West Virginia University
Department of Civil and Environmental Engineering

CE 361 - STRUCTURAL ANALYSIS 1
Fall 2018

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Office Hours: Mon, Wed, and Fri 12:00 - 12:50 P.M. (or by Appointment)
Course Prerequisite: MAE 241 & MAE 243 & MATH 261 with a minimum grade of C- in each.
Textbook: Kassimali, A., *Structural Analysis*, Fifth Edition, Cengage Learning, 2015.

Computer Program: RISA Technologies, *RISA-2D: Rapid Interactive Structural Analysis - 2 Dimensional*, Latest Version (**Demo Version** of *RISA-2D* can be downloaded free of cost from http://www.risa.com/downloads.html).

Other Material: USB Drive for saving electronic files (data files, PowerPoint slides, etc.)

Objectives: To study the fundamental structural theory for analysis of statically determinate and indeterminate structures; to apply the concepts to lab-scale experiments; to learn to use a computer analysis program (Matrix Displacement Method) and compare the results with hand calculations.

Expected Learning Outcomes: (Specific objectives related to ABET Program Outcomes)

Course Outcome Description	ABET Program Outcome*
(1) Study the concepts of equilibrium and support reactions with respect to civil engineering structures.	(a)
(2) Compute and draw the shear force, bending moment, and axial force diagrams for beams and plane frames through hand computations.	(a), (e), (g)
(3) Draw the qualitative deformed shape of beams and plane frames under the action of loads. Indicate critical points in the deformed shape such as points of local maxima and minima, and inflection points.	(a), (e), (g)
(4) Conduct computer analysis of beams and plane frames using structural analysis software with graphics capabilities for plotting the shear force, bending moment, and axial force diagrams as well as the	(a), (e), (g)

quantitative deformed shape to scale.	
(5) Compute axial forces and deflections in trusses using hand computations and structural analysis software including computer analysis of indeterminate trusses.	(a), (e)
(6) Compute displacements in beams and plane frames using various methods that fall under the category of geometric (differential equation) or energy methods.	(a), (e), (g)
(7) Introduce the concepts of structural stability and determinacy, and study static and kinematic indeterminacies.	(a)
(8) Analyze statically indeterminate beams and plane frames using slope-deflection method.	(a), (e), (g)
(9) Study the moment distribution method for analyzing statically indeterminate beams and plane frames.	(a), (e), (g)

*Description of Accreditation Board for Engineering and Technology (ABET) program outcomes is given below.

Accreditation Board for Engineering and Technology (ABET) Program (Student) Outcomes Applicable to this Course:

(a) An ability to apply knowledge of mathematics, science, and engineering

(e) An ability to identify, formulate, and solve engineering problems

(g) An ability to communicate effectively

POLICY AND GUIDELINES:

Course Materials:

All course materials, including lectures, class notes, quizzes, exams, handouts, presentations, and other materials provided to students for this course are protected intellectual property. As such, the unauthorized purchase or sale of these materials may result in disciplinary sanctions under the Campus Student Code.

Academic Integrity/Honesty:

You are bound by the university honor code; it is your responsibility to know the code and the risks of violations.

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed

policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code at http://studentlife.wvu.edu/office_of_student_conduct/student_conduct_code. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me before the assignment is due to discuss the matter. [adopted: 2-11-08]

Grading:

Pop Quizzes	10%**
Laboratory	20%††
Homework	20%
Exam I (Midterm Exam)	15%
Exam II	15%
Exam III (Final Exam)	20%

Total	**100%**

**Pop Quizzes will be given throughout the semester in the class without prior announcement.

††Your Lab Group Report scores will be multiplied by a factor (≤ 1.0) based on the average ratings that you receive from your group members in the "Peer-Rating of Group Members" form at the end of the semester. A blank form is attached at the end. The multipliers are as follows, and linear interpolation will be used between different categories as needed.

Peer Rating	Multiplier to Your Lab Report Score
4-5	1.00
3	0.75
2	0.50
1	0.25
0	0.00

Final course grades will be based on the following scale: 90% and above - A, between 80% and 90% - B, between 70% and 80% - C, between 60% and 70% - D, and below 60% - F.

Homework:

The homework solutions must be yours. **Don't copy!** Identical homework solutions will be given score of zero. Homework due dates will be specified in the class for each assignment; generally, late homework will not be accepted.

Students are expected to submit work which is reasonably neat, complete yet concise, orderly and well organized. Calculations and sketches should be presented in **standard size paper (8.5" x 11")**. No off-size sheets and/or ragged edged papers will be accepted. Please staple all sheets together, **assignment sheet on top**, and hand in flat, **not folded**.

Suggestions for Meaningful Learning:

Participate in class and make an effort to think with me. If you can't follow, let me know. Review your class notes as soon as possible and clarify them; identify weaknesses in your background (you may not always have time to eliminate them, but it is important to recognize them); **write down questions**: how does it work and why does it work?

To do well in this class, I strongly recommend that you attend every lecture, because <u>not all material presented in the class lectures is included in the textbook.</u>

Other Policies:

- Homework Assignments are to be done INDIVIDUALLY. **COPYING IS NOT PERMITTED. Identical homework solutions will be given score of zero.**

- **Cell Phone communications are <u>not</u> permitted during Quizzes and Exams.**

- Exams and Laboratory Quizzes are CLOSED BOOK and to be done INDIVIDUALLY. Laboratory Quizzes will be held at the beginning of each laboratory session and will be based on the topics corresponding to that day's laboratory.

- Laboratory Reports and Presentations are to be done in Groups. If any student does not participate, you are free to omit the student's name from the cover pages of the report and presentation, and this student will be given a score of ZERO.

- All laboratory presentations must be created using MS PowerPoint with LARGE FONTS (please review the guidelines for presentation by SPIE). Please bring your presentation to the lab on scheduled days in a USB drive.

- Attendance will be taken by the Graduate Teaching Assistant (GTA) at ***the end*** of each laboratory session. If you are absent, you will ***not*** get credit for that laboratory report.

Inclusivity Statement:

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Accessibility Services (304-293-6700). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives, please see http://diversity.wvu.edu/

Days of Special Concern:

WVU recognizes the diversity of its students and the needs of those who wish to be absent from class to participate in Days of Special Concern, which are listed in the web site of WVU's Office of Social Justice. *Students should notify their instructors by the end of the second week of classes or prior to the first Day of Special Concern, whichever is earlier, regarding Day of Special*

Concern observances that will affect their attendance. Further, students must abide by the attendance policy of their instructors as stated on their syllabi. Faculty will make reasonable accommodation for tests or field trips that a student misses as a result of observing a Day of Special Concern.

Adverse Weather Commitment:

In the event of inclement or threatening weather, everyone should use his or her best judgment regarding travel to and from campus. Safety should be the main concern. If you cannot get to class because of adverse weather conditions, you should contact me by email as soon as possible. Similarly, if I am unable to reach our class location, I will notify you of any cancellation or change as soon as possible (by 2 hours before class starts), using (MIX Email) to prevent you from embarking on any unnecessary travel. If you cannot get to class because of weather conditions, I will make allowances relative to required attendance policies, as well as any scheduled assignments.

LECTURE TOPICS:

1. Equilibrium and Support Reactions (Ch. 3)

2. Shear and Moment Diagrams for Beams and Frames (Ch. 5)

3. Plane Trusses (Ch. 4)

4. Deflections of Beams, Frames, and Trusses: Work-Energy Methods (Ch. 7)
   - Unit Load Method (Virtual Work Method)

5. Deflections of Beams: Geometric Methods (Ch. 6)
   - Direct Integration Method
   - Moment-Area Method
   - Conjugate-Beam method

6. Introduction to Statically Indeterminate Structures (Ch. 11)

7. Method of Consistent Deformations – Force Method (Ch. 13)

8. Slope-Deflection Method (Ch. 15)

9. Moment-Distribution Method (Ch. 16)

10. Arches – *introduction only*

Notes: (1) The chapter numbers above refer to the actual chapter numbers in the textbook.

(2) You should **read the introductory chapters 1 and 2 on your own** during the first week of classes.

LABORATORY TOPICS:

    1.   Principle of Equilibrium

    2.   Computer Analysis of Structures I: Beams

    3.   Deflected Shapes and Inflection Points for Beams

**   *Exam I*

    4.   Computer Analysis of Structures II: Frames and Trusses

    5.   Deflected Shapes and Inflection Points for Frames

**   *Exam II*

    6.   Displacements and Strains in Beams: Use of Data Acquisition System

    7.   Displacements and Strains in Frames: Use of Data Acquisition System

    8.   Displacements and Strains in Trusses: Use of Data Acquisition System

**   *Exam III (Final Exam)*

"Tell me and I forget. Teach me and I remember. Engage me and I learn."
-Chinese proverb

Structural Analysis 1 – Laboratory Topics

S. No.	Lab No.	Laboratory	Notes
1		Special Lecture Session 1 on Beam Analysis using Equilibrium Principle	
2		Special Lecture Session 2 on Beam Analysis using Equilibrium Principle	
3	1	Principle of Equilibrium[1]	
4	2	Computer Analysis of Structures I	
5	3	Deflected Shapes and Inflection Points for Beams[1]	
6		No Laboratory (**Exam I**[2])	**Exam I (Mid-Semester)**[2]
7	4	Computer Analysis of Structures II	
8		Approximate Analysis of Frames	
9	5	Deflected Shapes and Inflection Points for Frames[1]	**Designated as a WRITING LAB**
10		No Laboratory (**Exam II**[2])	**Exam II**[2]
11		Computation of Displacements	
12	6	Displacements and Strains in Beams[1]	
	7	Displacements and Strains in Frames[1]	
	8	Displacements and Strains in Trusses[1]	
13		Indeterminate Structural Analysis and Arches (ADVANCED TOPICS)	
14		Indeterminate Structural Analysis (REVIEW FOR FINAL EXAM)	
15		No Laboratory (**Exam III**[3])	**Exam III**[3]

1. **On days of Experimental Labs (1,3,5,6,7,8), PLEASE WEAR SHOES during the laboratory experiments.**
2. **Course contents and Dates for Exams I and II will be announced in the class in advance.**
3. **Exam III covers the entire course. This exam will be held in the class at the end of the semester.**

CE 361: STRUCTURAL ANALYSIS 1
PEER-RATING OF LABORATORY GROUP MEMBERS

Your Name:

Group Number:

Rating Description

Excellent	5.0	Went above and beyond, contributed a lot to this project.
Very Good	4.0	Did all what was supposed to do and very well prepared.
Good	3.0	Acceptably prepared and cooperative, difficult to bring onboard discussions, made acceptable contribution to the project.
Satisfactory	2.0	Minimally prepared and sometimes uncooperative, did not contribute much to this project.
Unsatisfactory*	1.0	Occasional no-show for group meetings and not prepared and uncooperative, contributed very little to this project.
No Show*	0	Did not contribute anything to the project.
*You need to provide justification for this grade (you can use back of this form) <u>or</u> at least one other member of your group should report the same in their evaluation.		

Print name of each group member (other than you) and assign the rating in the table below (Provide any remarks, if needed, below or on the back of this form. You can return the form to me or the GTA. Alternatively, you can email me and the GTA scanned copy of the form).

Last Name, First Name	Rating	Remarks

[**Your evaluation will <u>not</u> be shared with your group members.**]

Your Signature:

Date: