# CE410: Structural Design, Fall 2017

**Vision:** Develop structural engineers who understand the fundamental behavior of structural elements, connections and systems, and can apply this understanding to analysis, design, investigation, and assessment. The main materials studied in this course are reinforced concrete and steel but other structural materials will be covered. A high level view of structural engineering design will be provided with multiple industry examples and hand on design assignments.

**Objectives:** This course will enable students to:

1. Understand the principles and procedures for designing structural systems common in civil engineering, with an emphasis to buildings and bridges
2. Comprehend and apply the theoretical and experimental background related to the behavior and performance of structural elements, connections, and systems
3. Design structural elements, connections, and system using standard codes, manuals, and specifications
4. Comprehend the fundamental decisions and components involved in the structural performance of systems by understanding their fundamental design and behavior.

**Instructor:** Dr. Fernando Moreu, PE
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CENT-3056
Office phone (505) 277-1784

**Class hours:** Tuesdays and Thursdays 8:00am – 9:15 am
CENT-1030

**Office hours:** Wednesdays 3-5pm
After class, by appointment, or just drop by my office.

**Recommended Texts:**

- Segui, W. T., "LRFD Steel Design", (can be purchased at UNM Bookstore or online.)
- American Institute of Steel Construction, "Steel Construction Manual". This manual can be purchased from AISC.
- Reinforced Concrete: Mechanics and Design (6th Edition), (can be purchased online.)

- American Concrete Institute (ACI) 318-14: Building Code Requirements for Structural Concrete and Commentary. This manual can be purchased from ACI.

**Other References to be familiar with (no need to buy check them at the library):**

- AREMA (American Railway Engineering and Maintenance-of-Way Association). (2015). "Manual for railway engineering" (all 4 volumes), Lanham, MD.
- AREMA (American Railway Engineering and Maintenance-of-Way Association). (2008). AREMA bridge inspection handbook, Lanham, MD.
- Unsworth, J.F. (2010). "Design of Modern Steel Railway Bridges." RCR Press, Taylor and Francis Group, LLC, March.
- American Association of State Highway and Transportation Officials. Subcommittee on Bridges and Structures. "AASHTO LRFD bridge design specifications
- *Other related codes and references that will be presented during the semester.*

**Grading:**

| | |
|---|---|
| Up to 2 Exams: | 40 points |
| Individual class participation/quizzes: | 10 points |
| Homework: | 30 points |
| Group Design Projects: | 20 points |

**Homework:**

Homework will typically consist of the analysis and design of simple structural elements and connections and will be assigned throughout the semester. No late homework will be accepted except with a documented excuse. You are encouraged to work together to understand concepts and develop approaches for problem solving throughout the course. However, each student must submit their own/individual work. Evidence of inappropriate collaboration (i.e., submitting identical assignments) will result in no credit for that homework. Your problem solutions will generally involve sketches, calculations, and written, detailed descriptions of your solution method and procedure/s. Consequently, organization and neatness are very important and will be graded. Solutions must be presented on engineering graph paper.

**Class participation/Quizzes**

You are expected to follow a professional, participative, engaged participation in this class. Quizzes will take place during class and may or may not be announced throughout the semester. They may or may not include collaborative problems. You will be required to present a topic related to structural engineering design to your classmates (5 minutes) throughout the semester. This presentation will be scheduled.

## Group Design Projects

You will be grouped in teams to design at least two design projects throughout the semester. You will have to size, dimension, analyze, and budget the design of simple structures using the concepts covered in the homework. Your design projects will be submitted in a format that is similar to contractual designs and firms in structural engineering. You are highly encouraged to make design assumptions early on the semester to familiarize yourself with the creativity + analytical skills required for successful structural design. Group design projects are submitted as a group and receive the same grade for all members in the group.

## Grade Scale

A (>90%), A- (85-90%), B+ (80-85%), B (75-80%), B- (70-75%), C (60-70%), F (<60%)

## Course Schedule (Approximate):

| Date | Topics |
|---|---|
| | **Part I: Fundamentals of Structural Design** |
| Week 1 | Design Principles, Material Properties and Behavior |
| Week 2 | Loads, Failure types. Limit States |
| | **Part II: Timber and Masonry Systems** |
| Week 3 | Timber and masonry |
| Week 4 | Group Design Project 1 |
| | **Part III: Reinforced Concrete Structures** |
| Week 5 | Limit State Design, Rectangular Beams/Balanced Condition |
| Week 6 | Theory of Shear Design, Shear Design Example |
| Week 7 | Continuous Members, 1-way Slab Design |
| Week 8 | Design of Columns, Interaction Diagram, Column Shear Reinforcement, Spirals |
| Week 9 | Group Design Project 2 |

**Part IV: Steel Structures**

Week 10 Tension Members
Week 11 Compression Members
Week 12 Beams
Week 13 Simple Connections – Bolted and Welded
Week 14 Group Design Project 3

**Course Outcomes**

With Reference to:
Engineering Accreditation Commission Accreditation Board for Engineering and Technology (ABET)

The following ABET-specified outcomes are required from this course:
(a) An ability to apply knowledge of mathematics, science, and engineering
(c) An ability to design a system, component, or process to meet desired needs
(e) An ability to identify, formulate, and solve engineering problems
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

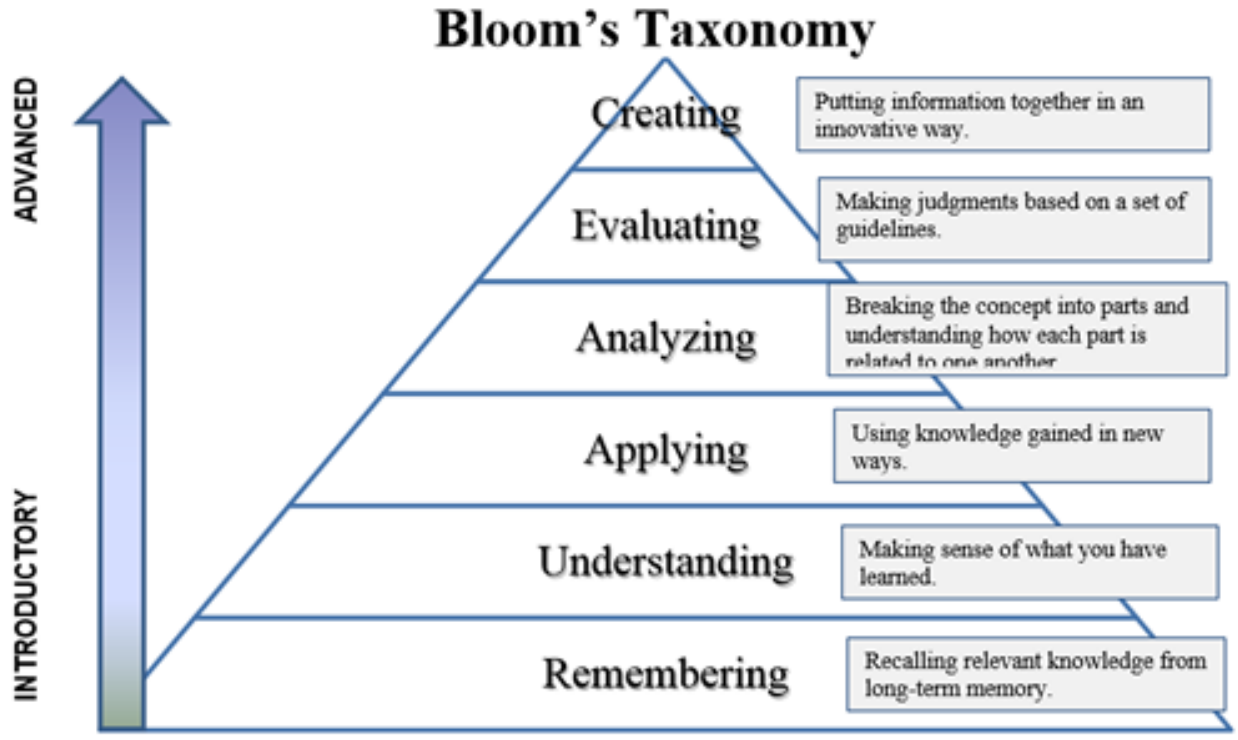
The following UNM Civil Engineering-specified outcomes are required from this course:
A. Graduates will achieve an appropriate level of **technical competence** in:
2. Using modern tools for engineering analysis, including computers and sophisticated laboratory equipment.
3. Approaching and solving engineering problems in a structured manner.
4. Synthesizing knowledge from various sources to produce creative, cost-effective designs for civil engineering facilities.
B. Graduates will be prepared for the **engineering profession** through:
8. An ability to communicate effectively, both in written and oral forms, as well as an ability to listen.
C. Graduates will have an **educated view of the world**, including:
11. An understanding of the role and limitations of technology in addressing society's problems.

**Accommodation Statement** Accessibility Services (Mesa Vista Hall 2021, 277-3506) provides academic support to students who have disabilities. If you think you need alternative accessible formats for undertaking and completing coursework, you should contact this service right away to assure your needs are met in a timely manner. If you need local assistance in contacting Accessibility Services, see the Bachelor and Graduate Programs office.

**Academic Integrity** The University of New Mexico believes that academic honesty is a foundation principle for personal and academic development. All University policies regarding academic honesty apply to this course. Academic dishonesty includes, but is not limited to, cheating or copying, plagiarism (claiming credit for the words or works of another from any type of source such as print, Internet or electronic database, or failing to cite the source), fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized

possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. The University's full statement on academic honesty and the consequences for failure to comply is available in the college catalog and in the Pathfinder.

**Educational Psychology - Bloom's Taxonomy**
(Bloom 1956, revised by Anderson 2001)




(Figure from Baruch College)

## ENGINEERING HOMEWORK PROBLEM FORMAT

Some guidelines for effective problem presentation

*Staple here*

*Name* *Course Number* *Date*

*Number of this sheet*

*Number of sheets in the assignment*

*Definition of all symbols*

*Statement of required answers*

*All information, verbal and graphic, needed to define the problem; paraphrasedwhen possible*

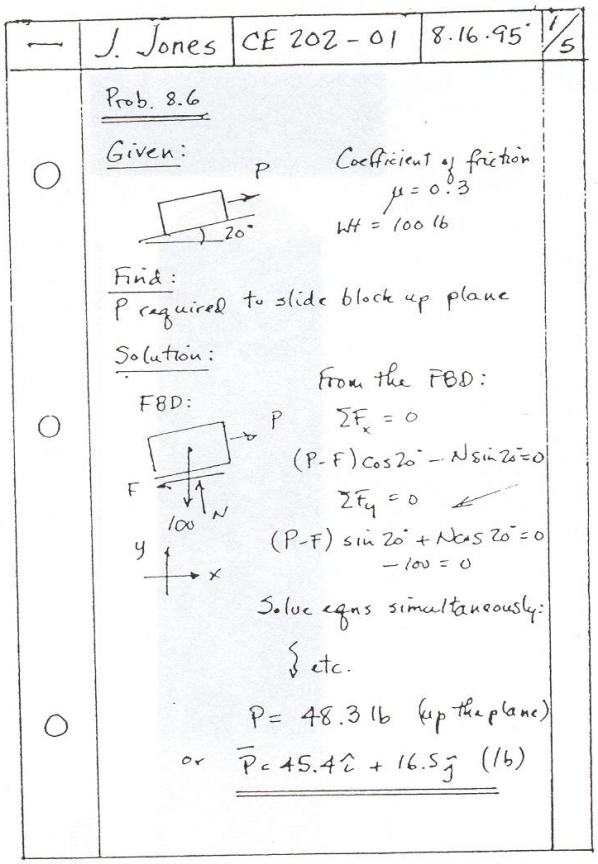
*Sketches on the left side*

*All calculations to solve problem*

*Statement of principle*

*Show all steps in the solution*

*Double underline answers, show units and signs.*




### Other Guidelines...

- Use standard engineering (quadrille) paper; one side only.
- Use pencil, so that you can erase errors.
- Use one sheet per problem, unless you can fit more than one entirely on the sheet. If you put a second problem on the sheet, separate it from the first with a double horizontal line.
- Present your work neatly and in an organized fashion; don't crowd your work.
- State any assumptions, citing references, if not the textbook.
- Explain, in words if necessary, any steps in the solution that are not obvious.