This one-term course integrates material from previous structural analysis and design courses and extends the knowledge and abilities of the students in structural behaviour and design. The general objectives are for students to develop an understanding of behaviour, and to develop abilities in design of reinforced concrete (RC). To achieve these objectives, students apply their knowledge of mathematics, science, and engineering while identifying, formulating, and solving structural design problems. The students design structural components to meet current code criteria. The techniques and skills used by the students prepare them for engineering practice. In the laboratory component of the course, students develop abilities in understanding aspect of experimental testing as well as interpreting data.

Calendar Copy:
Introduction to reinforced concrete design including serviceability and ultimate limit states; analysis and design of reinforced concrete beams and one-way slabs for flexure and shear; bar cutoffs in flexural members; deflections; short columns. (0.5 course)

Prerequisites: CEE 2202a/b, CEE 2221a/b
Corequisites: None
Antirequisite: None

Note: It is the student's responsibility to ensure that all Prerequisite and Corequisite 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 Antirequisite. The student may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Corequisite or Antirequisite conditions.

Instructor: Dr. M. A. Youssef, P. Eng., SEB 3043, email: youssef@uwo.ca.
Administrative Support: Sandra McKay (smckay@uwo.ca)

Textbook:
Required: Prepared class notes can be downloaded from the course website (http://owl.uwo.ca).
Recommended: Concrete Design Handbook, Cement Association of Canada, Ottawa, ON.
Recommended: Reinforced Concrete Design: A Practical Approach, S. Brzev and J. Pao, Pearson Education.

Contact Hours: 3 lecture hours/week, 3 tutorial/laboratory hours/week
Attendance at the tutorial/laboratory sessions is mandatory.
Computing:
Students are required to use personal computers.

Units:
SI units will be used in lectures and examinations

Specific Learning Objectives:
1. The Design Process:
   a) Recognize structural elements in typical RC structures [KB4].
   b) Recognize advantages and disadvantages of concrete as a building material [KB4].
   c) Identify the different codes and design standards related to the course [KB4, LL2].
   d) Understand the different design limit states [KB4].
   e) Know the requirements to satisfy the strength and serviceability limit states [KB4].
   f) Compute and sketch the distribution of maximum moments and shear forces for simple structures considering all potential cases of loading [PA2].

2. Properties of Concrete and Reinforcing Bars:
   a) Know the actual and simplified material constitutive relationships for both concrete and steel [I3, ITW1, CS3].

3. RC Beams: Flexural Behaviour and Design:
   a) Develop understanding of the flexural behaviour of RC beams [I3, ITW1, CS3]
   b) Calculate the moment capacity of a given beam section [PA2].
   c) Identify the expected failure mechanism for a given beam section [PA2].
   d) Calculate balanced section properties [KB4].
   e) Design rectangular beam sections [D4].
   f) Design T and L beam sections [D4].
   g) Design beams with compression reinforcing bars [D4].
   h) Sketch the designed beam sections that satisfy the skin reinforcements and crack control conditions [D4].

4. Development, Anchorage, and Splicing of Reinforcing Bars:
   a) Calculate the required tension and compression development lengths [PA2].
   b) Calculate the length of bars being curtailed in flexural members [PA2]

5. RC Beams: Shear Behaviour and Design:
   a) Develop understanding of the shear behaviour of RC beams [I3, ITW1, CS3]
   b) Calculate the shear capacity for a given section [PA2].
   c) Design a concrete beam to satisfy A23.3 shear requirements [D4].

6. Continuous Beams and one-way slabs:
   a) Sketch the moment and shear force diagrams for continuous beams and one-way slabs using A23.3 approximate values [KB4].
   b) Sketch the free body diagrams for slabs and beams of a given structural system [PA2].
   c) Perform detailed design of one-way slabs and beams [D4].
   d) Sketch reinforcing bar details for slabs and beams [D4].
7. Short Columns:
   a) Develop understanding of the flexural behaviour of short columns [I3, ITW1, CS3]
   b) Sketch an approximate interaction diagram for a given section [PA2].
   c) Design of RC columns using interaction diagrams in the design aids [D4].

8. Deflections:
   a) Calculate deflections of RC beams and slabs [PA2].

The instructor may expand, or revise material presented in the course as appropriate.

General Learning Objectives
E=Evaluate, T=Teach, I=Introduce (Developing Level)

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Evaluation:
The final course mark will be determined as follows:

- Participation in Tutorials and Lectures (includes 5% bonus) 15%
- Four Lab Reports 15%
- Quiz (Oct. 25th) 31%
- Written Final Exam 44%

Total 100%

Note: (a) Students who have failed this course previously must repeat all components of the course. No special permissions will be granted enabling a student to retain marks from previous years.

(b) If the quiz conflicts with a religious holiday that a student wishes to observe, the student must inform the instructor of the conflict no later than two weeks before its scheduled date.

(For further information on Accommodations for Religious Holidays see http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf)

1. Participation in Tutorials and Lectures:
10% of the mark will be assigned based on the weekly “gradescope.ca” assignments. The additional 5% will be assigned based on your participation in the lectures and tutorials and solution of bonus assignments.
2. Laboratories and tutorials:

During the term, you will have 4 in-person laboratories (Sep. 13, Nov. 8, Nov. 22, and Nov. 29) and 6 in-person tutorials (Sep. 20, Sep. 27, Oct. 4, Oct. 18, Nov. 15, and Dec. 6). Laboratories will be held in SEB 22 and Tutorials will be held in ACEB-1415.

The laboratories will allow you to observe experiments that evaluate:
Lab 1 (Sep. 13): mechanical properties of concrete and steel.
Lab 2 (Nov. 8): flexural performance of RC beams
Lab 3 (Nov. 22): shear behaviour of RC beams
Lab 4 (Nov. 29): capacity of eccentrically loaded RC columns.

Students will be divided into groups and each group of students will submit one report for each of the labs. The reports should describe the conducted tests and provide detailed analysis of the results. The reports must be submitted on gradescope.ca within 9 days (7 business days) following the laboratory.

Although it is expected that the lab mark will be the same for all group members, students can individually recommend in writing, with stated reasons, a suitable allocation of the report mark. The course instructor reserves the responsibility for making the final allocation. The mark for group work will then be allocated to the members in proportion to each member's contribution to the work.

3. Quizzes and Examinations:

One 120 minutes quiz is scheduled on October 25th from 12:00 pm to 2:00 pm. The quiz and the final exam are OPEN BOOK. Hand-held programmable calculators may be used, but programs and information stored in advance of the examination may not be used.

4. Use of English

In accordance with Senate and Faculty Policy, students may be penalised up to 10% of the marks 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.

Plagiarism Checking:

The University of Western Ontario uses software for plagiarism checking. Students are required to submit their Laboratory Reports in electronic form to Turnitin.com for plagiarism checking.

Cheating:

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:
Attendance in lectures and tutorials will be monitored using iClicker. 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. 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.

Students will be expected to wear triple layer, non-medical, paper masks always in the classroom as per University policy and public health directives. Students who are unable to wear a mask must seek formal accommodation through Western Accessible Education, and present medical documentation. Students are not permitted to eat or drink while in class to ensure masks stay in place. Students will be able to eat and drink outside of the classroom during scheduled breaks. Students unwilling to wear a mask as stipulated by Western policy and public health directives will be referred to the Dean, and such actions will be considered a violation of the student Code of Conduct.

Accommodation:
Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The accommodation policy can be found here: Academic Accommodation for Students with Disabilities.

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.

Academic Consideration for Student Absence
Students will have up to two (2) opportunities during the regular academic year to use an on-line portal to self-report an absence during the term, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student’s final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option for exams scheduled by the Office of the Registrar (e.g., December and April exams).

If the conditions for a Self-Reported Absence are not met, students will need to provide a Student Medical Certificate if the absence is medical or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.

For Western University policy on Consideration for Student Absence, see
Policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs
and for the Student Medical Certificate (SMC), see:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf
Course Absences due to Daily COVID Screening Questionnaire

Missed assessments (e.g., presentations, essays, quizzes, tests, midterms, etc.) require formal academic considerations (typically self-reported absences and/or academic counselling). Methods for dealing with missed work and course content are at the discretion of the instructor. Students should be aware that some learning outcomes cannot be easily made up and may need to be completed in a subsequent year. Your instructor will provide you with further information as to how this applies within this course.

Students who demonstrate a pattern of routinely missing coursework due to self-reported COVID symptoms, and therefore do not demonstrate mastery of the learning outcomes of the course, will not receive credit for the course.

Religious Accommodation

Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar.

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. On the premises of the University or at a University-sponsored program, students must abide by the Student Code of Conduct: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/code_of_conduct.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.

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

Notices:

Students are responsible for regularly checking their email, and course website (https://owl.uwo.ca).

Consultation:

Students are encouraged to discuss problems with their teaching assistant and/or the Instructor in tutorial sessions. Office hours will be arranged for the students to meet with the Instructor and teaching assistants. Other individual consultation can be arranged by appointment with the instructor.
Contingency plan for an in-person class pivoting to 100% online learning

In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining course content will be delivered entirely 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 remaining assessments will also be conducted online as determined by the course instructor. In the event that online learning is required, a stable internet connection with working microphone and webcam will be required. As has been the case in the past, the decision to pivot to online learning will be made by Western, and not individual instructors or departments (excepting temporary online instruction in the event of instructor illness).

Course breakdown:

Engineering design = 100%

The document “INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED” is part of this course outline.