Indoor Environmental Quality (IEQ) – ENVE 4106 / 5104

Winter 2017, Lectures: Thursdays, 8:35-11:35, Southam Hall 404
Tutorials and Labs: Fridays (even weeks), Sect. 1: 11:35-14:35, Sect. 1: 14:35-17:25, RB2311
Instructor: Prof. William (Liam) O’Brien, Ph.D., P.Eng., email: Liam.OBrien@carleton.ca, office: CB5208
Prof. O’Brien office hours: Thursdays 15:00-16:00 or by appointment only
TA contact: TBD

Course description
This course examines a wide variety of factors affecting the indoor environmental quality (IEQ), its impact, 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 is comprised of three lessons: 1) concepts, 2) measuring and modelling, and 3) application. By the end of the course, students should have good knowledge of IEQ issues, metrics, measurement techniques, modelling, solutions, and approaches to design. Numerous guest lectures and technical tours will 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 indoor air pollution, 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 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

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major assignments (4 total, spaced at about 3-week intervals)</td>
<td>50% (12.5% each)</td>
</tr>
<tr>
<td>Final Exam - Covers entire term; during exam period</td>
<td>50%</td>
</tr>
</tbody>
</table>

All 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, blackboard notes, PowerPoint presentations, conference and journal papers, government reports, and building standards. The concepts discussed by the guest lecturers are also testable on final exam. Hand-written/blackboard notes will not be made available online.

Additionally, there are approximately 12 examinable posted readings that will be discussed in class.

Assignments
Four assignments will be given throughout the term. They will be posted a minimum of two weeks before they are due. Refer to course schedule on cuLearn for deadlines. Assignments are due in class at the beginning of the lecture or will be considered late. Refer to assignment sheet for submission instructions. Late assignments will be accepted but with a 20% per day mark reduction. Assignments are to be completed individually; evidence of direct copying will be treated as cheating 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.
Participation
A significant portion of lectures will be devoted to discussing contemporary IEQ issues and academic publications. Therefore, students are expected to read assigned readings **before** class so they can participate in these discussions throughout the entire term.

Exam
The final exam is during the designated exam period and will cover all material (see Course Materials) taught during the course. A 1-page (8.5” by 11”, single-sided) formula sheet is allowed, but the exam is otherwise closed book. Notes, diagrams, definitions, and other conceptual materials are not permitted on the formula sheet.

IEQ Modelling Software (freely available for download on Windows-based PCs)
1. IA-QUEST
2. CONTAM
3. UC Berkeley CBE Thermal Comfort Tool
4. LBNL COMFEN

Key reference texts (*free on library website/online)
1. ASHRAE Fundamentals Handbook 2013-SI* (especially chap. 1,8, 9, 11,12,13,16)
2. The Indoor Environment Handbook by Philomena Bluyssen (especially chap. 3)
3. Architectural Acoustics by David Egan* (chap. 1, 2, 3, 4)
4. Lighting Engineering – Applied Calculations* by RH Simons (chap. 1,2,3,14)
5. ASHRAE Standard 55
6. ASHRAE Standard 62.1 (Google: “ASHRAE Standard”; click on link)

Other reference texts (not essential)
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