Instructor: Burak Gunay, Ph.D.
Office: CB 5206
Office Hours: Tuesday 9:00 to 10:00 and Wednesday 11:00 to 12:00
Email: Burak.Gunay@carleton.ca

PA Session: Tuesday 2:30 to 5:30 (on alternating weeks)

TA: Philippe Bisaillon
Office: ME 3374
Office Hours: Thursday 14:00 to 16:00 pm
Email: Philippe.Bisaillon@carleton.ca

TA: Shawn Shi
Office: CB 7206
Office Hours: Tuesday 14:00 to 15:00
Email: Zixiao.Shi@carleton.ca

Course meets: Monday 8:35 to 11:25 am

Learning Objectives:
1. Control of heat, air, and moisture in a severe climate
2. Fundamentals of heat, air, and moisture transfer in buildings
3. Engineering methods in building science

Reading (s)/Textbook (s):
1. Lecture notes and worked examples on cuLearn
2. Building Science for a Cold Climate by Hutcheon and Handegord – purchase online $55+tax
3. ASHRAE Fundamentals Handbook
5. Building Science for Building Enclosures by Straube and Burnett

Course Plan:

<table>
<thead>
<tr>
<th>Date</th>
<th>Heat transfer and storage in buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>9-Jan</td>
<td>- Definition and importance building science</td>
</tr>
<tr>
<td></td>
<td>- Units and conventions (Energy, Power, Temperature)</td>
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<td>- Steady-state 1D conduction (U-value, R-value, windows, walls)</td>
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<tr>
<td></td>
<td>- Steady-state 2D conduction (Thermal bridging)</td>
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<tr>
<td>Date</td>
<td>Topic</td>
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| 16-Jan| Heat transfer and storage in buildings                               | - Transient 1D conduction (Sensible storage and thermal mass)  
- Boundary conditions (Convective, radiative, and prescribed temperature boundary conditions, longwave radiation, view-factors) |
| 23-Jan| Heat transfer and storage in buildings                               | - Thermal properties of windows  
- Insulation materials (Thermal properties of building component assemblies)  
- Calculations for wood frame wall  
- Heat transfer in ceilings, attics, and roofs |
| 30-Jan| Properties of air                                                    | - Psychrometry  
- Vapour pressure, RH, enthalpy, moisture ratio, dew temperature  
- Mixing, heating / cooling, de-humidifying and humidifying air |
| 6-Feb | Airflow in buildings                                                 | - Why do we study airflow in buildings?  
- Air-leakage and infiltration (e.g., air-barriers, air-leakage testing)  
- Wind induced pressure differences  
- Stack driven pressure differences  
- Pressure induced by mechanical systems |
| 13-Feb| Airflow in buildings                                                 | - Air transfer in open-porous materials  
- Airflow across permeable layers, apertures, joints, leaks and cavities  
- Airflow across large intentional openings (natural ventilation) |
| 27-Feb| Midterm                                                              | |
• Transient heat balance in a shoebox on a winter day – continued (sensible/latent heat losses from walls, heat losses/gains from windows, air infiltration losses, solar gains, internal gains, ventilation losses, HVAC loads)
• Special topics: Design standards and guidelines (ASHRAE 90.1-2 and NECB)
• Special topics: Building performance simulation

Course Requirements & Methods of Evaluation:
30% MIDTERM
20% QUIZZES
DURING PA SESSIONS
50% FINAL

In accordance with the Carleton University Undergraduate Calendar (p 34), the letter grades assigned in this course will have the following percentage equivalents:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A+</td>
<td>90-100</td>
</tr>
<tr>
<td>A</td>
<td>85-89</td>
</tr>
<tr>
<td>A-</td>
<td>80-84</td>
</tr>
<tr>
<td>B+</td>
<td>77-79</td>
</tr>
<tr>
<td>B</td>
<td>73-76</td>
</tr>
<tr>
<td>B-</td>
<td>70-72</td>
</tr>
<tr>
<td>C+</td>
<td>67-69</td>
</tr>
<tr>
<td>C</td>
<td>63-66</td>
</tr>
<tr>
<td>C-</td>
<td>60-62</td>
</tr>
<tr>
<td>D+</td>
<td>57-59</td>
</tr>
<tr>
<td>D</td>
<td>53-56</td>
</tr>
<tr>
<td>D-</td>
<td>50-52</td>
</tr>
<tr>
<td>F</td>
<td>Below 50</td>
</tr>
<tr>
<td>WDN</td>
<td>Withdrawn from the course</td>
</tr>
<tr>
<td>ABS</td>
<td>Student absent from final exam</td>
</tr>
<tr>
<td>DEF</td>
<td>Deferred (See above)</td>
</tr>
<tr>
<td>FND</td>
<td>(Failed, no Deferred) = Student could not pass the course even with 100% on final exam</td>
</tr>
</tbody>
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Academic Regulations, Accommodations, Plagiarism, Etc.
University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university’s website, here: http://www.carleton.ca/calendars/ugrad/current/regulations/acadregsuniv.html

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 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). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).

For Religious Obligations:
Students requesting academic accommodation on the basis of religious obligation should make a formal, written request to their instructors for alternate dates and/or means of satisfying academic requirements. Such requests should be made during the first two weeks
of class, or as soon as possible after the need for accommodation is known to exist, but no later than two weeks before the compulsory event.

Accommodation is to be worked out directly and on an individual basis between the student and the instructor(s) involved. Instructors will make accommodations in a way that avoids academic disadvantage to the student.

Students or instructors who have questions or want to confirm accommodation eligibility of a religious event or practice may refer to the Equity Services website for a list of holy days and Carleton’s Academic Accommodation policies, or may contact an Equity Services Advisor in the Equity Services Department for assistance.

For Pregnancy:
Pregnant students requiring academic accommodations are encouraged to contact an Equity Advisor in Equity Services to complete a letter of accommodation. The student must then make an appointment to discuss her needs with the instructor at least two weeks prior to the first academic event in which it is anticipated the accommodation will be required.

Plagiarism
Plagiarism is the passing off of someone else’s work as your own and is a serious academic offence. For the details of what constitutes plagiarism, the potential penalties and the procedures refer to the section on Instructional Offences in the Undergraduate Calendar.

What are the Penalties for Plagiarism?
A student found to have plagiarized an assignment may be subject to one of several penalties including: expulsion; suspension from all studies at Carleton; suspension from full-time studies; and/or a reprimand; a refusal of permission to continue or to register in a specific degree program; academic probation; award of an FNS, Fail, or an ABS.

What are the Procedures?
All allegations of plagiarism are reported to the faculty of Dean of FASS and Management. Documentation is prepared by instructors and/or departmental chairs.

The Dean writes to the student and the University Ombudsperson about the alleged plagiarism.

The Dean reviews the allegation. If it is not resolved at this level then it is referred to a tribunal appointed by the Senate.

Plagiarism and cheating at the graduate level are viewed as being particularly serious and the sanctions imposed are accordingly severe. Students are expected to familiarize themselves with and follow the Carleton University Student Academic Integrity Policy (See http://www2.carleton.ca/sasc/advisingcentre/academic-integrity/). The Policy is strictly enforced and is binding on all students. Plagiarism and cheating – presenting another’s ideas, arguments, words or images as your own, using unauthorized material, misrepresentation, fabricating or misrepresenting research data, unauthorized co-operation or collaboration or completing work for another student – weaken the quality of the graduate degree. Academic dishonesty in any form will not be tolerated. Students who infringe the Policy may be subject to one of several penalties including: expulsion; suspension from all studies at Carleton; suspension from full-time studies; a refusal of permission to continue or to register in a specific degree program; academic probation; or a grade of Failure in the course.

Intellectual Property Statement:
Student or professor materials created for this course (including presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the author(s). They are intended for personal use and may not be reproduced or redistributed without prior written consent of the author(s).