Objectives:
This course introduces students to the physical properties and engineering characteristics of major civil engineering materials, including portland cement concrete and asphalt and concrete pavement. It covers the structural, durability, and sustainability aspects of civil infrastructure, with particular focus on flexible and rigid pavements. The general objectives are for the students to develop the ability to:

- Understand the chemical composition and the hydration process of portland cement and supplementary cementitious materials.
- Recognize the effects of chemical admixtures and mineral additions on the rheological and mechanical properties of concrete mixtures.
- Design a concrete mixture to meet specific design requirements.
- Identify various mechanisms of concrete’s deterioration and the actions needed to enhance concrete durability in aggressive environments.
- Recognize the performance, failure criteria and principles of modern design of rigid and flexible pavements.
- Design a flexible and rigid pavement for specific traffic, soil and environmental conditions.
- Incorporate sustainability and environmental considerations in the use of civil engineering materials, develop awareness of modern advances and novel applications involving civil engineering materials, recognize the need for life-long learning to keep abreast of new design and construction methods involving such materials, and to enhance one’s design abilities.

Contact Hours:
2 lecture hours/week; 2 lab-tutorial-design hours/week.
Attendance is mandatory.

Pre-requisites:
Completion of the second year of the Civil and Environmental Engineering program or permission of the Department.

Anti-requisites:
The former ES 369a/b and CEE 369a/b.

Note: It is the student’s responsibility to ensure that all Pre-requisite and Co-requisite conditions are met or that special permission to waive these requirements has been granted by the Faculty. It is also the student’s responsibility to ensure that they have not taken a course listed as an Anti-requisite. The students may be dropped from the course or not given credit for the course towards their degree if they violate the Pre-requisite, Co-requisite or Anti-requisite conditions.
Instructor:
Hassan EL-Chabib, PhD, P. Eng., helchab2@uwo.ca.
Administrative support: SEB 3005.

Class Notes:
- Class notes for each chapter of the course as well as additional reference materials will be regularly posted on the course website.

Recommended References:
2) Properties of Concrete, by. A.M. Neville, John Wiley & Sons Inc.
3) Concrete, by S. Mindess and J. F. Young, Prentice Hall Inc.

Units:
SI units will be generally used in lectures and examinations.

Course Delivery
The lectures emphasize the construction of meaning rather than information transmission. Hence, students shall study the notes for each lecture at home before it is presented by the instructor in class. The home study effort is crucial for the success of students in this course. The class time is dedicated to engaging students in exploring topics in greater depth and applying knowledge to create more meaningful learning opportunities. For instance, students may be invited to attempt solving problems on the board during lectures.

Specific Learning Objectives: At the completion of the course, the student should be able to:

1- Cement Manufacturing, Chemistry and Hydration: At the end of this section the student should be able to:
   a) Recognize the steps involved in manufacturing portland cement and the various reactions occurring in a cement kiln.
   b) Identify the oxide composition of portland cement and the difference in composition between different types of cements and its effect on the performance of concrete.
   c) Characterize the hydration reactions of the main phases in a cement clinker and the effect on their physical and chemical parameters on cement hydration kinetics.
   d) Identify the major phases in the microstructure of hydrated cement paste.

2. Mineral additions and Chemical Admixtures in Concrete: At the end of this section the student should be able to:
   a) Evaluate the effect of using supplementary cementitious materials on the sustainable development of the cement and concrete industry.
   b) Identify the effects of using mineral admixtures such as fly ash, slag and silica fume on the workability, mechanical properties and durability of concrete.
   c) Control the properties of concrete mixtures using chemical admixtures such as accelerators, retarders, superplasticizers and air-entraining admixtures.
   d) Design concrete mixtures involving mineral additions and chemical admixtures to meet
specific design requirements.

3. Workability, Mechanical Properties and Durability of Concrete
   a) Use various tests to characterize the workability of fresh concrete mixtures and recognize the effects of mixture proportions on workability.
   b) Appreciate the time and temperature dependence of the properties of fresh and hardened concrete.
   c) Control the mechanical properties of concrete via controlling its mixture proportioning, consolidation, and curing.
   d) Describe the performance of concrete under compressive and other mechanical loading.
   e) Learn the development of special concretes such as fibre-reinforced concrete, self-consolidating concrete, and high-performance concrete.
   f) Identify the mechanisms of deterioration of concrete in different aggressive environments and develop strategies for enhancing the durability of concrete structures.

4. Asphalt
   a) Recognize the chemical composition of asphalt cements, their physical structure, aging, rheological properties, and classification.
   b) Recognize the structure of asphalt concrete, ingredients, fillers and additives used in its making, its response to loads, desired properties, effect of temperature and moisture, durability, etc.
   c) Design aggregate mixtures for paving asphalt concrete.
   d) Design asphalt-aggregate mixtures to meet particular road design specifications.

5. Pavement Design
   a) Discuss and use the principles of pavement design including the concept of design life and failure criteria.
   b) Compute stresses and deflections in pavements using linear elastic-layered systems
   c) Rationally design flexible (asphalt) and rigid (concrete) pavements using different methods (AASHTO, Asphalt Institute, PCA) given specifications and properties of pavement materials including soil foundation, sub-grade, sub-base, and surface characteristics.
   d) Evaluate the performance of road pavements.

**General Learning Objectives**

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_E=Evaluate, T=Teach, I=Introduce_
**Evaluation:**
The final course mark will be determined as follows:

- **Quizzes:** 10%
- **Attendance/Participation:** 10%
- **Mid-term test:** 10%
- **Design Project:** 20%
- **Final examination:** 50%

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**Total:** 100%

**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.
- **Students who have failed an Engineering course (i.e.<50%) must repeat all components of the course.** No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories, if applicable, cannot be resubmitted for grading by the student in subsequent years.
- **Should a quiz or test conflict with a religious holiday that a student wishes to observe; the student must inform the instructor of the conflict no later than one week before the scheduled test.** For further information on Accommodations for Religious Holidays see: [http://www.uwo.ca/univsec/handbook/appeals/religious.pdf](http://www.uwo.ca/univsec/handbook/appeals/religious.pdf)

**Quizzes and Examinations:** Four Quizzes and a midterm will be conducted during lectures and/or tutorials with a one-week notice. The quizzes will be **closed book** and students who miss a quiz/midterm will get a mark of zero, unless a legitimate absence has been reported and documented beforehand. The **closed book midterm test is tentatively scheduled for the week immediately after the reading week.** The **final examination will be 3 hours and** will be **OPEN BOOK** in which class notes and approved handheld calculators may be used. Students should consult the list of approved calculators posted outside the Civil and Environmental Engineering Department Office.

**Tutorials and Laboratories:** Tutorial problems may be assigned but will not be marked and solutions will be posted on the course website. Groups for labs and the design project will be assigned by the instructor and may be revised during the term. All students must attend all laboratories and submit a group report with all members signature on the cover page. Late submission will not be accepted, and all group members will receive a grade of zero unless a pre-approved extension is granted. Lab data and knowledge as well as lab reports should be used as an integral part in the final report of the design project.

**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.
**Plagiarism Checking:** Western University uses software for plagiarism checking. Students are required to submit their Laboratory Reports (if applicable) in electronic form for plagiarism checking.

**Academic Integrity:** University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning. For more information on scholastic offenses, please see:

http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf

**Attendance:** Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

**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 Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

**Conduct:** Students are expected to **arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others.** Late comers may be asked to wait outside the classroom until being invited in by the Instructor. Please **turn off your cell phone** before coming to a class, tutorial, quiz or exam and refrain from using electronic devices. On the premises of Western University or at a University-sponsored program, students must abide by the **Student Code of Conduct:** http://www.uwo.ca/univsec/board/code.pdf

**Sickness and Other Problems:** Students should immediately consult with the Instructor or Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see attached). The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal. The attachment titled “INSTRUCTIONS” FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED” is an integral part of this course outline. Students that 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. For more information concerning medical accommodations, please see: http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf

**Notice:** Students are responsible for regularly checking their email, course website (https://owl.uwo.ca) and notices posted outside the Civil and Environmental Engineering Department Office.

**Consultation:** Students are encouraged to discuss problems with their teaching assistant and/or instructor in tutorial sessions. Office hours will be arranged for the students to see the instructor and teaching assistants. Other individual consultation can be arranged by appointment with the appropriate instructor.

**Course Breakdown:** Engineering Science = 50% = 18.9 AU’s, Engineering Design = 50% = 18.9 AU’s
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 Extemuating 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 2019 Western Academic Calendar available at 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 13, 2019
Full courses and full-year half course (i.e. “E”, “Y” or no suffix) September 13, 2019
Second term half course (i.e. “B” or “G”) January 14, 2020

Drop Deadlines: First term half course (i.e. “A” or “F”) November 12, 2019
Full courses and full-year half courses (i.e. “E”, “Y” or no suffix) November 30, 2019
Second term half or second term full course (i.e. “B” or “G”) March 7, 2020

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

Revised 08/01/19