The University of Western Ontario (Western University)
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9532 – Building Sustainability
Course Outline – Fall 2022

DESCRIPTION
In this course, students will be introduced to climate responsive building design concepts such as passive cooling and heating building systems, as well as building performance indicators. Students will be exposed to modeling methods to evaluate climate loads and energy demand, the use of building simulations for the selection of energy-efficient building components and systems, and applicable regulatory and sustainability frameworks. Students will also learn how buildings can produce less greenhouse gas emissions and consume less energy while remaining comfortable, healthy, and economical through the proper application of sustainable building design.

PREEQUISITES
This course is intended for graduate students enrolled in civil and environmental or mechanical engineering with an interest in sustainable building design. It is expected that students will have basic understanding of fluid mechanics and heat transfer obtained by taking suitable courses at either the undergraduate or graduate level. Students without a suitable background in fluid mechanics or heat transfer should discuss this with the instructor prior to registering for the course.

COREQUISITES & ANTIREQUISTES
None

TOPICS [1]
- *Sustainable building design (motivations, passive design, scales involved)* ***(Week 1)***
- *Building systems (focussed on building envelope)* ***(Week 2)***
- *Exterior climate and indoor environment analysis* ***(Week 3)***
- *Building envelope dominated climate design* ***(Week 4)***
- *Climate design strategies* ***(Week 5)***
- *Heat transmission through the building enclosure* ***(Week 6)***
- *Modelling of air-flow, heat- and moisture-transfer in building elements* ***(Week 7)***
    - *Air-flow in the atmosphere, around and inside a building*
    - *Water vapour transport*
- *Estimation of building thermal loads and energy consumption.* ***(Week 8)***
- *Building energy modelling and analysis* ***(Week 9)***
- *Solar energy systems in buildings* ***(Week 10)***
    - Sun geometry
    - Solar systems in buildings
- *Passive cooling systems* ***(Week 11)***
- *Green Regulations* ***(Week 12)***

[1] There will be no class in reading week (October 31, 2022, to November 04, 2022).

COURSE MATERIALS

There is no set textbook for the course. However, there are a number of books that cover many of the aspects of the course material and which are available through Western Libraries. These include:

- *Lechener, N. 2009. Heating, Cooling, Lighting: Design Methods for Architects (3rd Edition), John Wiley & Sons.*
- *Straube, J. and Burnett, E. 2005. Building Science for Building Enclosures. Building Science Press.*
- *Davies, M.G., 2004. Building heat transfer. John Wiley & Sons.*
- *Hutceon, N.B. and Handegord, G. O.P. 1995, Building Science for a Cold Climate, Institute for Research in Construction, IRC, National Research Council of Canada.*
- *Building Performance Simulation for Design and Operation by Hensen, Jan L.M. and Lamberts, Roberto, Spon Press, 2011.*
- *Energy Simulation In Building Design by Clarke, J.A., 2nd edition, Butterworth-Heinemann, Oxford, 2001.*
- *ASHRAE Handbook of Fundamentals (2009 or 2011). American Society of Heating Ventilating and Air Conditioning Engineers, Atlanta, Georgia, US.*
- *Environmental Life Cycle Assessment of Goods and Services – An Input-Output Approach by Hendrickson, C. T., Lave, L. B., and Matthews, H. S. Resources for the Future, 2006.*

Prepared class notes will be made available through the course OWL site at http://owl.uwo.ca/, along with other useful reference material and data for assignments.

COMPUTING

Assignments will require the processing of numerical/experimental data using computer data-analysis software such as MATLAB, Excel or other similar tools, and students will be assumed to be proficient in the use of the software of their choice. A full version of MATLAB can be downloaded for academic use only through the MATLAB portal for Western University: **https://www.mathworks.com/academia/tah-portal/western-university-964054.html**
Google Sketchup will be used in assignments and project for communicating design concepts graphically. Various climate analysis and fluid/heat transfer modelling software will also be introduced.

EVALUATION[2]

Student performance will be assessed as follows:

Biweekly Assignments (Max. of 6):	40%
Individual Project[4] (Includes oral presentation, abstract, Progress and final reports)	60%
TOTAL	100%

[2] Types of projects will be discussed in the class. Please notify your choice to the instructor with in the first three weeks, submit your abstract during the fourth week and your progress every other week (minimum of two progress report during the semester) and your final report before the last day of classes. The presentation schedule will be discussed in the class.

SPECIFC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	25%	• Assignments • Project	• Understanding of advanced concepts and theories in building energy and thermal performance analysis • Awareness of important current problems in the sustainable building design • Understanding of numerical methodologies to solve heat transfer, moisture transfer, solar geometry related problems
Research & scholarship	15%	• Assignments • Project	• Ability to conduct critical evaluation of current advancements in building sustainability • Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment
Application of knowledge	30%	• Assignments • Project	• Ability to apply knowledge in a rational way to analyze a particular problem • Ability to use coherent approach to design a building envelop dominated sustainable buildings using green building codes and advanced energy and climate analysis design tools
Professional capacity / autonomy	10%	• Project	• Awareness of academic integrity • Ability to implement established procedures and practices in the coursework • Defends own ideas and conclusions • Integrates reflection into his/her learning process
Communication skills	10%	• Project	• Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively
Awareness of limits of knowledge	10%	• Project	• Awareness of the need of assumptions in complex scientific analyses and their consequences • Understanding of the difference between theoretical and empirical approaches • Ability to acknowledge analytical limitation due to complexity of practical problems

INSTRUCTOR

Dr Girma Bitsuamlak, P Eng, F CSCE, email: gbitsuam@eng.uwo.ca [3].

CONTACT HOURS

- Three lecture hours per week - Wednesdays 9:30 AM to 12:30 PM, Lecture Room: TBD
- Weekly Office hours: Mondays 10:00 to 11:00 AM

USE OF ENGLISH

In accordance with Senate and Faculty Policy, students may be penalised up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

COURSE CONTENT

CHEATING, PLAGIARISM/ACADEMIC OFFENCES

Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence at the following website: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

CONDUCT

Students are expected to follow proper etiquette to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in course activities and/or is not following the rules and responsibilities associated with the course activities, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean

(Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

HEALTH/WELLNESS SERVICES

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. Information regarding health- and wellness-related services available to students may be found at http://www.health.uwo.ca/.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Faculty of Engineering has a Student Wellness Counsellor. To schedule an appointment with the counsellor, contact Kristen Edwards (khunt29@uwo.ca) via confidential email and you will be contacted by our intake office within 48 hours to schedule an appointment.

Students who are in emotional/mental distress should refer to Mental Health@Western: http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.

SICKNESS

Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.

Students who are not able to meet certain academic responsibilities due to medical, compassionate or other legitimate reason(s), could request for academic consideration. The Graduate Academic Accommodation Policy and Procedure details are available at:
https://www.eng.uwo.ca/graduate/current-students/academic-support-and-accommodations/index.html

ACCESSIBLE EDUCATION WESTERN (AEW)

Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program. Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW): http://academicsupport.uwo.ca/accessible_education/index.html

AEW is a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.