Western University
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9528 – Climate Hazards for Engineers

COURSE OUTLINE 2025-2026

DESCRIPTION

The purpose of this course is to introduce engineers to basic concepts in climate change and climate hazards such that they can perform basic analyses for climate risk assessments.

ENROLLMENT RESTRICTIONS

Enrollment in this course is restricted to graduate students in the Civil and Environmental Engineering department, as well as any student who 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: Greg Kopp
Email address: gakopp@uwo.ca
Office: TBA
Office hours: TBA

COURSE FORMAT

The course will be delivered in-person.

TOPICS

Topic #	Description	Learning Activities	Tentative timeline
1	**Introduction to Climate Hazards for Engineers** • Definitions and Purpose – why are engineers taking a climate course? Differences in definitions for similar terms (e.g., extreme, conservative, etc.), definitions of risk and vulnerability (e.g., basic risk equation).	• Lectures • Additional reading material	Week 1
2	**Statistical Analysis Methods for Extreme Values** • Statistical analysis – Calculation of probability of occurrence, extreme	• Lectures • Additional reading material	Weeks 2-3

	values for different return periods, using clean data sets for examples • **Assignment 1** – "*Derivation of Wind Design Values for Toronto International Airport"* how to obtain a "clean" wind data set, do extreme value analysis to obtain the code value/wind tunnel load o "This is for synoptic winds, next introduce localised extremes in the form of thunderstorm winds..."	• Assignment	
3	**Thunderstorm Hazards** • Thunderstorm hazards – what is a thunderstorm, how they differ from synoptic hazards, and what hazards to they produce? • Extracting thunderstorm hazards from observational data. o **Assignment 2 –** *"Interpretation and Presentation of Thunderstorm versus Synoptic Storm Extreme Rainfall"*- separate rainfall data set and do analysis again using t-storm and synoptic rainfall as separate distributions.	• Lectures • Additional reading material • Assignment	Weeks 4-5
4	**Spatial Analysis and Mapping** • Spatial analysis and mapping – differences in event intensity and/or frequency based on geographic location • Locating, extracting and mapping spatial occurrence data • Localised extremes – dealing with localized extreme events, how they are different (data collection and detectability, intensity) o **Assignment 3** – *"Hazard Mapping and Real-World Implications of High-Impact Low-Probability Events"* – Two part assignment which includes consideration of impacts associated with the loss of critical infrastructure in a major event, as well as the execution	• Lectures • Additional reading material • Assignment	Weeks 6-7

	of a data extraction and mapping exercise.		

5	**Climate Change**
	• Climate change – how to incorporate into analysis, differences between observations and projections
	  o Understanding global climate models, their appropriate use and limitations
	  o Understanding common climate change "downscaling" methods and their appropriate application
		• Lectures
		• Additional reading material
			Weeks 8-9

6	**Climate Hazards in the North** • Understanding why climate impacts are amplified in Canada's North • Introduction to unique hazards, challenges, and impacts in the North • Long-term versus rapid-onset events, permafrost impacts, and associated engineering resources o **Assignment 4** – *"Climate Change Projection Information Extraction Practice Using NISI CSA Guideline"* – Students will practice locating, interpreting and extracting climate change design information from a standard tailored to Canada's North.	• Lectures • Additional reading material • Assignment	Week 10
7	**Introduction to Impact Thresholds** • Impact Thresholds – Introduction to concept – what they are and how they fit into risk assessment • Sources of information for identifying impact thresholds, as well as basic methods for their development, will be discussed	• Lectures • Additional reading material	Week 11
8	**Multi-Hazards and Course Summary** • Multi-Hazard – concurrent and sequential hazards, common geological and atmospheric hazard interactions; typical sequences, interactions which result in increase severity • Emerging methods for incorporation of multi-hazards into risk estimation • Course summary and review	• Lectures • Additional reading material	Week 12

SPECIFIC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	25%	• Assignments	• 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%	• Assignments	• 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	• 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	5%	• Assignments • In-class presentations	• 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%	• Assignments • In-class presentations	• Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively
Awareness of limits of knowledge	10%	• Assignments	• 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

Assessment Type	Material Covered	Tentative Due Date	Weight
Homework Assignments (four)	Topics 2, 3, 4, 6		80%
Participation in class activities			10%
In-class assignment presentations			10%

Activities in which collaboration is permitted:

- You are permitted to discuss the assignments with colleagues, but you must do the analysis yourself.

Activities in which students must work alone (collaboration is not permitted):

- Assignments must be written and submitted as an individual.

REQUIRED TEXTBOOK

n/a

OPTIONAL COURSE READINGS

Provided in class

STATEMENT ON THE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE (AI)

The use of AI in the preparation of the project and assignments must be acknowledged in the submission. Please refer to the published Provisional Guidance for the Use of Generative AI in Graduate Studies at Western University.

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 https://www.uwo.ca/health/.

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