Florida International University, Department of Civil and Environmental Engineering
Reinforced Concrete Design (CES 4702), Fall 2009
Course Information and Policies

Course Description: Behavior, strength, and design of reinforced concrete members subjected to moment, shear, and axial forces. Introduction to the design of reinforced concrete structures.

Prerequisite: CES 3100 (Structural Analysis)

Instructor: Dr. Mirmiran, P.E. **Teaching Assistant:** Shuo Zhang

Class: Tue/Thu (8:00 – 9:15), EC 2410 **Office Hours:** Tue/Thu (9:15 – 10:00) or by appointment [TA schedule TBA]
Course Website: **http://web.eng.fiu.edu/~mirmiran/ces4702/**

Course Text: 1. Reinforced Concrete Design, Limbrunner/Aghayere, 7th Edition, Prentice Hall, 2008
2. ACI 318-08 Building Code Requirements for Structural Concrete [For a student discounted copy, contact Dr. Suksawang, EC 3602, suksawan@fiu.edu, Office Hours: Tue/Thu (2:00 – 3:00 pm)]

Course Objectives: By the end of this course, students will be able to apply design provisions from the ACI Code, as:

- Analyze, design and detail singly and doubly reinforced concrete beams and one-way slabs in flexure
- Design shear reinforcement for concrete beams, when necessary
- Calculate short-term and long-term deflections for reinforced concrete beams
- Check for serviceability requirements to control deflections and cracking
- Analyze, design and detail short reinforced concrete columns
- Specify required reinforcement anchorage

Attendance: Course attendance and on-time arrival are required. Excessive and chronic absences and/or tardiness, late arrival and leaving class early will result in a lower overall grade by as much as 5%.

Assignments: Homework problems will be assigned almost every week, and will be collected **at the beginning of the class** on its due date. Late submissions will **NOT** be accepted. All work submitted for grading must be done **neatly**, **professionally**, and orderly on only one side of consecutively numbered engineering **computation papers**, and must include a **brief** problem statement, brief description of all **steps** in the solution procedure, appropriate sketches and equations, the important results **labeled** (boxed or underlined) along with proper units, and conclusions. The computer printouts, when necessary, must be appended with proper **annotations**.

Exams: There will be 3 hourly exams and a comprehensive final exam as shown on the tentative course schedule. All exams will be closed book and closed notes. Necessary equations will be provided. **No makeup exam, except for emergencies with documented proofs**.

Honor Code: All homework assignments should be individual work. Consultation with classmates is acceptable as long as it is limited to a discussion of solution techniques. All exams are to be individually performed. Florida International University's Academic Honor Code will be enforced.

Students with Disabilities: Any student with disability in need of classroom accommodations should contact the Office of Disability Services for Students: Tel: 348-3532, TDD/TTY: 348-3852.

Grading Plan and Scale:

Grading Plan	
Homework	10%
Exam No. 1	20%
Exam No. 2	20%
Exam No. 3	20%
Final Exam	30%

Grading Scale											
A	A-	B+	B	B-	C+	**C**	C-	D+	D	D-	F
≥95	≥90	≥87	≥83	≥80	≥77	**≥73**	≥70	≥67	≥63	≥60	≥0
<100	<95	<90	<87	<83	<80	**<77**	<73	<70	<67	<63	<60

***Please note: There is no incomplete grade for this course.**

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Tentative Schedule

Week	Classes		Topic	Text Assignment
	Day	**Date**		
1	Tue	8/24	Introduction, ACI Building Code, Concrete Materials	1-1 – 1-6
	Thu	8/26	Reinforcing Steel Materials, Review of Bending	1-7 – 1-8
2	Tue	9/1	Flexural Strength of Concrete Beams	2-1 – 2-5
	Thu	9/3	Modes of Failure	2-6 – 2-7
3	Tue	9/8	Ductility and Strength, Analysis vs. Design	2-8 – 2-11
	Thu	9/10	Slabs and Beams: Singly Reinforced Concrete	2-12 – 2-17
4	Tue	9/15	Non-Rectangular Concrete Sections	3-1 – 3-6
	Thu	9/17	Doubly Reinforced Concrete Beams	3-7 – 3-13
5	Tue	9/22	Review of Flexure	Chapters 2 and 3
	Thu	**9/24**	**Exam 1 (tentative date)**	**Chapters 2 and 3**
6	Tue	9/29	Shear and Diagonal Tension	4-1
	Thu	10/1	Shear Strength of Concrete	4-2 – 4-3
7	Tue	10/6	Shear Reinforcement	4-2 – 4-3
	Thu	10/8	Analysis and Design of Reinforced Concrete Beams for Shear	4-3 – 4-4
8	Tue	10/13	Bond and Development	5-1 – 5-2
	Thu	10/15	Simple-Span Bar Cutoffs	5-9 – 5-10
9	Tue	10/20	Review of Shear and Development/Bond	Chapters 4 and 5
	Thu	**10/22**	**Exam 2 (tentative date)**	**Chapters 4 and 5**
10	Tue	10/27	Serviceability: Deflections	7-1 – 7-5
	Thu	10/29	Serviceability: Crack Control	7-7
11	Tue	11/3	Short Columns	9-1 – 9-4
	Thu	11/5	Interaction Diagrams	9-5 – 9-7
12	Tue	11/10	Design and Analysis of Short Columns	9-8 – 9-10
	Thu	11/12	Review of Columns	Chapter 9
13	Tue	11/17	Design of Footings	10-1 – 10-4
	Thu	11/19	Design of Footings	10-5 – 10-7
14	**Tue**	**11/24**	**Exam 3 (tentative date)**	**Chapter 7, 9, 10**
	Thu	*11/26*	*Thanksgiving*	*University Closed*
15	Tue	12/1	Course Review	Chapters 1-5, 7, 9-10
	Thu	12/3	Course Review	Chapters 1-5, 7, 9-10
16	**Week of 12/7-12/12**		**FINAL EXAM** **Please verify the date and time with the Office of the Registrar** **http://www.fiu.edu/~register/index.htm**	**Comprehensive**

ABET-related Objectives & Outcomes

This course accomplishes, to various extents, the following ABET-related objectives and outcomes:

Objective 1 - Technical Proficiency: Our graduates will have ability to:

3a. Apply knowledge of mathematics, science, and engineering to solve civil engineering problems;
3b. Design and conduct experiments, and **analyze and interpret data related to** at least four of the technical areas encompassed by civil engineering (i.e., **structural**, geotechnical, transportation, environmental and water resources engineering, construction, and general/comprehensive);
3c. Design a system, component, or process to meet desired needs related to at least four of the **technical areas** encompassed by **civil engineering**;
3e. Identify, formulate, and solve civil engineering problems;
3k. Utilize the techniques, skills, and modern scientific and engineering tools necessary for civil engineering practice.

Objective 2 - Communication: Our graduates will have an acceptable level of proficiency in:

3d. Working with others as part of multi-disciplinary teams;
3g. Written, oral, **and graphical communication**.

Objective 3 – Responsible Citizenship: Our graduates will have an acceptable level of appreciation for and understanding of:

3h. The impact of engineering solutions in a global and societal context;
3j. Contemporary issues facing society as a whole.

Objective 4 – Lifelong Learning: Our graduates will:

3i.1. Recognize that graduation is a first step in their development of professional engineering competency;
3i.2. Recognize the need for lifelong learning to maintain and enhance their professional practice of civil engineering.

Objective 5 – Ethical Behavior: Our graduates will:

3f. Have an understanding of professional and ethical responsibility.

The outcome identifiers, herein used (e.g., “3h”), correspond to the same calling system that is used in the ABET Criteria for Accrediting Engineering Programs (www.abet.org).

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Homework 1 – Review of Pre-requisite Information

The frame shown, carry out the following:

1. Find support reactions.
2. Draw shear force, bending moment and axial force diagrams.
3. Tabulate locations and magnitudes of the maximum bending moment and shear force for the beam.
4. Tabulate locations and magnitudes of the maximum moment, shear force, and axial force for the left column.
5. Draw distribution for normal (bending) stresses at point B in the beam.
6. Draw distribution for normal (axial+bending) stresses at point B in the column.
7. Draw distribution for shear stresses at Point B in the beam.
8. Using Mohr's circle, find principal stresses at the flange/web juncture at point B in the beam.
9. Assuming E = 5,000 ksi, find the maximum tensile strain in the beam and the maximum compressive strain in the column.