Western University - Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 2221b – Structural Theory and Design - Course Outline 2025/26

This course focuses on identification, formulation, analysis and design of civil engineering structures. After completing the course, the students will be able to

- quickly calculate the reactions and draw the internal force diagrams for statically determinate two-dimensional structures based on equilibrium;
- identify the load path and tributary loading for surface loads on statically determinate three-dimensional structures;
- quickly calculate the deflections of statically determinate two-dimensional structures using the virtual work principle;
- quantitatively determine the influence lines for statically determinate structures and use the influence lines to calculate the internal forces and deflections of structures subjected to moving loads;
- distinguish working stress and limit states designs, and recognize different types of loads in structural designs;
- use the limit states design approach to either proportion structural steel members subjected to axial force, shear force and bending moment or to check the adequacy of such members;
- apply the force method to analyze statically indeterminate structures with two degrees of redundancy, and
- work individually and in groups to develop the capacities for critical thinking, problem solving, as well as communicating their work and ideas both in writing and in oral class discussions.
- recognize the need for life-long learning to keep abreast of the new advancements in the analysis, design and construction of engineering structures, and to enhance one's abilities as a civil engineer.

Calendar Copy:
A consolidation of the analysis and design of statically determinate structures, and an introduction to the analysis of indeterminate structures. Analysis and design of statically determinate beams and frames; virtual work and energy methods, introduction to indeterminate structural analysis.

Prerequisites:
CEE 2202A/B, CEE 2220A/B, AM 2270A/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
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.

2 tutorial hours/week
Weekly assignments will be distributed during the tutorials.

Instructor:

[redacted]

Textbook:

1. *Structural Theory and Design* – Lecture Notes, posted on OWL, required.

Other References:

Structural Analysis, A. Kassimali, CENGAGE Learning, 6th Edition, 2019, **Purchase optional**

- https://www.cengage.ca/c/structural-analysis-6e-kassimali/9781337630931/
- One-year access to the eTextbook for $77.95 or purchase a hardcopy for $223.95
- Earlier editions of the book may also be used.

Structural Analysis, R. C. Hibbler, Pearson, 11th Edition, 2024. **Purchase optional**.

- https://www.pearson.com/en-ca/subject-catalog/p/structural-analysis-in-si-units/P200000012383/9781292745756
- One-year access to the eTextbook for $107.99 or purchase a hardcopy for $169.99
- Earlier editions of the book may also be used.

Units:

Both SI and Imperial unit systems may be used in lectures, tutorials and examinations.

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

1. *Analysis of Beams and Plane Frames (Weeks 1-3)*. At the end of this section, the students should be able to:
    a. quickly and accurately develop the axial force, shear force and bending moment diagrams for statically determinate beams and plane frames [CS2, **KB4**]
    b. qualitatively sketch the deflection curves of beams and frames [CS2, KB4];
    c. apply the principle of superposition to calculate the beam and frame internal forces [CS2, KB4], and
    d. apply the principle of symmetry to recognize and analyze symmetric plane structures [CS2, KB4].
2. *Structural Idealization and Tributary Loading (Weeks 3-4)*. At the end of this section, the students should be able to:
    a. recognize basic types of structure elements, structures, loads and load paths [KB3, KB4];
    b. know the purposes of the Canadian national building code and various design codes [KB4].
    c. know typical support conditions and joint connections, and convert supports and joints in actual structures into idealized support conditions and joint connections for performing structural analyses [KB3, KB4, PA1, PA2];
    d. create idealized framing plans for simple structures [KB4, PA1, PA2], and
    e. identify the load path and compute the tributary loading for vertically applied surface loads [KB4**, PA1,** PA2].
3. *Introduction to Strength Design (Week 5)*. At the end of this section, the students should be able to:
    a. know the basic formats of the work stress design and limit states design [PA2, PA3, D1], and
    b. use the limit states design formulae to check the adequacy of steel members subjected to tension, bending and shear [**KB3**, PA2, **PA3**, D1].
4. *Deflection Calculation (Weeks 5-7)*. At the end of this section, the students should be able to:
    a. apply the Virtual Work Principle to calculate the deflections of statically determinate trusses, beams and two-dimensional frames [KB3, KB4, PA1, **PA2**, PA3], and

b. qualitatively sketch the deflection curves for trusses, beams and frames [KB4].

5. *Influence Lines (Weeks 8-11)*. At the end of this section, the students should be able to:

   a. quickly quantify the influence lines for statically determinate trusses and beams using a tabulated solution and Muller-Breslau Principle [KB4, PA1, PA2], and

   b. apply the influence line to calculate the maximum internal forces in trusses and beams subjected to moving loads [KB4, PA1, PA2].

6. *Introduction to Indeterminate Structures (Week 12)*. At the end of this section, the students should be able to:

   a. identify the three general sets of conditions for structural analyses: equilibrium, constitutive model and compatibility condition [KB4], and

   b. use the force method to calculate the internal forces for statically indeterminate trusses, beams and frames with up to two degrees of redundancy [KB4, PA1, PA2].

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

General Learning Objectives:

Knowledge Base	E(I)	Team Work		Economics and Project Management	-
Problem Analysis	E(I)	Communication	I	Life-Long Learning	-
Investigation	-	Professionalism			-
Design	I	Impact on Society	-		
Engineering Tools	-	Ethics and Equity	-		

Evaluation:

The final mark will be determined as follows:

Participation	5%
Assignments	25%
Mid-term Exam	20%
Final Exam	50%
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 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.

1. **Mid-term and Final Examinations:**

One 1.5-hour mid-term exam will be held during tutorial hours. The mid-term exam is **tentatively** scheduled from [redacted] The classrooms for the mid-term will be announced in due course. **Academic consideration will not be given for this assessment without appropriate documentation.**

A three-hour written final examination will be held during the regular examination period.

The mid-term and final exams are close book.

2. **Assignments:**

Assignments will be distributed on a weekly basis through Gradescope. Each student must complete the assignment and submit the solution **electronically** by the due date specified. Discussions with classmates during the tutorial session to complete the assignment are encouraged.

3. **Participation:**

Participation will be assessed based on class and tutorial attendances. Full attendance marks (i.e. 5% of the final course grade) are awarded to students who attend **80% or more of** the scheduled classes and tutorials; partial attendance marks are prorated accordingly.

I. Missed/Late Accommodation Policy:

1. Students missing a test/assignment/lab or examination will report the absence by submitting Academic Consideration Request form through STUDENT ABSENCE PORTAL.
2. Documentation must be provided as soon as possible.

II. Exam Accommodation:

1. If you are unable to write a final examination, report your absence using the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
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 submit an Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
   PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

III. Late Assignments:

1. Students must advise the course instructor if they are having difficulty completing an assignment on time (prior to the due date of the assignment).

2. Students should be prepared to submit the Academic Consideration Request Form and provide documentation if requested to do so by the course instructor (see reverse side for information on documentation).
3. If granted an extension, a revised due date should be established with the course instructor. 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. This course has 8 assignments with **only 6/8 assignments** counted towards your final grade. Academic consideration will not be granted for missed assignments. If a student misses 2 out of the 8 assignments, the remaining assignments will be used in the calculation of their final grade. If a student misses more than 2 assignments, they will receive a grade of zero on each additional missed assignment starting with the third.
5. This course employs flexible deadlines for assignments. The assignment deadlines can be found in the assignment question sheet. For each assignment, students are expected to submit the assignment by the deadline specified. Should illness or extenuating circumstances arise, students are permitted to submit their assignment up to 72 hours past the deadline without academic penalty. Should students submit their assessment beyond 72 hours past the deadline, they will receive a zero grade for the assignment. As flexible deadlines are used in this course, requests for academic consideration will not be granted. If you have a long-term academic consideration or an accommodation for disability that allows greater flexibility than provided here, please reach out to your instructor at least one week prior to the posted deadline.
6. 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.

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

IV. Medical Accommodation:

1. Requests for Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
2. Requests for academic consideration must include the following components:
    a. Self-attestation signed by the student (*This is only accepted for the first/one absence*)
    b. Medical note
    c. Indication of the course(s) and assessment(s) affected by the request
    d. Supporting documentation as relevant
3. Requests without supporting documentation are limited to one per term per course.
4. **Students must request academic consideration as soon as possible and no later than 48 hours after the missed assessment.**
5. Once the request and supporting documents have been received and reviewed, appropriate academic consideration, if granted, shall be determined by the instructor in consultation with the academic advisor, in a manner consistent with the course outline. Academic consideration may include extension of deadlines, waiver of attendance requirements for classes/labs/tutorials, or re-weighting of course requirements. Some forms of academic consideration, such as arranging Special Examinations, assigning a grade of Incomplete, or granting late withdrawals without academic penalty, may only be granted by the Academic Advising office of the Faculty of Engineering.

V. Religious Accommodation:

When scheduling unavoidably conflicts with religious holidays, which (a) require an absence from the University or (b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate Department Chair and, if necessary, the student's Dean.

It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action.

VI. Academic Integrity:

In the Faculty of Engineering, we encourage students to create a culture of honesty, trust, fairness, respect, responsibility, and courage, befitting the professional degree you are pursuing.

Please visit Academic Integrity Western Engineering for more information

VII. Academic Offences:

Plagiarism means using another's work without giving credit. The university has rules against plagiarism and other scholastic offences. Western Engineering has a zero-tolerance policy on plagiarism. The minimum penalty is zero on the course work and a repeat offence will earn you zero on the course. A third offence may lead to expulsion from the university. Scholastic Discipline for Undergraduate Students & Cheating, Plagiarism and Unauthorized Collaboration: What Students Need to Know

Students must write their reports, essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on 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). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

VIII. Faculty of Engineering AI Policy:

The use of generative Artificial intelligence (GenAI) tools won't be discouraged in the Faculty of Engineering. As we pride ourselves on building the future we can't hide from the use of GenAI tools to contribute to the understanding of the course materials. However, the use of GenAI tools in any assignment or contribution during the course will have to be disclosed, as a resource.
GenAI tools use won't be permitted in any type of examination or other assessments where the faculty have prohibited their use. If use of GenAI tools is detected by the instructor in these instances, academic offences penalties might be imposed against the student.

IX. Use of English Policy:

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for 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.

X. Accessibility:

Western is committed to achieving barrier free accessibility for persons with disabilities studying, visiting and working at Western. As part of this commitment, there are a variety of services, groups and committees on campus devoted to promoting accessibility and to ensuring that individuals have equitable access to services and facilities. To help provide the best experience to all members of the campus community, please visit the Accessibility Western University for information on accessibility-related resources available at Western.

Students with disabilities may arrange for academic accommodation at Western. For a more detailed explanation, please visit Academic Support & Engagement -Academic Accommodation.

XI. Inclusivity, Diversity, and Respect:

The Faculty of Engineering at Western University is committed to creating equitable and inclusive learning environments that value diverse perspectives and experiences. We recognize that university courses often marginalize students based on social identity characteristics such as, but not limited to, Indigeneity, race, ethnicity, nationality, ability, gender identity, gender expression, sexuality, age, language, religion, and socioeconomic status. Understanding this, we strive to facilitate equitable experiences and inclusion within the classroom by respecting and integrating multiple ways of knowing, being, and doing. Please visit the Office of Equity, Diversity and Inclusion.

XII. Health and Well-Being:

- Health & Wellness Services – Students - Offers appointment-based medical clinic for all registered part-time and full-time students.
- Mental Health Support - Provides professional and confidential services, free of charge, to students needing assistance to meet their personal, social and academic goals. Services include consultation, referral, groups and workshops, as well as brief, change-oriented psychotherapy.
- Crisis Support - For immediate assistant, please visit Thames Hall Room 2170 or call 519-661-3030. The crisis clinic operates between 11:00 am - 4:30 pm. For after-hours crisis support, click here.
- Gender-Based Violence and Survivor Support - Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, here. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Important Contacts:

Engineering Undergraduate Services	SEB 2097	519-661-2130	engugrad@uwo.ca
Civil & Environmental Engineering	SEB 3005	519-661-2139	civil@uwo.ca
Office of the Registrar/Student Central	WSSB 1120	519-661-2100	

Important Links:

- WESTERN ACADEMIC CALENDAR
- ACADEMIC RIGHTS AND RESPONSIBILITIES

Course Breakdown: (Values given in accreditation units)
Engineering Science = 50%; Engineering Design = 50%