Sharif University of Technology
School of Civil Engineering

Structural Analysis II
Fall 2017

COURSE DESCRIPTION:

This is a second of a two-course sequence on structural analysis required of all civil engineering students. The course concentrates on the calculation of deflections and the analysis of statically indeterminate structures. Various methods will be presented to compute displacements, with the use of virtual work emphasized. For analysis of statically indeterminate structures, the force method of analysis (also called flexibility method) will be emphasized. Displacement-based methods will also be introduced including slope deflection method and moment distribution. Structures examined in this course will be modeled as planar trusses, beams and/or frame structures. Students will use a general purpose structural analysis program to analyze more complicated structures.

COURSE STAFF:

Instructor: Siamak Epackachi
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CLASS SCHEDULE:

Lecture: Sat. 10:30-12:30 Room 209

REFERENCES:

Fundamentals of Structural Analysis by Leet, Uang, and Gilbert
Structural Analysis, Hibbeler, R.C.
Elementary Theory of Structures, Hsieh, Yuan-Yu
Elementary Structural Analysis, Norris, Wilber, and Utku

GRADING:

Assignments	20%
Midterms	30% (each 15%)
Quiz	10%
Final	40%

- Attendance at all lectures and recitations, and active participation is expected. The instructor regularly brings up questions and discussions during lecture time. Students are encouraged to volunteer in answering questions and participate in discussions.

- *Sustained effort starting today*: Come to class and recitations regularly. Pay attention in class without distractions through smartphones etc. Bring a scientific calculator and follow along with calculations in class.

- For the assignments, although students may consult with classmates, it is expected that solutions that are submitted, reflect the individual work of students.

- During recitation, the instructor will show in detail how to solve the problem(s), and help you reach the correct answer. Attendance is not mandatory but it is strongly recommended as it will help you succeed in the course.

- A significant part of engineering is written communication of laboratory work and analysis/design proposals. Heavy emphasis will be placed on clarity, organization and readability of your work. (a) All assignments must be submitted with no more than one problem per page. (b) Write your name, course and homework number on a cover sheet. (c) Staple pages together. (d) A clear and well-labeled **drawing** or **free body diagram** as appropriate *must* be presented with every problem. (e) Always use **units** everywhere in your work – a number without units makes no sense in engineering. (f) Show each step of the problem and clearly explain the logic being used. (g) Clearly box all final answers.

COURSE OBJECTIVES:

When you graduate as a Civil Engineer, you will be responsible for designing buildings, roads and railroads, bridges, retaining walls, water carrying pipes and many other structures that make up the backbone of our society. To do this, you must be able to calculate the forces acting on these structures and the stresses and deformations that develop in them as a result, so that you can design them for strength and serviceability. In Statics, you learnt to calculate internal forces in statically *determinate* structures; in Mechanics of Materials, you learnt about stresses and how to calculate deflections of beams; and in Structure I, you began the study of deflections of structures. In this course, you will learn how to calculate deflections not just of components such as beams, but of complete structures. You will also learn to analyze statically *indeterminate* structures. Students who take this course will be expected to achieve the following objectives:

i. To develop a strong intuition of structural behavior, i.e., being able to answer questions like "What is the predominant mode of behavior of a structure?", "what are the principal load paths in a structure?" etc., that is essential for conceptual design of structures.
ii. To obtain a thorough understanding of the analytical principles of structural mechanics. Such principles form the basis of computer methods such as the Finite Element Method. After taking this course, therefore, you will be able to take such classes as Matrix Structural Analysis, and Finite Element Method.

COURSE LEARNING OUTCOMES:

When you complete this course, you will be able to:

Course learning outcomes	SO	Assessment tools
a. Compute deflections of structures using the Principle of Virtual Work	a, e	HW, exams
b. Draw influence lines and use them to calculate the response of bridges to moving loads	a, e	HW, exams
c. Analyze qualitatively, the response of statically indeterminate structures	a, e	HW, exams
d. Distinguish between the Force Method and the Displacement Method of indeterminate structural analysis	a, e	HW, exams
e. Compute internal forces in statically indeterminate structures by the Force Method and by the Displacement Method	a, e	HW, exams
f. Apply Matrix Structural Analysis to simple one-dimensional structures	a, e	HW, exams
g. Navigate and use a general purpose structural analysis program	a, e	HW
h. Present calculations in an organized and readable form.	g	HW, exams

(a) *Apply knowledge of mathematics, science and engineering*: Structure II is an engineering problem solving course that builds upon students' background in mathematics and physics to form a linkage between abstract concepts and physical problems common in engineering practice.

(e) *An ability to identify, formulate and solve engineering problems*: The problems demonstrated in class and in homework assignments encourage students to idealize real-world problems so that they may apply their engineering knowledge and judgment to develop meaningful solutions. These exercises are designed to develop students' confidence, so that they will be able to make the next transition, from problem-solving to design.

(g) *Communicate effectively*: Because engineers frequently communicate via engineering calculations, a premium is placed on the quality, order, neatness and correctness of all solution of problems performed as part of Structure II. Students are continually reminded that the quality of their engineering calculations is a statement of their regard of their profession.

Relationship of Structure II to Student Outcomes (Course Assessment Matrix):

a	b	c	d	e	f	g	h	i	J	k
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SYLLABUS/SCHEDULE:

Class No.	Date	Topic
1	09/24/2016	Introduction and course outline Review Structure I (Analysis of statically indeterminate structures by the method of consistent deformation)
2	10/01/2016	Review Structure I (Force method)
3	10/08/2016	Influence line of indeterminate structures
4	10/15/2016	Approximate analysis of structures
Mid-term I Exam		
5	10/22/2016	Slope deflection method – Introduction – Frames without lateral deformation
6	10/29/2016	Slope deflection method– Frames without sideways
7	11/05/2016	Slope deflection method– Frames with sideways (more examples)
8	11/12/2016	Slope deflection method– Matrix form
9	11/19/2016	Moment distribution method
10	11/26/2016	Moment distribution method - Frames with and without sideways
Mid-term II Exam		
11	12/03/2016	Analysis of non-prismatic members
12	12/10/2016	General Stiffness method
13	12/24/2016	Matrix analysis of trusses – matrices
14	12/31/2016	Matrix Analysis of beams and frames – flexural member
15	-	Analysis of structures using SAP2000 (tentative)
Final Exam		