

Course: *Civ_Env 216, Mechanics of Materials, Spring 2023*
Credits: 1 Unit credit; contact hours; 3 hrs lecture
Instructor: Arantzazu Alarcon-Fleming
Text: *Mechanics of Materials*, F.B. Beer, E. R. Johnston, J. T. DeWolf, D. F. Mazurek, 8th edition, Mc Graw Hill.
Description: Analytical study of stresses and deformations and their application to the design of machine and structural elements subjected to static loads.
Prereq: GEN_ENG 205-2 (Engineering Analysis II- Statics)
Required: Required

Specific Goals for the Course:

By the end of the course, students should be able to

1. Visualize and understand the fundamental behavior of structures and solids (ABET #1)
2. Compute stresses in several types of structural and machine components subjected to external loading conditions (axial, torsion, bending and general transverse loading) (ABET #1,2)
3. Determine internal forces and stresses in indeterminate structures by using of equations of equilibrium, force-temperature-deformation relations, and expressions for the geometry of the deformations (ABET #1)
4. Conduct preliminary design of simple structural and machine components (ABET #1,2)
5. Write computer codes to design components (ABET #3)
6. Present calculations in a professional manner (ABET #3)

Course Grades

- **Homework 10%** Weekly homework due on Canvas. Solutions will be posted after due date. No late homework will be accepted. (Guidelines provided)
- **Lab reports 15%** Three written reports on computer lab assignments (Rubric provided)
- **Midterm 1 20%** Exam on Tuesday April 18, 11-11.50 am
- **Midterm2 20%** Exam on Tuesday May 16, 11-11.50 am
- **Final exam 35%** Two-hour final exam scheduled for Wednesday June 7, 7-9 pm

COURSE OUTLINE

| Lecture | Date | Topic | Reading (from textbook and my videos (PLi)) |
|-----------|----------|---|---|
| Lecture 1 | March 28 | Organization | |
| Lecture 2 | March 29 | Stress and Strain | 1.2 - 1.4 & (*) videos PL1 & 2.1A & 2.7 |
| Lecture 3 | March 31 | Matlab Review | |
| Lecture 4 | April 3 | Mechanical Properties, Poisson's Ratio & Multiaxial Loading | 2.1B-2.1F & App. D, 2.4 & 2.5 |
| Lecture 5 | April 4 | Axial Loading* | 2.1G, 2.10 & (*) videos PL2 |

| | | | |
|-------------|----------|--|--|
| Lecture 6 | April 5 | Statically Indeterminate Axially Loaded Members | 2.2 |
| Lecture 7 | April 7 | Thermal Effects | 2.3 |
| Lecture 8 | April 10 | Torsion of circular shafts | 3.1 |
| Lecture 9 | April 11 | Angle of twist | 3.2 |
| Lecture 10 | April 12 | Statically Indeterminate Torque Loaded Members | 3.3 |
| Lecture 11 | April 14 | Statically Indeterminate Torque Loaded Members | |
| Lecture 12 | April 17 | Review | |
| Exam | April 18 | Midterm # 1 | (*) PL9 |
| Lecture 13 | April 19 | Pure Bending | 4.1- 4.2 |
| Lecture 14 | April 21 | Centroids and Moment of Inertia* | Appendix B & C & (*) videos PL3 |
| Lecture 15 | April 24 | Shear and Bending Moment Diagrams | 5.1, 5.2 |
| Lecture 16 | April 25 | Shear and Bending Moment Diagrams* | (*) videos PL4 |
| Lecture 17 | April 26 | Shear and Bending Moment Diagrams | |
| Lecture 18 | April 28 | Design of Prismatic Beams for Bending | 5.3, Appendix E |
| Lecture 19 | May 1 | Design of Prismatic Beams for Bending | |
| Lecture 20 | May 2 | Shear Stress in Beams | 6.1 & 6.2 |
| Lecture 21 | May 3 | Shear Stress in Beams* | (*) videos PL8 |
| Lecture 22 | May 5 | Shear Stress in Beams | |
| Lecture 23 | May 8 | Deflection of Beams: The elastic curve | 9.1A |
| Lecture 24 | May 9 | Deflection of beams: Slope and Displacement by Integration | 9.1B |
| Lecture 25 | May 10 | Method of Superposition: Statically Determinate Beams | 9.4A & (*) videos PL6 |
| Lecture 26 | May 12 | Statically Indeterminate Beams | 9.4B |
| Lecture 27 | May 15 | Review | |
| Exam | May 16 | Midterm # 2 | |
| Lecture 28 | May 17 | Transformation of plane stress | 7.1 |
| Lecture 29 | May 19 | Mohr's Circle for plane stress | 7.2 & (*) videos PL5 |
| Lecture 30 | May 22 | Mohr's Circle | |
| Lecture 31 | May 23 | Principal Stresses under a given loading | 8.1 & 8.3 |
| Lecture 32 | May 24 | Principal Stresses under a given | |

| | | | |
|----------------|--------|---------------------|--------------------------|
| | | loading | |
| Lecture 33 | May 26 | Buckling of Columns | 10.1 & (*) videos PL7 |
| WEEK 10 | May 29 | Memorial Day | NO CLASS |
| Lecture 34 | May 30 | Review Final Exam | |
| Lecture 35 | May 31 | Review Final Exam | |
| Lecture 36 | June 2 | Review Final Exam | |

Contact Information:

Arantzazu Alarcon-Fleming, Ph.D., P.E., LEED AP

Tech A220 , Phone (847) 467-1392

E-mail: arancha.alarconflaming@northwestern.edu

Office hours: Monday and Tuesday 12-1pm and Wednesday 2.30-4.30 pm and by appointment