AMIRKABIR
University of Technology

Structural Engineering II
Fall 2019

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: Dr. Siamak Epackachi
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Office hours: M/W 15:00-16:00 pm

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CLASS SCHEDULE:
Lecture: Tu/Thu 9:15-10:45 (Group I) M/W 9:15-10:45 (Group II)
Recitation: Will be scheduled at the first week of classes.

REFERENCES:
Fundamentals of Structural Analysis by Leet, Uang and Gilbert, McGraw-Hill, ISBN-13: 978-0073401096, ISBN-10: 0073401099.
Structural Analysis (8th Edition) by Russell C. Hibbeler, Prentice Hall, ISBN-13: 978-0132570534, ISBN-10: 013257053X.

GRADING:

Assignments	20%
Final project	10%
Quiz	10%
Midterm	25%
Final	35%

- 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. At least one question from the assignments will appear on the mid-term and final exams, modified only for dimensions and values of loading.

- Every week, problem(s) will be assigned during the recitation. You must attempt to solve the problem(s). During recitation, the instructor will show in detail how to solve the problem(s), and help you reach the correct answer. The problem(s) will be collected at the end of recitation for extra credit. You will get 5 bonus points towards your HW grade for solving problems during each recitations. 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.

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Course outlines:

1. Introduction and course outline
2. Review Structure I
3. Virtual Work
    - Overview
    - Trusses
    - Beams
    - Frames + Bernoulli
4. Introduction to indeterminate structures
5. Flexibility Method
    - Overview
    - Frames
    - Multiple degrees of indeterminacy
    - Support settlement, temperature change and fabrication error
6. Slope-Deflection Method
    - Overview
    - Equations
    - Continuous beams

Review and mid-term exam

6. Slope-Deflection Method
    - frames without sideways
    - frames with sideways
7. Moment Distribution
    - Overview
    - beams
    - more examples
    - frames without sideways
    - frames with sideways
8. Influence Lines
    - Review

- Indeterminate structures
- Using moment distribution
- Using Muller-Breslau Principle
- Live load patterns

9. General Stiffness method
10. Matrix analysis of trusses
    - Matrices
    - individual member
    - inclined truss bar
11. Matrix Analysis of beams and frames – flexural member
12. Analysis of structures using SAP2000

Review, final exam, and final project