



COURSE OUTLINE

CIV228 Course Number	REINFORCED CONCRETE DESIGN Course Title	3 Credits
2/3 Hours: Lecture/Lab/Other	CIV227 Prerequisite	January 2008 Implementation sem/year

Catalog description (2006-2009 Catalog):

Examines the design of basic reinforced concrete structural members, including rectangular beams, slabs, columns, footings, and retaining walls. Requires a thorough knowledge of the ACI Standard Code. Covers field inspection procedures. Lab projects involve designing, mixing, and evaluating concrete cylinders and beams, adhering to alternate design and strength design approaches. Spring offering.

Required texts/other materials:

Design of Reinforced Concrete (Latest Edition)
By J.C. McCormac and J.K. Nelson
Wiley Publishers

Last revised: January, 2008

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Information resources: (Describe the primary information resources that support the course, including books, videos, journals, electronic databases, websites, etc. To request new materials for your course, use the library request form at: www.mccc.edu/student_library_course_form.shtml)

Videos: Materials for Concrete – Admixtures
Finishing and Curing Quality Concrete

Other learning resources: N/A

I. Course competencies/goals

The student will be able to...

- Recite the composition and properties of concrete.
- Design, proportion, mix and test concrete.
- Interpret sections of the “Building Code Requirements for Reinforced Concrete, ACI318)” latest edition.
- Become familiar with the “Working Stress” (Alternate Design Method) and “Ultimate Strength” (Strength Design Method) methods of analysis and design of reinforced concrete beams and columns.
- Calculate the principles of analysis and design of footings and retaining walls.
- Become familiar with the use of reinforcing steel in various reinforced concrete building members.
- Become familiar with reinforced concrete construction and inspection techniques.

II. Course-Specific General Education Knowledge Goals and Core Skills.

General Education Knowledge Goals

Goal 2. Mathematics. Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.

Goal 3. Science. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.

Goal 4. Technology. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.

Goal 9. Ethical Reasoning and Action. Students will understand ethical issues and situations.

MCCC Core Skills

Goal A. Written and Oral Communication in English. Students will communicate effectively in speech and writing, and demonstrate proficiency in reading.

Goal B. Critical Thinking and Problem-solving. Students will use critical thinking and problem solving skills in analyzing information.

Goal C. Ethical Decision-Making. Students will recognize, analyze and assess ethical issues and situations.

Goal D. Information Literacy. Students will recognize when information is needed and have the knowledge and skills to locate, evaluate, and effectively use information for college level work.

Goal E. Computer Literacy. Students will use computers to access, analyze or present information, solve problems, and communicate with others.

Goal F. Collaboration and Cooperation. Students will develop the interpersonal skills required for effective performance in group situations.

Goal G. Intra-Cultural and Inter-Cultural Responsibility. Students will demonstrate an awareness of the responsibilities of intelligent citizenship in a diverse and pluralistic society, and will demonstrate cultural, global, and environmental awareness.

III Units of Study in Detail.

UNIT I (3½ Weeks): CONCRETE MIXTURES; REINFORCED CONCRETE BEAMS (ALTERNATE DESIGN METHOD)

The student should be able to...

- List and describe the components of a concrete mixture.
- List and describe the requirements of a quality concrete.
- List and describe the types of Portland cement.
- Describe, using a flowchart, the manufacture of Portland cement.
- List the approximate percentages by volume of each component of an air-entrained or non-air-trained concrete mixture.
- Define air-entrained concrete and state the reasons for its use.
- Define the term "admixture" and describe reasons for its use.
- Discuss the principal factors influencing the strength of concrete.
- Define "slump".
- Describe in detail the procedure for making a slump test.
- List the advantages for curing of concrete and describe several methods used.
- Using the absolute volume method, calculate the proportions of each component (by weight) to prepare a cubic yard of concrete, given the ratio of cement, water, fine aggregate and coarse aggregate.
- Design a concrete mix for given conditions of weather and strength, using the P.C.A. "absolute volume" method.
- Analyze a reinforced concrete rectangular beam for tensile stress, allowable moment and/or allowable loads using the "Alternate Design Method".
- Define "over-reinforced", "under-reinforced" or "balanced" as it applies to the analysis of a reinforced concrete rectangular beam.

UNIT II (4 Weeks): REINFORCED CONCRETE BEAMS (ALTERNATE AND STRENGTH DESIGN METHODS)

The student should be able to...

- Calculate concrete cover and bar spacing for reinforced concrete beams.
- Design a reinforced concrete beam with tensile steel using the "Alternate Design Method".
- Analyze a reinforced concrete rectangular beam for tensile steel stress, concrete compressive stress, allowable ultimate moment and/or allowable ultimate load using the Strength Design Method.
- Compare and contrast the design of a rectangular beam by the Alternate Design and Strength Design Methods.
- Describe the concept of shear as a measure of diagonal tension.
- Calculate the allowable and actual ultimate shear stress for a beam, and determine if web reinforcement is needed, using the Strength Design Method.
- Design vertical U-shaped stirrups for a rectangular reinforced concrete beam using the Strength Design Method.

UNIT II (Cont'd)

- Calculate basic developmental length (l_d) of reinforcing bars for given conditions.
- Determine the "splice class" for given conditions of splices in tension.
- Calculate the lapped length for various splice classes in tension.
- Describe the criteria for "control of cracking" in reinforced concrete beams.
- Solve the appropriate equations for controlling cracking resulting from deflection.

UNIT III: REINFORCED CONCRETE COLUMNS (STRENGTH DESIGN METHOD)

The student should be able to...

- Describe and sketch five types of concrete columns.
- Distinguish between "tied", "spirally reinforced", "combination" and "composite" columns, and "pipe columns filled with concrete".
- Analyze and design tied reinforced concrete columns with concentric axial loads.
- Analyze and design spirally reinforced concrete columns with concentric axial loads.
- Sketch and describe the "interaction diagram".
- Calculate the allowable load on a short tied column using the interaction diagram.
- Design spirals and ties.
- Calculate the allowable load on a short spirally reinforced column using the interaction diagram.
- Calculate and use the appropriate strength reduction factors for "long" reinforced concrete columns

UNIT IV (3 ½ Weeks): FOOTINGS AND RETAINING WALLS

The student should be able to...

- List and describe the several types of footings.
- List the methods of failure of footings.
- Analyze plain, wall, square spread and rectangular footings for soil bearing pressure, moment, shear, concrete bearing, load transfer and reinforcement developmental length.
- Design wall and square spread footings by the "Strength Design Method".
- List and describe the types of retaining walls.
- Check a "cantilever" retaining wall for overturning and sliding.
- Describe the location of structural and temperature/shrinkage reinforcement in a cantilever retaining wall.

IV METHOD OF PRESENTATION

The lecture/discussion approach is used with transparencies and handouts presented for more complicated problems and formula derivations. Class participation is emphasized by asking the students questions and encouraging discussion.

Practical examples encountered in everyday construction involving both structures in general, and specific concrete structures are introduced in the lecture. The building code requirements as published by the American Concrete Institute (ACI 318) latest edition must be adhered to. The textbook and handouts are used for homework assignments.

Students are given a "Manual of Formulas" which conforms to the ACI 318 latest edition Code.

V EVALUATION OF STUDENT LEARNING

A test is given at the end of each of the first three units, which consists of four or five problems covering the objectives of that unit. The length of each test is approximately two hours. The final exam consists of several problems covering principles learned throughout the semester.

Students are expected to submit a laboratory report of the design, mixing and molding of the concrete cylinders and beams. The student is expected to analyze the data and prepare a comprehensive written report with observations and conclusions. Library research may be required.

Several homework assignments will be collected, graded and returned.

GRADE WEIGHTS

Tests 1, 2 and 3	50-55%
Final Exam	20-25%
Homework, Class Participation	5-10%
Lab Report and Lab Participation	15-20%

VI LABORATORY

Problems and principles of construction and design are discussed. Students are encouraged to research literature, and propose projects for discussion which involve present-day concrete construction methods and materials, and design techniques. Several labs will be devoted to problem solving.

A concrete mix is designed using the Portland Cement Association booklet. The concrete is proportioned, mixed and molded into 4" diameter by 8" cylinders. A reinforced concrete beam is also prepared. Seven-day and twenty-eight day tests are made on the cylinders. The beam is also tested to failure by applying a concentrated load at the midpoint. The results are analyzed and compared with theoretical considerations.

Field trips may be taken to study and view manufacturing and/or construction procedures.

VII LIBRARY USAGE

The summary, findings and conclusions of the major laboratory report may require library research. A bibliography of references is to be included in the report.

VIII Academic Integrity Statement:

Students are expected to comply with the college-wide requirements for academic integrity. Mercer County Community College is committed to Academic Integrity—the honest, fair, and continuing pursuit of knowledge, free from fraud or deception. This implies that students are expected to be responsible for their own work. Presenting another individual's work as one's own and receiving excessive help from another individual will qualify as a violation of Academic Integrity. The entire policy on Academic Integrity is located in the Student handbook and is found on the college website (http://www.mccc.edu/admissions_policies_integrity.shtml).

IX Special Needs Students Statement

Any student in this class who has special needs because of a disability is entitled to receive accommodations. Eligible students at Mercer County Community College are assured services under the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973. If you believe you are eligible for services, please contact Arlene Stinson, the Director of Academic Support Services. Ms. Stinson's office is LB221, and she can be reached at (609) 570-3525.