Western University

Faculty of Engineering

Department of Civil and Environmental Engineering

CEE 9532 B – Building Sustainability

COURSE OUTLINE, winter 2022, Fridays 2:30pm-5:30pm, ACEB 1410

Instructor:	Dr Maja Staniec	Email:	mstaniec@uwo.ca
	Faculty of Engineering	Office:	Online - Zoom
	Dep. of Civil and Environm. Eng.	Office hours:	To be announced
	University of Western Ontario	Contact:	via email

1 COURSE DESCRIPTION

1.1 Course 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.

1.2 Course prerequisites

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.

1.3 Course corequisites and antirequisites

None

1.4 Course format

The lectures will include presentations, videos, calculations, analyses, and discussions. You will work individually and in a group. The group work is built directly on your individual projects, and each constitutes a building block of the final product. For that reason, it is important that you keep the copy of all your assignments, address the comments in the feedback provided, participate in each class, keep to the schedule, and not fall behind.

Students should check OWL (owl.uwo.ca) regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class.

2 CLASSES SCHEDULE AND DELIVERY MODE

2.1 Classes schedule

The schedule presented below is meant to highlight important due dates and to give you an idea of what activities are planned for each class. The lecture topics, layout and deadlines may change as the semester develops. The individual assignments need to be submitted to OWL before following Wednesday @10pm (unless stated otherwise). All assignments must be submitted individually to OWL before their deadline. If you have any concerns, please speak about this with the main instructor early in the course - do not leave such concerns to the last minute.

Topic	Description	Assignments	Timeline
1	Introduction: course structure, syllabus. Sustainable Buildings Design: definition, history, motivations, building sector, fundamental principles.		Lecture 1 January 14
2	Interior and Exterior Environment: thermal comfort, climate, solar geometry.	[indiv.] Assignment 1 *Wed @10pm	Lecture 2 January 21
3	Modeling energy demand: energy balance, useful energy, final energy, primary energy, CO_2 emissions for various end-uses.	[indiv.] Assignment 2 *Wed @10pm	Lecture 3 January 28
4 5	Assignment results' discussion Road to sustainability. Introduction: Conserving vs. harvesting - the battle, How to achieve a sustainable building, Sustainable buildings – examples, Sensitivity analyses of retrofit options, Road to sustainability. Shape of a building: Efficient use of size, shape, space.	[indiv.] Assignment 3 *Wed @10pm	Lecture 4 February 04
6	Road to sustainability. Envelope, part 1/2 (thermal): heat transfer, energy efficient envelope, opaque and glazed partitions, thermal bridges, design exercises.	[group] Project - draft *Feb 11th @2pm [indiv.] Assignment 4 *Wed @10pm	Lecture 5 February 11
7	Road to sustainability. Envelope, part 2/2 (moisture, air): moisture transfer, airtightness, infiltration, design exercises. ** If a reading week is scheduled, classes will be shifted by one week and the last class will take place on April 8th.*		Lecture 6 February 18
8	Road to sustainability. Cooling: passive and active: shading, solar geometry, surface and colors, passive cooling (ventilation)	[indiv.] Assignment 5 *Wed @10pm	Lecture 7 February 25
9	Road to sustainability. Heating: passive and active (solar and mechanical).		Lecture 8 March 04
10 11	Road to sustainability. Energy sources: fuels and CO_2 emissions Low Energy Demand Buildings: design exercises	[group] Project- design * March 11th @2pm	Lecture 9 March 11
12 13 14 15 16 17	Road to sustainability. Sustainable site design Road to sustainability. Water conservation and Quality Road to sustainability. Indoor Environment Quality Road to sustainability. Conservation of Materials and Resources Green buildings across the World: rating systems, energy standards, major polices Course summary		Lecture 10 March 18
	[group] Project Presentation, part 1/2		Lecture 11 March 25
	[group] Project Presentation, part 2/2	[group] Project - final * April 1st @2pm	Lecture 12 April 01

2.2 Delivery mode

Although the intent is for this course to be delivered in-person, the changing COVID-19 landscape may necessitate some or all of the course to be delivered online, synchronously, at the times indicated in the timetable. The grading scheme will not change. Any assessments affected will be conducted online as determined by the course instructor. Attending all lectures is strongly recommended, and live lectures will be recorded and uploaded to course OWL site. The grading scheme will not change. When in-person delivery mode becomes available, the course content will be delivered in face-to-face mode. Those students who need accommodation please contact the Graduate Chair - Dr Ayman M. El Ansary at aelansa@uwo.ca.

3 COURSE MATERIALS AND COMPUTING

3.1 Course materials

Classes summary, guides, supplemental information, description of assignments and other materials will be posted through OWL. 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:

[1] Lechener, N. 2009. Heating, Cooling, Lighting: Design Methods for Architects (3rd Edition), John Wiley & Sons.

[2] Straube, J. and Burnett, E. 2005. Building Science for Building Enclosures. Building Science Press.

[3] Davies, M.G., 2004. Building heat transfer. John Wiley & Sons.

[4] 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.

[5] Building Performance Simulation for Design and Operation by Hensen, Jan L.M. and Lamberts, Roberto, Spon Press, 2011.

[6] Energy Simulation In Building Design by Clarke, J.A., 2nd edition, Butterworth-Heinemann, Oxford, 2001.

[7] ASHRAE Handbook of Fundamentals (2009 or 2011). American Society of Heating Ventilating and Air Conditioning Engineers, Atlanta, Georgia, US.

[8] 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.

3.2 Computing

Assignments will require the processing of numerical data using computer data-analysis software such as MS Excel. You are required to use MS Office package for all assignments. Students will be assumed to be proficient in the use of this software.

Google Sketchup will be used in assignments and project for communicating design concepts graphically. Various climate analysis and heat transfer modelling software will also be introduced. Major energy demand simulations will be done in Excel and in Design Builder. Other software includes Climate Consultant and Opaque. More information on download options will be released during the lectures.

3.3 Technical Requirements

Make sure you have access to a computer, a reliable Internet connection, and a webcam with microphone. You are required to use MS Office package for the assignment and other software (free version), which you will be asked to install on your computer.

3.4 Units

SI units will be used in lectures and assignments.

4 COURSE EVALUATION

4.1 Assessments

The overall course grade will be calculated as listed below:

Assessment type	Material covered	Tentative due date	Weight
Individual assignments, 50% total			
- assignment 1	Topics 1+2	following Wednesday @10pm, see 2.1.	5%
- assignment 2	Topic 3	following Wednesday @10pm, see 2.1.	15%
- assignment 3	Topic 5	following Wednesday @10pm, see 2.1.	5%

- assignment 4	Topic 6	following Wednesday @10pm, see 2.1.	15%
- assignment 5	Topic 8	following Wednesday @10pm, see 2.1.	10%
Group project, 50% total			
- project: draft version	Topics 1-4	February 11th, 2022, at 2pm	10%
- project: design	Topics 5-9	March 11th, 2022, at 2pm	15%
- project: final version	Topics 10-17	April 1st, 2022, at 2pm	15%
- project: presentation	Topics 1-17	March 25th, April 1st, 2022 - during classes	10%

4.2 Specific learning outcomes

Degree level expectation	Weight	Assessment tools	Outcomes
Depth and breadth of knowledge	25%	• Indiv. assignments • Group project	• Understanding of advanced concepts and theories in building energy demand and thermal performance analysis • Awareness of important current problems in the sustainable building design • Understanding of numerical methodologies to solve heat transfer, solar geometry, and other related problems
Research & scholarship	10%	• Indiv. assignments • Group 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%	• Indiv. assignments • Group 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%	• Indiv. assignments	• 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	15%	• Group project	• Ability to communicate (oral and/or written) ideas, issues, results, and conclusions clearly and effectively
Awareness of limits of knowledge	10%	• Group 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

4.3 Class participation

You are expected to attend every class session. You will get from this course only as much as you put in. You need to take initiative and responsibility for your learning. You will be expected to demonstrate active engagement in the class. Excused absences require evidence of a valid medical or emergency reason (with Academic Counselor's approval), or prior consultation with the instructor. Whether excused or unexcused absence you are responsible for work missed and you must arrange for any make-up work to be finalized before the following class. In case the make-up work was not arranged by you before the following class (within six days since the missed class or deadline), you will receive 0% for the missed requirement.

4.4 Collaboration

For individual assignments collaboration between students is not permitted. For group assignments collaboration (brainstorming, calculations, analyses, conclusions, design, modeling, etc.) is permitted only within the members of a group.

4.5 Description of assignments

Individual assignments: homework assignments include climate analyses, sustainable solutions, energy demand calculations, shape and size of a building analyses, various thermal envelope related problems, shading options.

Group Project – draft version: Introduction, climate and country analyses, comparison of energy demand in a standard building and possible retrofit options in reference to various climate conditions.

Group Project – sustainable building design: A complete draft version of a sustainable building design, including visualizations, floor plans.

Group Project – final version: Final version of your report. This is the culminating product of the course which includes an integrated and thoroughly edited document. All previous comments must be addressed. A complete design of a sustainable building should be discussed in reference to each fundamental principle of sustainable buildings. It needs to be submitted together with an Excel and all other supporting files.

Presentation: Group presentation of final project.

4.6 Group work grade

You will work individually and in groups. I expect the workload to be distributed evenly between the group members and all members to participate equally at all stages of the project. The final grade for group assignments will be applied to all students within the group, unless it becomes clear that a group member/s did not participate equally in the project. In such case the final decision will be based on the main instructor judgement.

4.7 Missed deadline

If you can not meet the deadline for any other reason that stated above, please contact the instructor with detail explanations. It will be possible to accept the late submission (up to six days after the deadline) however the grade will be reweighted to 90%.

5 OTHER STATEMENTS

5.1 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.

5.2 Course content

The lecture notes and online lecture videos are copyrighted to the instructor and legally protected. Do not post these videos and lecture notes on any other website or online forums. The recording of the live/synchronous sessions of the course without the permission from the instructor is prohibited. The illegal posting and sharing of the copyrighted course content could be subjected to legal actions.

5.3 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 under “Assessments” 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 (see Western's scholastic discipline regulations for graduate students).

5.4 Synchronous learning activities

Students are expected to participate in synchronous learning activities as outlined in the course syllabus and/or described by the instructor. If you have issues that will impede your ability to participate in synchronous activities, please discuss with the course instructor at the beginning of the course.

5.5 Conduct

Students are expected to follow proper etiquette during synchronous and asynchronous activities to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in the synchronous and asynchronous learning activities and/or is not following the rules and responsibilities associated with the online learning 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.

5.6 Health / Wellness

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 (remotely accessible) 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. Campus mental health resources may be found at http://www.health.uwo.ca/mental_health/resources.html

https://www.uwo.ca/health/psych/index.html

5.7 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.

5.8 Accessibility

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at 661-2111 x 82147 or http://academicsupport.uwo.ca/accessible_education/index.html, for any specific question regarding an accommodation.