Western University
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9532 – Building Sustainability

COURSE OUTLINE 2024-2025

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.

ENROLLMENT RESTRICTIONS

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 understand the basic level 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. Enrollment in this course is restricted to graduate students in (PhD, and MEng/MSc as well as any student that has obtained special permission to enroll in this course from the course instructor as well as the Graduate Chair (or equivalent) from the student's home program.

INSTRUCTOR CONTACT INFORMATION

Course instructor: Anwar Awol
Email address: ademsis@uwo.ca
Office: ACEB: #4410
Office hours: Fridays 9:30 -10:30 AM

COURSE FORMAT

This course is intended to be delivered in a face-to-face instruction format.

TOPICS[1]

Topic #	Description	Learning Activities	Tentative timeline
1	Sustainable building design: • Motivations, passive design, scales involved	• Lectures and Additional reading material	Week 1
2	Building systems	• Lectures	Week 2

	(focussed on building envelope)	and additional reading material	
3	Exterior climate and indoor environment analysis	• Lectures and additional reading material	Week 3
4	Building envelope dominated climate design [2]	• Lectures and additional reading material	Week 4
5	Climate design strategies	• Lectures and additional reading material	Week 5
6	Heat transmission through the building enclosure	• Lectures and additional reading material	Week 6
7	Modelling of airflow, heat- and moisture-transfer in building elements • Airflow in the atmosphere, around and inside a building • Water vapour transport	• Lectures and additional reading material	Week 7
8	Estimation of building thermal loads and energy consumption.	• Lectures and additional reading material	Week 8
9	Building energy modelling and analysis	• Lectures and additional reading material	Week 9
10	Solar energy systems in buildings • Sun geometry • Solar systems in buildings	• Lectures and additional reading material	Week 10
11	Passive cooling systems	• Lectures and additional reading material	Week 11
12	Green Regulations	• Lectures and additional reading material	Week 12

[1] There will be no class in reading week (October 12th – October 20th).
[2] Monday, September 30th, is the National Day for Truth and Reconciliation. Hence, week 4 lecture will be rescheduled to a later day in the week with consultation.

SPECIFC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes

Depth and breadth of knowledge	25%	• Assignments • Project • Examinations	• Understanding of advanced concepts and theories • Awareness of important current problems in the field of study • Understanding of computational and/or empirical methodologies to solve related problems
Research & scholarship	15%	• Project	• Ability to conduct critical evaluation of current advancements in the field of specialization • Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment
Application of knowledge	30%	• Assignments • Project • Examinations	• Ability to apply knowledge in a rational way to analyze a particular problem • Ability to use coherent approach to design a particular engineering system using existing 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

ASSESSMENTS[3]

Student performance will be assessed as follows:

Assessment Type	Weight
Biweekly Assignments (Max. of 6)	40%
Individual Project (Includes oral presentation, abstract, Progress and final reports)	60%

[3] 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 reports during the semester) and your final report before the last day of classes. The presentation schedule will be discussed in the class.

Activities in which collaboration is permitted:
Students are encouraged to collaborate in circumstances where course related tasks don't require submission of work for grading purposes.

Activities in which students must work alone (collaboration is not permitted):
All work submitted for a grade must be the student's own original, independent work, unless the instructor specifically permits collaboration, use of sources, or outside assistance.

COURSE READINGS

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.

STATEMENT ON THE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE (AI)

Students have an obligation to act with academic integrity and abide by the syllabus the course, and the expectations for each milestone, including the project submission and presentation. The use of AI in the preparation of the project and assignments must be acknowledged in the submission.

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.

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

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. Information on how to schedule an appointment with the counsellor is available at: https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/Student-Wellness-Counselling.html.

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.

STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE

Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who is going through or has gone through these traumatic events. If you are experiencing or have experienced GBSV (either recently or in the past),

you will find information about support services for survivors, including emergency contacts at the following website: https://www.uwo.ca/health/student_support/survivor_support/get-help.html. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

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.