OBJECTIVE
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 & ANTIREQUISITES
None

TOPICS
• Sustainable building design (motivations, passive design, scales involved) (Week 1)
• Building systems (focused 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)
  o Air-flow in the atmosphere, around and inside a building
  o 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)
  o Sun geometry
  o Solar systems in buildings
• Passive cooling systems (Week 11)
• Green Regulations (Week 12)
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:

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

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
Student performance will be assessed as follows:

<table>
<thead>
<tr>
<th>Biweekly Assignments (Max. of 6):</th>
<th>40%</th>
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<tbody>
<tr>
<td>Individual Project⁴</td>
<td>60%</td>
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<tr>
<td>(includes oral presentation, abstract, Progress and final reports)</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100%</strong></td>
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⁴ 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.
### SPECIFIC LEARNING OUTCOMES

<table>
<thead>
<tr>
<th>Degree Level Expectation</th>
<th>Weight</th>
<th>Assessment Tools</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td><strong>Depth and breadth of knowledge</strong></td>
<td>25%</td>
<td>● Assignments</td>
<td>● Understanding of advanced concepts and theories in building energy and thermal performance analysis</td>
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<tr>
<td></td>
<td></td>
<td>● Project</td>
<td>● Awareness of important current problems in the sustainable building design</td>
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<td>● Understanding of numerical methodologies to solve heat transfer, moisture transfer, solar geometry related problems</td>
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<tr>
<td><strong>Research &amp; scholarship</strong></td>
<td>15%</td>
<td>● Assignments</td>
<td>● Ability to conduct critical evaluation of current advancements in building sustainability</td>
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<td></td>
<td>● Project</td>
<td>● Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment</td>
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<tr>
<td><strong>Application of knowledge</strong></td>
<td>30%</td>
<td>● Assignments</td>
<td>● Ability to apply knowledge in a rational way to analyze a particular problem</td>
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<tr>
<td></td>
<td></td>
<td>● Project</td>
<td>● 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</td>
</tr>
<tr>
<td><strong>Professional capacity / autonomy</strong></td>
<td>10%</td>
<td>● Project</td>
<td>● Awareness of academic integrity</td>
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<td>● Ability to implement established procedures and practices in the coursework</td>
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<td>● Defends own ideas and conclusions</td>
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<td>● Integrates reflection into his/her learning process</td>
</tr>
<tr>
<td><strong>Communication skills</strong></td>
<td>10%</td>
<td>● Project</td>
<td>● Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively</td>
</tr>
<tr>
<td><strong>Awareness of limits of knowledge</strong></td>
<td>10%</td>
<td>● Project</td>
<td>● Awareness of the need of assumptions in complex scientific analyses and their consequences</td>
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<td>● Understanding of the difference between theoretical and empirical approaches</td>
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<td>● Ability to acknowledge analytical limitation due to complexity of practical problems</td>
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### INSTRUCTOR
Dr Girma Bitsuamlak, P Eng, F CSCE, email: gbitsuam@eng.uwo.ca

### CONTACT HOURS
- Three lecture hours per week - Tuesdays 9:30 AM to 12:30 PM, Lecture Room: Online
- Lecture will be delivered synchronously during the scheduled class hours. Attending all lectures is strongly recommended, and live lecture will be recorded and uploaded to course OWL site.
- Weekly Office hours: Friday’s from 9:30-11:30 AM.
- Weekly Office hours are held via Zoom.
- Contact instructor via email (above) or through messages in OWL

**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**
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.

**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).

**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.

**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.

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/](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](http://www.health.uwo.ca/mental_health/resources.html) [https://www.uwo.ca/health/psych/index.html](https://www.uwo.ca/health/psych/index.html)

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.

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](http://academicsupport.uwo.ca/accessible_education/index.html), for any specific question regarding an accommodation.