CARLETON UNIVERSITY
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
CIVE 5707 – FALL 2021
ENERGY MODELLING FOR EXISTING BUILDINGS

Instructor: Burak Gunay, PhD, PEng

Virtual meeting room: Zoom link

Office Hour: Email to make an appointment for a virtual one-on-one meeting. I will keep the following timeslots available: Wednesday 5 pm to 6 pm and Thursday 5 pm to 6 pm.

Email: burak.gunay@carleton.ca

Recorded software tutorial videos will be posted on cuLearn. The class will meet on Wednesdays at 6:05 pm via Zoom. Lectures will be recorded and posted on cuLearn. After each lecture, there will be time allocated to answer your questions.

Learning Objectives:

1. Learn about the heat and mass transfer processes in buildings
2. Understand models representing the heat and mass transfer processes in buildings
3. Learn about the indoor climate control systems
4. Learn about common control sequences for building energy systems
5. Perform scripting to incorporate control sequences in building energy models
6. Calibrate energy models with hourly meter data
7. Understand common energy efficiency measures for existing buildings
8. Apply optimization in retrofit decision making

Supplementary text:
ASHRAE Guideline 14 and Standard 90.1
ASHRAE Energy Efficiency Guides for Existing Commercial Buildings

Software:
SketchUp Make 2017
Euclid
EnergyPlus
Matlab

Course Plan:

Introduction
Lesson 1: Course overview
Lesson 2: Background on building energy modelling in existing buildings

Weather and climate
Lesson 3: Weather data for energy modelling
Assignment 1: Weather data analysis
Tutorial 1: Installation of EnergyPlus and Sketchup

Geometry and zoning
Lesson 4: Geometry and thermal zoning
Tutorial 2: Representing the geometry of a building

Constructions
Lesson 5: Thermal properties walls, roofs, and windows
Assignment 2: Thermal properties of walls and windows
Tutorial 3: Defining envelope properties

Infiltration
Lesson 6: Air infiltration
Assignment 3: Air infiltration
Tutorial 4: Modelling infiltration in EnergyPlus

Schedules and internal gains
Lesson 7: Casual gains
Tutorial 5: Constant schedules and use of EMS environment to define custom schedules

Basics of HVAC systems in buildings
Lesson 8: Common HVAC configurations
Tutorial 6: HVAC templates in EnergyPlus

Advanced control sequences
Lesson 9: Sequences of operation for AHUs and VAVs
Tutorial 7: Economizer settings and demand control ventilation in EnergyPlus

Energy efficiency measures for existing buildings
Lesson 10: Review of common energy efficiency measures
Assignment 4: Operational energy efficiency measures
Tutorial 8: Parametric analysis by coupling EnergyPlus with Matlab

Calibration and optimization
Lesson 11: Calibration and optimization
Assignment 5: Model calibration process
Tutorial 9: EnergyPlus and Matlab coupling with Genetic Algorithm for model calibration
Tutorial 10: Use of calibrated energy models in decision making

Grade Distribution:

- Assignments 50% - Five assignments (each 10%)
- Final report 50% - Develop an ASHRAE Guideline 14 compliant calibrated energy model and investigate energy efficiency measures.

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.

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