

**West Virginia University**  
**Department of Civil and Environmental Engineering**

**CE 361 - STRUCTURAL ANALYSIS 1**  
**(CRN:10691/10693, 4.0 Credits)**  
**Spring 2015**

**Instructor:** Dr. P.V.Vijay, P.E.  
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**Office Hours:** Mon, Wed, and Fri 10:00 - 10:50 A.M. (or by Appointment)

**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)

<b>Course Outcome Description</b>	<b>ABET Program Outcome*</b>
(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 quantitative deformed shape to scale.	(a), (e), (g)
(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:**

### **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](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.

### **Grading:**

Pop Quizzes	10% **
Laboratory	20%
Homework	20%
Exam I (Midterm Exam)	15%
Exam II	15%
Exam III	20%
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<b>Total</b>	<b>100%</b>
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\*\*Pop Quizzes will be given throughout the semester in the class without prior announcement.

Final 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. 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. Staple all sheets together, **assignment sheet on top**, and hand in flat, **not folded**.

**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.

### **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 and work to eliminate or minimized them; **engage in discussions, ask questions**; and analyze a problem to understand how and why does it work?

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

### **Other Policies:**

- Homework Assignments are to be done INDIVIDUALLY. **COPYING IS NOT PERMITTED. Identical homework solutions will be given score of zero.**
- 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 chapter of the laboratory manual 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 that will be provided in the class). 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.

### **Social Justice 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.

### **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.

## 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*

**CE 361- Spring 2015 (Dr. P.V.Vijay)**  
**Structural Analysis 1 – Laboratory Topics**

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 <sup>1</sup>	
4	2 Computer Analysis of Structures I	
5	3 Deflected Shapes and Inflection Points for Beams <sup>1</sup>	
6	No Laboratory ( <b>Exam I</b> <sup>2</sup> )	<b>Exam I (Mid-Semester)</b> <sup>2</sup>
7	4 Computer Analysis of Structures II	
8	Approximate Analysis of Frames	
9	5 Deflected Shapes and Inflection Points for Frames <sup>1</sup>	<b>Designated as a WRITING LAB</b>
10	No Laboratory ( <b>Exam II</b> <sup>2</sup> )	<b>Exam II</b> <sup>2</sup>
11	Computation of Displacements	
12	6 Displacements and Strains in Beams <sup>1</sup> 7 Displacements and Strains in Frames <sup>1</sup> 8 Displacements and Strains in Trusses <sup>1</sup>	
13	Indeterminate Structural Analysis and Arches (ADVANCED TOPICS)	
14	Indeterminate Structural Analysis (REVIEW FOR FINAL EXAM)	
15	No Laboratory ( <b>Exam III</b> <sup>3</sup> )	<b>Exam III</b> <sup>3</sup>

1. On days of Experimental Labs (1,3,5,6,7,8), PLEASE WEAR SHOES during the laboratory experiments.
2. Course contents 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 from 2:00 to 4:00 P.M. in Room 401 ESB.