Northwestern University
Department of Civil & Environmental Engineering

Fall 2018

CivEnv 221 – Theory of Structures I

MWF 9:00 am – 9:50 am (Tech L150); Th 9:30 – 10:50 pm (Tech F281)

Instructor: Dr. K.C. Chou, P.E., Rm. A218, Tech Institute
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Required text: any text from CivEnv 216 and draft text by K.C. Chou & S. Moaveni

Suggested text: If you wish to purchase a text book for this course, the following is a list of suggestions. It is not critical which edition you wish to buy as homework problems will not be assigned from these textbooks. Some of these books are available in AG 52.
Analysis & Behavior of Structures by Rossow; *Elementary Structural Analysis* by Norris, Wilbur, & Utku
Structural Analysis by Hibbeler; *Structural Analysis* by Kassimali

Computer Software: *Visual Analysis* (free to students); RISA 3D, SAP: available in AG 52 and AG 50:

Catalog description: deflection of structures, energy concepts, idealization of structures, truss analysis, column stability, and influence lines. Introduction to indeterminate truss and frame analyses, slope-deflection analysis, and moment distribution. ~~Portal Method~~. Prerequisite: CivEnv 216

Course Goals: To develop an understanding of structural behavior under loads.

Course Objectives: To apply the concepts introduced in statics and mechanics of materials to the analysis of typical civil structures. Both classical techniques and computer tools will be incorporated and complemented each other in the course. At the end of this course, you will have the ability to:

1. Classify if a structure is determinate or indeterminate
2. Differentiate a plane truss from a plane rigid frame structure
3. Analyze determinate and indeterminate plane trusses and plane rigid frames
4. Determine the deflection of a structure under load (forces and other types) — both plane rigid frames and plane trusses using virtual work
5. Analyze a structure using consistent displacement method, slope deflection, and moment distribution method
6. Use Excel proficiently as a calculation tool for the analyses discussed in the course
7. Analyze a structure using commercial computer software
8. Develop and apply influence lines for determinate beams
9. Determine stability (buckling load capacity) of axial members
10. Experimental stress analysis of beams

Course outcomes*:* This course addresses the following student learning outcomes:

O1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering sciences, and mathematics

O3) an ability to communicate effectively with a range of audience (through proper presentation of homework solution and lab reports)

O6) an ability to develop and conduct appropriate experimentations, analyze and interpret data, and use engineering judgment to draw conclusion

Pre-requisite topics: static equilibrium; free body diagrams; simple truss analysis (method of joints and sections); simple frame analysis (reactions and internal forces), shear and moment equations and diagrams for beam; beam deflection using deflection equations; indeterminate beam analysis using consistent displacement; superposition; Excel (equations and graphing).

Academic Integrity: Engineers are required to adhere to the highest professional responsibility and ethics. Hence, Academic Integrity is strictly enforced in this course. A grade of F may be assigned to the course if Academic Integrity is bleached. Refer to the University and McCormick School policy of Academic Integrity, http://www.mccormick.northwestern.edu/students/undergraduate/academic-integrity.html and *Clarification of Academic Integrity* handout.

Meeting Date		Topics	Reading chapter in notes	Homework Problems
1.	9/27	Course Overview and Introduction		Problem Set R
4.	9/28	Reactions, determinacy & stability	2.1, 2.2, 2.3	
5.	10/1	Plane Truss (PT) – co-linear forces	2.4,3.1,3.2, 3.3.1	
2-3	10/2*	Introduction	1	Set R due in class
6.	10/3	PT – method of section, determinacy & stability	3.4	
7.	10/4	PT – complex truss analysis	3.5 – 3.6	
8.	10/5	PT – matrix, computer tool (Excel, visual analysis)	3.7 + VA	
9.	10/8	Shear & moment – differential relationship	CivEnv 216 text & 4.3	
10.	10/10	Shear & moment – differential relationship	CivEnv 216 text & 4.3	
11.	10/11	Shear & moment – floor system	4.4	
12.	10/12	Plane frame (determinate) analysis	5.1, 5.2	
13.	10/15	Plane frame – determinacy & stability	5.3	
14.	10/17	Stability (buckling)	CivEnv 216 text, notes Appendix S	
15.	10/18	Stability (buckling)	CivEnv 216 text, notes Appendix S	
16.	10/19	Stability (buckling)	CivEnv 216 text, notes Appendix S	
17.	10/22	Deflections – trusses (Virtual Work)	6.1 – 6.3.4	
18.	10/24	Deflections – trusses (Virtual Work)	6.3.4	
19.	**10/25**	**Test 1**	**up to and include lecture 14**	
20.	10/26	Deflections – beams (Virtual Work)	6.3.5	
21.	10/29	Deflections – beams & frames (Virtual Work)	6.3.5	beam lab report 10/26
22.	10/31	Deflections – frames (Virtual Work)	6.3.5	
23.	11/1	Influence lines – beams	7.1 – 7.3	
24.	11/2	**Cantilever beam lab (lab report due 11/28)**	**AG 40**	no grace period
25.	11/5	Influence lines – applications	7.4	
26.	11/7	Influence lines – moving loads	7.7, 7.8	
27.	11/8	Indeterminate analysis – consistent displacement (CD)	8.1 – 8.3	
28.	11/9	Indeterminate analysis – CD – trusses	8.4.1	
29.	11/12	Indeterminate analysis – CD –beams	8.4.2	
30.	11/14	Indeterminate analysis – CD –beams + frames	8.4.2	
31.	**11/15**	**Test 2**	**Up to and include lecture ??**	
32.	11/16	Indeterminate analysis – CD – frames	8.4.2	
	11/19	*Class canceled for Thanksgiving holiday**		class canceled*
	11/21			Safe travel
33.	11/26	slope deflection – with no joint translation	9.1 – 9.3	
34.	11/28	slope deflection – with no joint translation	9.3	
35.	11/29	slope deflection – with no joint translation	9.3	
36.	11/30	Moment distributions – no joint translation	10.1 - 10.3	
37.	12/3	Moment distributions – no joint translation	10.3	
38.	12/5	Moment distributions – no joint translation	10.3	
39.	12/6	Review/Catch up		
40.	12/7	Review/Catch up		
*	***canceled class will be made up on 10/2 for 2 hours in the evening***			
Final exam is scheduled for Thursday 13 December 2017 from 3-5 pm. Final exam is comprehensive				

Any student with a disability requesting accommodations is required to register with AccessibleNU Center (accessiblenu@northwestern.edu; 847-467-5530) and present an accommodation letter from SSD to his/her professor, preferably within the first two weeks of class. All discussions will remain confidential. Any student who wishes to seek assistance beyond the content of this course may want to meet with a staff member at CAPS (Student Affairs http://www.northwestern.edu/counseling/)