

CARLETON UNIVERSITY
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
CIVE 3209 – WINTER 2021
BUILDING SCIENCE

Instructor: Burak Gunay, PhD, PEng

Virtual meeting room via Zoom: <https://carleton-ca.zoom.us/j/99469943607>

Office Hour: Email to make an appointment for a one-on-one meeting. I will keep the following timeslot available: Tuesday 12 pm to 1 pm.

Email: burak.gunay@carleton.ca

The class will meet on Tuesdays at 8:35 am via Zoom. Lectures will be recorded and posted on cuLearn. After the lecture, there will be time allocated to answer your questions.

Software tutorial and problem analysis session videos will be posted on cuLearn.

Teaching assistants will hold office hours on three different timeslots.

Teaching Assistants

Email to make an appointment for a one-on-one meeting. Following timeslots will be kept available.

Brodie Hobson (Brodie.Hobson@carleton.ca) – Thursday 11 am to 12 pm

Narges Torabi (Narges.Torabi@carleton.ca) – Monday 9 am to 10 am

Weihao Liu (Weihao.Liu@carleton.ca) – Thursday 4 pm to 5 pm

Dre Markus (Andre.Markus@carleton.ca) – Friday 1 pm to 2 pm

Learning Objectives:

- Analyze heat, air, and moisture transfer in buildings
- Understand engineering methods in building science
- Design for control of heat, air, and moisture in a severe climate

Reading (s)/Textbook (s):

- Lecture slides on cuLearn
- Lecture notes and tutorials

Software:

See instructions for remote access to computers with the required software. You can also install LBNL Therm and LBNL Window on your personal computer at the link provided.

<https://carleton.ca/dbom/wp-content/uploads/CEE-Computer-Lab-Instructions.pdf>

- LBNL Therm
- LBNL Window
- WUFI

Additional reference books:

- Building Science for a Cold Climate by Hutcheon and Handegord
- ASHRAE Fundamentals Handbook
- Building Physics - Heat, Air and Moisture: Fundamentals and Engineering Methods with

Examples and Exercises by Hens

- Building Science for Building Enclosures by Straube and Burnett

Course Plan:

Week 1: Background

- Definition and importance of building science
- A brief history of building science

Week 2: Weather and climate

- Climate data for building performance analysis
- Heating and cooling degree-day
- Solar geometry and radiation

Week 3: Heat transfer and storage in buildings - part 1

- Thermal transmittance
- Methods to compute thermal transmittance for wood-frame and steel-frame assemblies

Week 4: Heat transfer and storage in buildings - part 2

- Boundary conditions (film coefficients, sol-air temperature, SHGC)
- Thermal mass

Week 5: Heat transfer and storage in buildings - part 3

- Thermal properties of envelope materials and windows
- Thermal analysis and design of walls, ceilings, attics, and roofs
- Measuring thermal properties

Assignment 1 due Feb 23

Week 6: Properties of air

- Psychrometric analysis
- Mixing, heating, cooling, dehumidifying and humidifying air

Week 7: Midterm

Week 8: Infiltration

- Driving mechanisms
- Air pressure calculations
- Measuring air leakage
- Energy cost of infiltration
- Control of infiltration in buildings

Week 9: Ventilation

- Natural, mechanical, and mixed-mode ventilation
- Mechanical ventilation configurations
- Ventilation standards
- Heat recovery and economizers
- Psychrometric analysis of air handling units and variable air volume terminal zones

Assignment 2 due Mar 23

Week 10: Vapour diffusion

- Vapour diffusion
- Analysis of condensation potential

- 1D steady-state vapour transfer in materials and assemblies
- Condensation & drying rates

Week 11: Vapour convection and condensation control

- Vapour convection
- Design strategies for condensation control

Week 12: Moisture

- Capillary action
- Moisture storage and deterioration mechanisms
- Strategies to mitigate moisture damage in cold climates

Assignment 3 due April 13

Week 13: Rain control and summary

- Rain control
- Case study

Grade Distribution:

Midterm 20%

Assignment 1 (Heat) 10%

Assignment 2 (Air) 10%

Assignment 3 (Moisture) 10%

Final exam 50%

Letter Grade Distribution:

>= 90.00	A+
85.00 - 89.99	A
80.00 - 84.99	A-
77.00 - 79.99	B+
73.00 - 76.99	B
70.00 - 72.99	B-
67.00 - 69.99	C+
63.00 - 66.99	C
60.00 - 62.99	C-
57.00 - 59.99	D+
53.00 - 56.99	D
50.00 - 52.99	D-
<= 49.99	F

Academic Regulations, Accommodations, Plagiarism 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.

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). 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).

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 here.). 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.

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