs)

1. Excel and/or Matlab
2. IA-QUEST
3. UC Berkeley CBE Thermal Comfort Tool
4. LBNL COMFEN

Key reference texts (*free on library website/online)

1. ASHRAE Fundamentals Handbook SI
2. ASHRAE Standard 55 (Google "ASHRAE Standard"; click on link to find free preview)
3. ASHRAE Standard 62.1 (Google "ASHRAE Standard"; click on link to find free preview)

Other reference texts (not essential; *free on library website/online)

1. Sustainable Facades: Design Methods for High-Performance Building Envelopes*
2. Human Factors in Lighting, 3rd Edition by Peter Boyce*
3. Illuminating Engineering: From Edison's Lamp to the Led by Joseph Murdoch
4. Daylighting Performance and Design, Second Edition by Gregg Ander*
5. The Indoor Environment Handbook by Philomena Bluyssen (especially chap. 3)
6. Architectural Acoustics by David Egan* (chap. 1, 2, 3, 4)
7. Lighting Engineering – Applied Calculations* by RH Simons (chap. 1,2,3,14)

Student accommodation
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 for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). Requests made within two weeks will be reviewed on a case-by-case basis. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam (if applicable).