COURSE OUTLINE

Course Number	Course Title	Credits
CIV228	**Reinforced Concrete Design**	**3**
Hours: Lecture/Lab/Other	**Co- or Pre-requisite**	**Implementation Semester & Year**
2/3/0	**CIV227 or divisional permission**	**Spring 2022**

Catalog description:
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.

General Education Category:
Not GenEd

Course coordinator:
James Maccariella, 609-570-3462, maccarij@mccc.edu

Required texts & Other materials:

Design of Reinforced Concrete, latest edition
McCormac and Brown
Wiley & Sons
ISBN: 978-1-118-87910-8

Course Student Learning Outcomes (SLO):

Upon successful completion of this course the student will be able to:

1. Demonstrate the composition and properties of concrete. [Supports ILG 1; PLO 1]
2. Design, proportion, mix and test concrete. [Supports ILG 1, 4, 11; PLO 1, 3]
3. Interpret sections of the "Building Code Requirements for Reinforced Concrete, ACI318)" latest edition. [Supports ILG 1, 4, 11; PLO 1]
4. Demonstrate the "Working Stress" (Alternate Design Method) and "Ultimate Strength" (Strength Design Method) methods of analysis and design of reinforced concrete beams and columns. [Supports ILG 1, 4, 11; PLO 1]
5. Calculate the principles of analysis and design of footings and retaining walls. [Supports ILG 4; PLO 1]
6. Demonstrate the use of reinforcing steel in various reinforced concrete building members. [Supports ILG 1, 11; PLO 1]
7. Demonstrate reinforced concrete construction and inspection techniques. [Supports ILG 1, 11; PLO 1]

Course-specific Institutional Learning Goals (ILG):

Institutional Learning Goal 1. Written and Oral Communication in English. Students will communicate effectively in both speech and writing.
Institutional Learning Goal 2. Mathematics. Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.

Institutional Learning Goal 4. Technology. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.
Institutional Learning Goal 11. Critical Thinking: Students will use critical thinking skills understand, analyze, or apply information or solve problems.

Program Learning Outcomes for Civil Engineering Technology (PLO)

1. Prepare designs for highways, buildings, and bridges.
2. Perform route/construction surveys using survey equipment and methods.
3. Test and analyze various construction materials.
4. Prepare design drawings.

Units of study in detail – Unit Student Learning Outcomes:

Unit I Concrete Mixtures, Reinforced Concrete Beams (Alternate Design Method) [Supports Course SLO #1, 2, 3, 4, 6, 7]

Learning Objectives
The student will 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 Reinforced Concrete Beams (Strength Design Method) [Supports Course SLO #1, 2, 3, 4, 6, 7]

Learning Objectives
The student will be able to:

- Calculate concrete cover and bar spacing for reinforced concrete beams.
- 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.
- Calculate basic developmental length of reinforcing bars for given conditions.

Unit III **Reinforced Concrete Columns (Strength Design Method) [Supports Course SLO #1, 2, 3, 4, 6, 7]**

Learning Objectives
The student will 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.

Unit IV **Footings and Retaining Walls [Supports Course SLO #1, 2, 3, 4, 5, 6, 7]**

Learning Objectives
The student will 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.

Evaluation of student learning:

Course student learning outcomes will be assessed by the following activities:

Tests (3)	60%
Lab and Homework	20%
Final Exam	20%