CARLETON UNIVERSITY
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
ENVE 4105 – FALL 2017
GREEN BUILDING DESIGN

Instructor: Burak Gunay, PhD
Office: CB 5206
Office Hours: Mon 9:00 am to 10:00 am and Thu 4:30 pm to 5:30 pm
Email: Burak.Gunay@carleton.ca

Lectures at LB C264 – Thu 6:05 pm to 8:55 pm
Laboratory at CB 5301 – Tue 10:35 am to 11:25 am or Tue 3:35 pm to 4:25 pm

Learning Objectives:
1. Ability to perform steady-state thermal analysis of buildings and their subsystems
2. Ability to perform solar geometry calculations
3. Basic understanding about the principles of passive solar design
4. Familiarity with common HVAC systems in buildings
5. Familiarity with building envelope components and basic thermal analysis methods
6. Familiarity with factors that influence occupant comfort
7. Familiarity with occupant behaviour based design
8. Familiarity with building-integrated renewable energy systems
9. Basic understanding about the principles of lighting and daylighting design
10. Ability to apply the integrated design process

Software:
- UCLA Climate Consultant
- LBNL THERM
- LBNL WINDOW
- NRCan HOT2000

Course Plan:
Week 1: Background on building sector and energy use patterns – Chapter 1
- Motivation behind this course
- Energy use patterns by building type and end-use
- Roles of building energy professionals and HVAC design engineers
- Units and conversions
- Order of magnitude calculations

Week 2: Review of heat transfer – Chapter 2
- Conduction, convection, radiation heat transfer for building elements
- Evaporation and moisture transfer

Week 3: Review of thermodynamics – Chapter 2
- First law of thermodynamics
• Second law of thermodynamics
• Conservation of mass and momentum

Week 4: Psychrometric properties and processes – Chapter 13
• Definition and importance of psychrometrics
• Composition and pressure of atmospheric air
• Psychrometric properties of moist air
• The psychrometric chart
• Basic psychrometric processes

Week 5: Solar radiation – Chapter 5
• Solar movement and basic angles
• Solar geometry with respect to local observer
• Extra-terrestrial insolation
• Effect of atmosphere
• ASHRAE clear sky irradiance model

Week 6: Heat gains through windows – Chapter 6
• Optical and thermal properties of windows
• Solar heat gains
• External and internal shading
• High-performance glazing

Week 7: Infiltration and natural ventilation – Chapter 6
• Importance and basic definitions
• Infiltration rates across building stock
• Simplified physical models for single-zone air infiltration
• Natural ventilation airflow through large openings

Week 8: Steady-state heat flows – Chapter 7
• Load calculations
• Solar air temperature
• Below grade heat transfer
• Internal heat gains

Week 9: Simplified annual energy estimation methods – Chapter 9
• Degree-day method
• Models for estimating degree-days under different base temperature

Week 10: Description of typical building HVAC systems and components – Chapter 10
• Boilers and chillers
• District heating and cooling systems
• Air-handling units and their components
• Thermal zoning and terminal HVAC equipment

Week 11: Lighting and Daylighting – Chapter 22
• Electric lighting
• Daylighting
• Design of buildings for daylighting

Week 12: Design for energy efficiency – Chapter 24
• Design elements and recommendations for residential and commercial buildings
• Alternative energy technologies
• Energy benchmarking and rating
• Drivers for efficiency
Grade Distribution:
Assignment 1 – Infographic for visualizing a high-performance house case-study 5%
Assignment 2 – Solar geometry and shading design 7%
Assignment 3 – Heating and cooling degree days analysis 5%
Assignment 4 – Steady-state thermal analysis 8%
Group project – Selection of HVAC, envelope, lighting, and control ECMs 25%
Final exam 50%

Laboratory hours should be used for group projects. During these time-slots, the teaching assistants will be available to provide guidance about the assignments and the group projects. The final laboratory session of the semester will be a review session for the final exam.

Letter Grade Distribution:

\[\begin{align*}
    & \geq 90.00 & \text{A}+ \\
    & 85.00 - 89.99 & \text{A} \\
    & 80.00 - 84.99 & \text{A} - \\
    & 77.00 - 79.99 & \text{B} + \\
    & 73.00 - 76.99 & \text{B} \\
    & 70.00 - 72.99 & \text{B} - \\
    & 67.00 - 69.99 & \text{C} + \\
    & 63.00 - 66.99 & \text{C} \\
    & 60.00 - 62.99 & \text{C} - \\
    & 57.00 - 59.99 & \text{D} + \\
    & 53.00 - 56.99 & \text{D} \\
    & 50.00 - 52.99 & \text{D} - \\
    & \leq 49.99 & \text{F} \\
\end{align*}\]

If you fail the final exam, you will fail the class!

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). 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 [here](#)). The Policy is strictly enforced and is binding on all students. Plagiarism and cheating presenting anothers 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).