Western University  
Faculty of Engineering  
Department of Civil and Environmental Engineering  

CEE 9571 – Advanced Concrete Technology  
Course Outline, 2021 - 2022

DESCRIPTION:
This course helps students understand the properties, development, and application of the most common and advanced special concretes. It covers the rheological and mechanical properties/performance with particular focus on durability and sustainability.

OBJECTIVES: The objectives of this course are for the students to:

- Learn the properties of portland cement, its hydration and microstructure,
- Characterise the engineering properties of cement-based materials,
- Recognise the effects of the rheology and early-age properties of concrete on its long-term behaviour,
- Develop an advanced knowledge of the mechanical performance of cement-based materials and how it can be controlled,
- Use various chemical admixtures and mineral additives to design cement-based materials with tailor-made mechanical and durability properties,
- Understand the engineering properties of special concretes such as mass concrete, high-performance concrete, self-consolidating concrete, fibre-reinforced concrete, sprayed concrete, pervious concrete, etc.
- Acquire knowledge on how sustainability affects the design and life cycle performance of concrete structures.
- Bridge the gap between materials science and structural engineering so that concrete can be used properly in structural concrete projects.

ENROLLEMENT RESTRICTIONS:
Enrollment in this course is restricted to graduate students in civil and environmental engineering
Pre-requisite: CEE 3358, CEE 3369b or their equivalent.

CONTACT INFORMATION:
Course instructor: Hassan EL-Chabib, PhD, P. Eng.,
Email address: helchab2@uwo.ca
Administrative support: SEB 3005.
Office hour: TBD

COURSE DELIVERY/NOTES:
- 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, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will not change. Any assessments affected will be conducted online as determined by the course instructor.
• When deemed necessary, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide personal information (including some biometric data) and the session will be recorded. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western’s Remote Proctoring website at: https://remoteproctoring.uwo.ca

• Class notes for each topic as well as related reference materials (if needed) will be regularly posted on the course website.

• The instructor will deliver formal lectures for all topics. In addition, students are asked to study the topic material at home and come to class with specific questions to ask, that will form the basis for class discussion

RECOMMENDED REFERENCES

• Properties of Concrete, A.M. Neville, Wiley
• Concrete Admixtures Handbook, Noyes
• Manual of Concrete Practice, ACI
• Concrete Microstructure, Properties and Materials, PK Mehta and PJM Monteiro
• Technical Journals including ACI Materials Journal, Cement and Concrete Research, Materials and Structures, etc.

TOPICS

<table>
<thead>
<tr>
<th>Topic #</th>
<th>Description</th>
<th>Learning Activities</th>
<th>Tentative timeline</th>
</tr>
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<tr>
<td>1</td>
<td>Cement manufacturing, cement types and properties</td>
<td>Lectures/Reading material</td>
<td>Week 1</td>
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<tr>
<td>2</td>
<td>Cement hydration, microstructure and early age behaviour</td>
<td>Lectures/Reading material</td>
<td>Week 2</td>
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<tr>
<td>3</td>
<td>Admixtures in Concrete</td>
<td>Lectures/Reading material</td>
<td>Week 3</td>
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<tr>
<td>4</td>
<td>Aggregates in concrete</td>
<td>Lectures/Reading material</td>
<td>Week 3</td>
</tr>
<tr>
<td>5</td>
<td>Test methods for cement and concrete</td>
<td>Lectures/Reading material</td>
<td>Week 4</td>
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<tr>
<td>6</td>
<td>Concrete mixture design</td>
<td>Lectures/Reading material</td>
<td>Week 5</td>
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<td>7</td>
<td>Batching, mixing, handling, placing and finishing</td>
<td>Lectures/Reading material</td>
<td>Week 6</td>
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<tr>
<td>8</td>
<td>Rheology and properties of fresh concrete</td>
<td>Lectures/Reading material</td>
<td>Week 7</td>
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<tr>
<td>9</td>
<td>Mechanical properties of concrete</td>
<td>Lectures/Reading material</td>
<td>Weeks 7-8</td>
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<tr>
<td>10</td>
<td>Mass concrete</td>
<td>Lectures/Reading material</td>
<td>Week 8</td>
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<td></td>
<td>Lecture/Reading material</td>
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<tr>
<td>11</td>
<td>High performance and ultra-high performance concrete</td>
<td>Lectures/Reading material</td>
<td>Week 9</td>
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<tr>
<td>12</td>
<td>Self-consolidating concrete</td>
<td>Lectures/Reading material</td>
<td>Week 10</td>
</tr>
<tr>
<td>13</td>
<td>Fibre-reinforced concrete</td>
<td>Lectures/Reading material</td>
<td>Week 11</td>
</tr>
<tr>
<td>14</td>
<td>Shotcrete</td>
<td>Lectures/Reading material</td>
<td>Week 11</td>
</tr>
<tr>
<td>15</td>
<td>Pervious concrete</td>
<td>Lectures/Reading material</td>
<td>Week 12</td>
</tr>
<tr>
<td>16</td>
<td>Concrete sustainability</td>
<td>Lectures/Reading material</td>
<td>Week 12</td>
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</tbody>
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**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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</table>
| **Depth and breadth of knowledge** | 35% | 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** | 35% | Term paper | • 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** | 15% | 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** | 5% | Term paper | • 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% | Presentation | • Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively |
### ASSESSMENTS

<table>
<thead>
<tr>
<th>Assessment Type</th>
<th>Material Covered</th>
<th>Tentative Due Date</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examinations</td>
<td>All topics</td>
<td>TBD</td>
<td>50%</td>
</tr>
<tr>
<td>Term paper</td>
<td>Topics to be decided later</td>
<td>March 21</td>
<td>40%</td>
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<tr>
<td>Paper presentation</td>
<td></td>
<td>March 28</td>
<td>10%</td>
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</table>

**Note:** Students must pass the final examination to pass this course. Students who fail the final examination will be assigned the aggregate mark, as determined above, or 48%, whichever is less.

### ACTIVITIES IN WHICH COLLABORATION IS PERMITTED:
- Term paper and presentation

### ACTIVITIES IN WHICH COLLABORATION IS NOT PERMITTED:
- Examinations

### TERM PAPER
Students will be divide in groups. Group term papers must be submitted by March 21. The paper must be written in the format of the ACI Materials Journal. The topic of the paper is selected from a list provided by the instructor. A topic proposed by a group of students can be used if approved by the instructor.

### PRESENTATION
Each group of students will have a 20-minute presentation of their term paper followed by a 5-minute question period scheduled during the last week of classes.

**Use of English:** In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work, except for 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.

**Notice:** Students are responsible for regularly checking their email and the course website (https://owl.uwo.ca) for announcements and updates.

**Consultation:** Students are encouraged to discuss problems with their instructor during the office hours or by appointment.

### 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.
INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

NEW: Requests for Academic Consideration using the Self-Reported Absence Form

If you experience an unexpected illness or injury or an extenuating circumstance (48 hours or less) that is sufficiently severe to temporarily render you unable to meet academic requirements (e.g., attending lectures or labs, writing tests or midterm exams, completing and submitting assignments, participating in presentations) you should self-declare using the online Self-Reported Absence portal. This option should be used in situations where you expect to resume academic responsibilities within 48 hours or less.

Each student will be allowed a maximum of two self-reported absences between September and April and one self-reported absence between May and August. Self-reporting may not be used for final exams or assessments (e.g. midterm exams, tests, reports, presentations, or essays) worth more than 30% of any given course.

For full instructions about the Self-Reporting System refer to the Academic Calendar link here.

A. GENERAL REGULATIONS & PROCEDURES (other than self-reported absences)

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.

2. If you are an upper year student and you are missing a test/assignment/lab or examination that is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If your course work is worth MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097.

3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.

4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.

5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM/MIDTERM TESTS (other than self-reported absences)

1. If you are in first year and you are unable to write a midterm/term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.

2. If you are an upper year student and you are unable to write a midterm/term test, inform your instructor PRIOR to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request relief.

3. Be prepared to provide supporting documentation to the Department Chair and/or the Undergraduate Services Office (see next page for information on documentation).

4. Discuss with the instructor if and when the test can be rescheduled. N.B. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.
C. **FINAL EXAMINATIONS (cannot be self-reported)**

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.

2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.

3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department and the Associate Dean and in order to apply you must sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

   **PLEASE NOTE:** It is the student's responsibility to check the date, time and location of the Special Examination.

D. **LATE ASSIGNMENTS**

1. Advise the instructor if you are having problems completing the assignment on time (prior to the due date of the assignment).
2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4. i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.
   ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

E. **SHORT ABSENCES**

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. **EXTENDED ABSENCES**

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

G. **DOCUMENTATION**

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, you must provide the doctor with a Student Medical Certificate to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor’s notes will not be accepted; only the Student Medical Certificate will be accepted.

   **In Case of Serious Illness of a Family Member:** Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

   **In Case of a Death:** Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

   **For Other Extenuating Circumstances:** If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

   **Note:** Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).
H. **ACADEMIC CONCERNS**

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).

2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**

3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your Academic Counsellor.

**Calendar References:** Check these regulations in your 2021 Western Academic Calendar available at [www.westerncalendar.uwo.ca](http://www.westerncalendar.uwo.ca).

**Self-Reporting Absences**

**Absences Due to Illness**

**Academic Accommodations for Students with Disabilities**

**Academic Accommodations for Religious or Holy Days**

**Course Withdrawals**

**Examinations**

**Scheduling of Term Assignments**

**Scholastic Offences**

**Student Medical Certificate**

**Engineering Academic Regulations**

**Note:** These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

**Add Deadlines:**

- First term half course (i.e. “A” or “F”)  September 16, 2021
- Full courses and full-year half course (i.e. “E”, “Y” or no suffix)  September 16, 2021
- Second term half course (i.e. “B” or “G”) January 11, 2022

**Drop Deadlines:**

- First term half course (i.e. “A” or “F”)  November 12, 2021
- Full courses and full-year half courses (i.e. “E”, “Y” or no suffix)  November 30, 2021
- Second term half or second term full course (i.e. “B” or “G”) March 7, 2022

**Contact Information:**

- Undergraduate Services Office SEB 2097  Phone: 519-661-2130  E-mail: engugrad@uwo.ca
- Chemical & Green Process Engineering TEB 477  Phone: 519-661-2131  E-mail: cbeugrad@uwo.ca
- Civil Engineering: SEB 3005  Phone: 519-661-2139  E-mail: civil@uwo.ca
- Computer, Electrical, Mechatronic Systems & Software Engineering TEB 279  Phone: 519-661-3758  E-mail: eceugrad@uwo.ca
- Integrated Engineering ACEB 2410 Phone: 519-661-6725  E-mail: engceli@uwo.ca
- Mechanical Engineering SEB 3002  Phone: 519-661-4122  E-mail: mmeundergraduate@uwo.ca

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