CEE 3346b– Structural Theory and Design - Course Outline 22/23

Objectives:
This course focuses on identification, formulation, analysis and design of steel structural members. The general objectives are for the student to develop the ability to:

- Identify, formulate and solve problems involving structural steel while working individually or functioning on a team.
- Recognize that the essential criteria in CSA Standard CAN/CSA-S16-14 (“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-S16-14.
- 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
- Recognize 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:

Pre-requisites: CEE 3340A/B

Corequisites: None

Antirequisites: None

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.

Contact Hours:
- 3 lecture hours/week: Lectures will be delivered in-person. In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, affected 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.

- **3 tutorial hours:** A 3-hour in-person tutorial session will be delivered each week. Student attendance of the tutorial is mandatory. Attendance marks will be given for each tutorial.

**Contact Information:**
Instructor: Hassan EL-Chabib, PhD, P. Eng., SEB 3029
Email: helchab2@uwo.ca.
Office hour: Tuesday, 11:00 am – 12:00 pm or by appointment
Administrative Assistant: SEB 3005 or (civil@uwo.ca)

**Textbook and Notes:**
  **Purchase of the Handbook is required.** Instructions for purchasing the book at a 50% discount price will be posted on the course OWL site.
- 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):**

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

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, LL1, CS1, D1, ITW1]
   - a) Classify limit states as Ultimate, Fatigue or Serviceability Limit States.
3. **Load Paths in Structures (Weeks 2-3)** [KB4, PA1, 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, ET2, D1, D4]**
   a) Analyze 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, ET2, D1, D4]**
   a) Determine the axial capacity of short, long, and intermediate columns using CSA S16-14.
   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, ET2, D1, D4]**
   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 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, ET2, D1, D4]**
   a) Calculate the elastic lateral-torsional buckling capacity of a laterally-unsupported beam subjected to uniform or non-uniform applied moments.

8. **Composite Construction (Weeks 9-10) [KB4, PA2, PR1, CS1, D1, D4]**
   a) Identify the 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-story structures using CSA S16-14.

10. **Beam Columns (Week 12) [KB4, PA2, PR1, ET2, D1, D4]**
    a) Analyze 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 (time permits) [KB4, PA2, PR1, ET2, D1, D4]**
    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 S16-14.
    c) Rapidly design fasteners using tables in the CISC Handbook.

### General Learning Objectives

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<tr>
<td>Problem Analysis</td>
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<td>Investigation</td>
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<td>Design</td>
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<td>Engineering Tools</td>
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Evaluation:
The final course mark will be determined as follows:

- Quizzes (3): 30%
- Attendance/Participation: 10%
- Assignments: 20%
- Final examination: 40%

Total: 100%

Note: 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.

1. Quizzes and Examinations
   - Three one-hour open book quizzes are tentatively scheduled during the tutorial or lecture period at the following dates: February 16; March 13, and April 06. Classroom for the quizzes will be announced in due course.
   - Final Exam: A 3-hour open book final examination will be held during the final examination period

2. Missed Quiz or Midterm
   The policy of the department of Civil and Environmental Engineering is that there will be no make-up for missed quizzes or midterms. For those that do legitimately miss a quiz or midterm and provide the required supporting documentation, the standard practice will be that the weight of the missed quiz/midterm will be reassigned to the final exam.

3. Assignments
   Assignments will be given on a bi-weekly basis and each student must submit a solution of the assignment. Assignments are to be submitted prior to the due date to OWL. Late assignments will receive a mark of zero. Extensions are to be negotiated with the course instructor, not the teaching assistants. If an assignment is missed without appropriate accommodation, students will receive a mark of ZERO. Only a selection of questions from an assignment may be marked – the questions worth marks 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.

4. Use of English:
   In accordance with Senate and Faculty Policy, students may be penalised 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.
5. **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

6. **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.

**Accommodation and Accessibility:**
- **Students** are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students can be found at: https://www.eng.uwo.ca/undergraduate/academic-consideration-for-absences.html

**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. 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/board/code.pdf

**Sickness and Other Problems:**
Students should immediately consult with the instructor if they have any problems that could affect their performance in the course. The student should seek advice from the instructor regarding how best to deal with the problem. Failure to notify the instructor immediately (or as soon as possible thereafter) will have a negative effect on any appeal. If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

- **Assessments worth less than 10% of the overall course grade:**
  For work worth less than 10% of the total course grade, academic consideration might be granted by the instructor to students with a legitimate reason. If approved, an extension will be given to submit any missing work. In such a case where documentation is required, please visit: https://www.eng.uwo.ca/undergraduate/academic-consideration-for-absences.html

- **Assessments worth 10% or more of the overall course grade:**
  https://www.eng.uwo.ca/undergraduate/academic-consideration-for-absences.html

**Absences from Final Examinations**
https://www.eng.uwo.ca/undergraduate/academic-consideration-for-absences.html
Absences from Final Examinations

- If you miss the Final Exam, please visit: [https://www.eng.uwo.ca/undergraduate/academic-consideration-for-absences.html](https://www.eng.uwo.ca/undergraduate/academic-consideration-for-absences.html)
- You may also be eligible to write the Special Exam if you are in a “Multiple Exam Situation” (e.g., more than 2 exams in 23-hour period, more than 3 exams in a 47-hour period).

**Note:** missed work can only be excused through one of the mechanisms above. Being asked not to attend an in-person course requirement due to potential COVID-19 symptoms is not sufficient on its own.

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

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