CE47400 – STRUCTURAL ANALYSIS II [Spring 2013]   MWF 1:30-2:20pm, HAMP 1144
http://engineering.purdue.edu/~ce474

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COURSE CATALOG DESCRIPTION
Determination of deflections by the method of virtual work; analysis of trusses, continuous beams, and frames by direct stiffness method; approximate methods of analysis. 3 credits.

SCOPE
Basic concepts of structural analysis; approximate methods of analysis; virtual work principles; displacement/stiffness-based structural analysis (linear, static): derivation of element stiffness matrices, assembly procedures; special topics in structural analysis. Emphasis will be on planar truss and frame structures.

PREREQUISITES
- CE371
- Mastery of statics; good understanding of physics, mechanics of materials and behavior of deformable bodies, calculus, and linear algebra including matrix methods.

COURSE OUTLINE
- **Review of Basic Concepts in Structural Analysis**
  - Equilibrium conditions
  - Statical determinacy/indeterminacy
  - Kinematic indeterminacy (degree of freedom)

- **Approximate Methods in Structural Analysis**
  - Approximate analysis of trusses
  - Approximate analysis of moment-frame building systems for vertical loads
  - Approximate analysis of moment-frame building systems: portal method and cantilever method

- **Work-Energy Methods in Structural Analysis**
  - Conservative systems
  - Strain energy due to axial, bending, shear, torsional forces and deformation
  - Using real work to find real deflection

- **Virtual Work Methods in Structural Analysis**
  - Principle of virtual work (virtual forces); using virtual forces to find real deflections (unit load/dummy load method)
  - Deflections due to temperature changes, member misfits, settlements
  - Betti's law & Maxwell's law of reciprocal deflections
  - Principle of virtual work (virtual displacements); using virtual displacements to find real forces
  - Use of virtual displacements in plastic (limit state) analysis and to draw influence lines

- **Displacement Method (Stiffness Method) of Structural Analysis**
  - Quick review of matrix algebra
  - Truss element; beam element; frame element
  - Stiffness influence coefficients
  - Local coordinates versus global coordinates; coordinate transformations
  - Fixed end forces/moments
  - Formation of the global analysis equations
  - General assembly procedure
  - Direct stiffness analysis of planar truss systems, frame systems
  - Computer implementation (introduction to structural analysis software)

GRADING
- Homeworks: 10% (all problems have equal weight unless otherwise noted)
- Two term exams (closed notes; in class): 25% each
- Final exam (closed notes; in class): 40%

Weighted average of three exams needs to be at least 60/100 to receive a passing grade.

Final grades will be based on standard catalogue grade division, at the discretion of the instructor:
A ≥ 90 | 90 > B ≥ 80 | 80 > C ≥ 70 | 70 > D ≥ 60 | 60 > F

When it comes to grades, what counts is what you actually did; not what you think you could do or could have done. There is no special treatment for anyone in this class. Please be aware of the consequences of failing in this course particularly if you think you are a graduating senior.

HOMEWORKS
Homeworks are due at <u>the beginning of class</u> on the date noted; <u>no late homeworks will be accepted</u>.

Homeworks will be distributed in class and posted on the course website. If you miss homework hand-out, it is your responsibility to obtain the homework from the course website or a classmate.

- Your solutions should be intelligible and of professional quality. Any solution that does not look professional will not be reviewed and will receive automatically a zero/F grade.
- Use engineering paper and write neatly.
- Do not crowd your solutions; start each solution on a separate page.
- Draw your illustrations neatly; use straight edge/ruler/French curves.
- Indicate your sign convention, and relevant parameters, labels, and coordinates on your illustrations.
- State your assumptions where and when they would not be obvious.
- Your final answer should be identifiable; underline or draw a box around your final answer.
- No multiple answers.
- Provide full solutions. If it is not possible to follow your solution logic easily, you may get zero/F grade for your solution even if your "final" answer has the right value or expression.

You will get full point (100%) for a problem if you submit a relevant and intelligible solution. In case of blank, irrelevant, or unintelligible solution you will get zero/F grade for that problem.

You will receive feedback regarding the quality of your solution (in terms of letter grades *A*, *B*, *C*, *D*, *F*). *F* means zero point. <u>It is up to you to study and understand the concepts and steps involved in solving each problem.</u> Homework solutions will be posted on the course website after the due date.

Homework solutions from previous years, solutions manual, or so-called help sites shall not be consulted. Any action to the contrary is considered a case of cheating, which is a violation of the course and University academic honesty policy. Consequences for the perpetrator(s) include failure in the course.

REFERENCE BOOKS
There is no text book for this course. However, the book by Hibbeler (see below, underlined) is recommended.
- *Structural Analysis: A Unified Classical and Matrix Approach* – A. Ghali and A.M. Neville. 2nd ed., Chapman and Hill, 1978 (newer ed. exists)
- *Matrix Structural Analysis* – W. McGuire, R.H. Gallagher, R.D. Ziemian. 2nd ed., J. Wiley and Sons, 2000 (relatively advanced)
- <u>*Structural Analysis*, R. C. Hibbeler, 6th, 7th, 8th ed., Pearson/Prentice Hall, 2005, 2008, 2011.</u>
- *Theory of Matrix Structural Analysis* – J.S. Przemieniecki. Dover, 1985 (1968 McGraw-Hill ed.)
- *Matrix Structural Analysis* – R.L. Sack. PWS-KENT Publishers, 1989
- *Matrix Structural Analysis* – M.D. Vanderbilt. QPI Press, 1974
- *Introductory Structural Analysis* – C.K. Wang and C.G. Salmon. Prentice-Hall, 1984.
- *Intermediate Structural Analysis* – C.K. Wang. International ed., McGraw-Hill, 1983 (other ed.)

POLICIES

Academic Integrity and Course Honor Code
Simply put, you shall never take unfair advantage of others in this course.

Purdue University academic policies and procedures apply:

> *Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Part 5, Section III-B-2-a, University Regulations] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972]*

General Course Policies
You are expected to arrive in class and be seated on time and not leave the classroom before the instructor dismisses class except for emergency reasons (emergency call or restroom use). If you will not be arriving on time or have to leave early because of your engagement in a university activity or a doctor's appointment, let the instructor know beforehand.

If you have a course-related question, please see the instructor or the TA during their respective office hours. Questions posed through email may not be answered quickly, depending on the availability of the instructor/TA or the nature of the question. If you cannot come to office hours, ask for an appointment with the instructor/TA.

If you are expecting an emergency phone call or text message, you need to let the instructor know at the beginning of a class. Otherwise, all cell phones, mobile devices including instant messaging/texting devices, and computers have to be turned off. No exceptions. Turning the sound off is not sufficient. Please be respectful towards your classmates and the instructor, and do not disturb the flow of the class.

Activities not related to the immediate classroom meeting such as reading unassociated documents such as newspapers or magazines, solving homework problems, chatting, texting, etc. are not permitted. If you are sure you should rather be doing something else (like chatting, texting, listening to music, following the latest news on Facebook, Twitter, etc., or sleeping), you are welcome not to come to the class. Note that if you are absent from a classroom meeting, you are responsible for catching up with the class.

Individuals engaged in any activity that disturbs the attention of the class will be asked to leave the classroom immediately.

Collaboration Policy
Homeworks: It is strongly encouraged that you solve the homework problems on your own. In any case, your solution write-up should be, by definition, yours. Copy submissions will receive zero/F grade. If you collaborate in solving a problem, you will have to write on your answer sheet the name(s) of your classmate(s) whom you have collaborated with.

Exams: No collaboration or sharing of any kind is allowed. Zero-tolerance against transgressions.

Actions violating the University academic integrity and honesty policies or, simply, the course honor code, will result in failure in the course. You may be asked to show your Purdue Identification card in exams.

Attendance
It is recommended that you attend classroom meetings. No attendance will be taken except in special circumstances to be decided by the instructor. The University policy for attendance is as follows:

> *Students are expected to be present for every meeting of the classes in which they are enrolled.*

Students with Disabilities
If you have a medical condition that affects your performance in class, please follow the University policy and notify the instructor:

> *Purdue University is required to respond to the needs of the students with disabilities as outlined in both the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 through the provision of auxiliary aids and services that allow a student with a disability to fully access and participate in the programs, services, and activities at Purdue University.*
>
> *It is the student's responsibility to notify the Disability Resource Center of an impairment/condition that may require accommodations and/or classroom modifications.*

Absence due to Health Problems/Concerns
If you think you may have a cold, flu, or any other contagious disease, or simply are not feeling well, please: 1) see your doctor or visit PUSH immediately; 2) do not come to class; you may safely consider yourself excused from attending class. You do not need to provide doctor's report for occasional classroom absence due to health concerns.

In the case of a health problem prohibiting you from attending class for more than two consecutive class meetings, please be prepared to present a report from your doctor explaining your situation. If you miss/will be missing an exam due to a health problem, you will have to present the doctor's report recommending that you should be excused from taking an exam at the scheduled time. The doctor's report has to be presented to the instructor no later than 12:00 pm (noon) the day after the exam. Note that a PUSH/doctor's appointment slip stating that you have seen a doctor is not sufficient documentation to be exempt from an exam. If you miss an exam and cannot show a valid doctor's report, you will receive 0 (zero) grade for that exam.

Students missing classroom meetings are responsible for catching up with the rest of the class.

Health and Other Emergencies
In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Here are ways to get information about changes in this course.

1. The instructor or the TA will email you information through a one-way, broadcast type mailing-list: spring-2013-ce-47400-001@lists.purdue.edu.
2. If you want to communicate your questions to the instructor directly, the best way to reach him is via email at ayhan@purdue.edu. A less efficient way to reach him is by phone at (765) 496-8270.
3. The course website at http://engineering.purdue.edu/~ce474 will be updated with information.

In case of a campus emergency closure, virtual classroom meetings, for example via AdobeConnect or WebEx, could be held. Should such an action become necessary, you will receive an email with information as to how you could participate in virtual meetings for this class. Until then, we will keep our classes as "real" as possible.

If for any pandemic or other emergency reasons one or more of the exams need to be cancelled the following weights will be used in calculating the final grade for performance in this course:

- One term exam cancelled: HW: 15%, one term exam: 35%; final exam: 50%
- Both term exams cancelled: HW: 30%; final exam: 70%
- Final exam cancelled: HW: 20%; term exams: 40% each

Final grades will be based on standard catalog procedure, at the discretion of the instructor.

For more information on Purdue campus emergency planning and preparedness, please visit http://www.purdue.edu/emergency_preparedness/index.htm.

Last but not least, please make yourself familiar with the evacuation routes in the HAMP building.