Introduction
This is the final lecture-based structural design course in the Civil/Structural options, and synthesizes material taken in previous structural design and analysis courses. The general objectives are for the student to become able to
- identify, formulate and solve problems involving structural steel while working individually or functioning on a team;
- recognise that the essential criteria in CSA Standard CAN/CSA-S16-19 (“Design of Steel Structures”), that address the design of steel members and structures, are simple and direct applications of the fundamentals of statics and applied mechanics;
- rapidly design steel structures, components and connections in accordance with the provisions of CSA Standard CAN/CSA-S16-19;
- improve communication skills by documenting decisions made during the design process in coherent and legible design calculations;
- appreciate professional responsibility issues in steel design and construction, and
- recognise the need for life-long learning to keep abreast of new design and construction methods, and to enhance one’s abilities as a designer.

Calendar Copy:

Prerequisites:
CEE3340A/B

Corequisites:
None.

Antirequisites:
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.

Contact Hours:
3 lecture hours/week

Although the intent is for this course to be delivered in-person, the current COVID restrictions dictate that the classes will be delivered online until further notice, 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.

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.

Lectures will be organized into learning modules, which students should review on a weekly basis. Review of lecture material and self-study should take approximately 6 hours per week.

3 tutorial hours/week
A 3-hour tutorial session will be delivered synchronously through Zoom each week from 6:30 to 9:30 pm on Monday until relaxed COV restrictions allow the tutorials to be conducted in-person. Tutorials are not mandatory but students seeking assistance with assignments or clarification on lecture materials are strongly encouraged to attend. Participations in tutorials will be considered as part of the basis for assigning the participation component of the final course grade. The link to the Zoom meeting will be posted to OWL.

Instructor:
Dr. Wenxing Zhou, P. Eng.
E-mail: wzhou@eng.uwo.ca
Office hour:
- 12:00 – 1:00 pm on Wednesday via Zoom (or in CMLP1303 once in-person classes return)
- Students may also set up appointment for office hours with TAs
Administrative support: Ms. S. McKay, SEB3005

Textbook:
- Prepared course notes, available on OWL, shall be brought to each class

Other References:
Other excellent structural steel references are available in the Taylor Library, or online at www.cisc-icca.ca.

Units:
SI units will be used in lectures, tutorials and examinations

Specific Learning Objectives [GA indicators – bold represents evaluated indicators]:

1. Identification and Properties of Steel and Steel Sections (Week 1) [KB4, PR1, CS1, D1, D4]:
   a) Identify mechanical properties of steel: yield strength, toughness.
b) Identify Canadian and American steel grades.
c) Identify and determine properties of commonly-used rolled sections.
d) Calculate properties of built-up sections

2. Limit States Design Concepts (Week 2) [KB4, CS1, LL1, ITW1, D1]
a) Classify limit states as Ultimate, Fatigue or Serviceability Limit States.

3. Load Paths in Structures (Weeks 2-3) [PA1, KB4, D4]
a) Visualize gravity load paths, and so calculate tributary areas.
b) Visualize lateral load paths, and so calculate force effects in diaphragms, bracing, and moment-resisting frames.

4. Tension Members (Week 3-4) [KB4, PR1, D1, D4, ET2]
a) Analyse tension members to determine capacity based on yield of the gross section or fracture of the net section accounting for staggered holes and shear lag.
b) Design tension members to satisfy both Serviceability and Ultimate Limit States.

5. Simple Columns (Week 4-5) [KB4, PA2, PR1, D1, D4, ET2]
a) Determine the axial capacity of short, long, and intermediate columns using CSA S16-19.
b) Design simple columns for factored loads at Ultimate Limit States, using first principles or tables in the CISC Handbook.

6. Laterally Supported Beams (Weeks 5-6) [KB4, PA2, PR1, D1, D4, ET2]
a) Calculate moment-curvature relationship for W and rectangular sections.
b) Determine class of section, and equation defining flexural capacity, based on local buckling (b/t and h/w) considerations.
c) Design beams for shear forces and bending moments at Serviceability and Ultimate Limit States, using first principles or tables in CISC Handbook.

7. Laterally Unsupported Beams (Weeks 7-8) [KB4, PA2, PR1, D1, D4, ET2]
a) Calculate the elastic lateral-torsional buckling capacity of a laterally-unsupported beam subjected to uniform or non-uniform applied moments.
b) Design laterally-unsupported beams, using tables in the CISC Handbook.

8. Composite Construction (Weeks 9-10) [KB4, CS1, PA2, PR1, D1, D4]
a) Identify effect of construction method on behaviour of composite sections.
b) Calculate moment resistance of composite section at Ultimate Limit State.

9. Stability Concepts (Week 11) [KB4, PA2, PR1, D1, D4]
a) Distinguish between first- and second-order analyses.
b) Identify effect of deformations on the behaviour of a member or a structural system.
c) Determine the sway amplification factor for single-storey structures using CSA S16-19.

10. Beam Columns (Week 12) [KB4, PA2, PR1, D1, D4, ET2]
a) Analyse cross section for combination of axial tension and bending moment.
b) Determine capacity for combination of axial compression and bending moment as limited by local buckling, cross-section strength, member strength based on in-plane behaviour, and member strength based on lateral-torsional buckling.
c) Calculate beam-column capacity rapidly using tables in the CISC Handbook.

11. Fasteners (if time permits) [KB4, PA2, PR1, D1, D4, ET2]
a) Identify common types of bolts, and installation methods.
b) Determine number and arrangement of bolts to resist shear, tension, and combined shear and tension at Serviceability and Ultimate Limit States using CSA S16-19.
c) Rapidly design fasteners using tables in the CISC Handbook

Examinations and Quizzes: Two one-hour quizzes will be held during tutorial/lecture hours. These quizzes are tentatively scheduled on Thursday, February 17 (9:30 – 10:30 AM) and Monday, March 21 (6:30 – 7:30 PM). Whether the quiz will be held online or in-person will depend on the COVID restrictions at the time of the quiz. If the quiz is held in-person, the classroom for the quiz will be announced in due course.
A three-hour written final examination will be held during the regular examination period.

Both the quizzes and final examination will be open book exams. They must be completed by the individual student without any external help or collaboration. Online proctoring via Zoom may be used to monitor student activity during the quizzes and final examination (if used, this will be clearly indicated prior to the exam). Also, the uploaded answers to both the quizzes and final exam may be submitted to Turnitin to ensure no copying or plagiarism.

**Assignments**
Assignments will be given on a bi-weekly basis. Each student must submit a solution of the assignment, although consultation with peers to complete the assignment is permitted. Assignments are to be submitted on OWL prior to the due date. Late assignments will receive a mark of zero. Extensions are to be negotiated with the course instructor, not the teaching assistants. The maximum number of missed assignments for each student will be one; if more than one assignment is missed without appropriate accommodation, a student may be barred from writing the final exam. Only a selection of questions from an assignment may be marked – the questions to be marked will not be determined or announced in advance. The intention is for students to complete the entire assignment in order to maximize learning the course material.

**Evaluation**
The final grade is computed as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Participation</td>
<td>5%</td>
</tr>
<tr>
<td>Assignments</td>
<td>35%</td>
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<tr>
<td>Quizzes</td>
<td>20%</td>
</tr>
<tr>
<td>Final exam</td>
<td>40%</td>
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<tr>
<td>TOTAL</td>
<td>100%</td>
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**Note:** 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 laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted.

**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 with the exception of final examinations 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.

**General Learning Objectives**

<table>
<thead>
<tr>
<th>Knowledge Base</th>
<th>Team Work</th>
<th>Economics and Project Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Analysis</td>
<td>Communication</td>
<td>Life-Long Learning</td>
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<tr>
<td>Investigation</td>
<td>Professionalism</td>
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<tr>
<td>Design</td>
<td>Impact on Society</td>
<td>I</td>
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<tr>
<td>Engineering Tools</td>
<td>Ethics and Equity</td>
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**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:
Any student who, in the opinion of the instructor, has not engaged sufficiently in 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.

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.

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 in the following circumstances:
- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student’s final grade,
- if a student has already used the self-reporting portal twice during the academic year

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.

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.

Use of Recordings:
All of the remote learning sessions for this course will be recorded. The data captured during these recordings may include your image, voice recordings, chat logs and personal identifiers (name displayed on the screen). The recordings will be used for educational purposes related to this course, including evaluations. The recordings may be disclosed to other individuals under special circumstances. Please contact the instructor if you have any concerns related to session recordings. Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

**Conduct:**
Some components of this course will involve online interactions. To ensure the best experience for both you and your classmates, please honour the following rules of etiquette:

- please “arrive” to class on time
- please use your computer and/or laptop if possible (as opposed to a cell phone or tablet)
- ensure that you are in a private location to protect the confidentiality of discussions in the event that a class discussion deals with sensitive or personal material
- to minimize background noise, kindly mute your microphone for the entire class until you are invited to speak, unless directed otherwise
- [suggested for classes larger than 30 students] In order to give us optimum bandwidth and web quality, please turn off your video camera for the entire class unless you are invited to speak
- [suggested for cases where video is used] please be prepared to turn your video camera off at the instructor’s request if the internet connection becomes unstable
- unless invited by your instructor, do not share your screen in the meeting

The course instructor will act as moderator for the class and will deal with any questions from participants. To participate please consider the following:

- if you wish to speak, use the “raise hand” function and wait for the instructor to acknowledge you before beginning your comment or question
- remember to unmute your microphone and turn on your video camera before speaking
- self-identify when speaking.
- remember to mute your mic and turn off your video camera after speaking (unless directed otherwise)

**General considerations of “netiquette”:**

- Keep in mind the different cultural and linguistic backgrounds of the students in the course.
- Be courteous toward the instructor, your colleagues, and authors whose work you are discussing.
- Be respectful of the diversity of viewpoints that you will encounter in the class and in your readings. The exchange of diverse ideas and opinions is part of the scholarly environment. “Flaming” is never appropriate.
- Be professional and scholarly in all online postings. Cite the ideas of others appropriately.

Note that disruptive behaviour of any type during online classes, including inappropriate use of the chat function, is unacceptable. Students found guilty of Zoom-bombing a class or of other serious online offenses may be subject to disciplinary measures under the Code of Student Conduct.

**Online Proctoring Notice:**
Tests and examinations in this course may be conducted using Zoom. You will be required to keep your camera on for the entire session, hold up your student card for identification purposes, and share your screen with the invigilator if asked to do so at any time during the exam. The exam session will not be recorded.*
More information about the use of Zoom for exam invigilation is available in the Online Proctoring Guidelines at the following link:
Completion of this course will require you to have a reliable internet connection and a device that meets the system requirements for Zoom. Information about the system requirements are available at the following link:
https://support.zoom.us/hc/en-us.

* Please note that Zoom servers are located outside Canada. If you would prefer to use only your first name or a nickname to login to Zoom, please discuss this with your instructor in advance of the test or examination.

**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 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.

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

**Course Breakdown:** (Values given in accreditation units)
Engineering Design = 100%