## COURSE OUTLINE

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CIV227</td>
<td>STRUCTURAL STEEL DESIGN</td>
<td>3</td>
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### Hours:
- **2/3 Lecture/Lab/Other
- **CIV106/CIV229 Prerequisite/Co-requisite
- **January 2008 Implementation

### Catalog description (2006-2009 Catalog):**
Application of basic principles of material mechanics to the analysis and design of structural steel members that occur most commonly in bridge and building construction. Requires thorough knowledge of the American Institute of Steel Construction Code as well as orderly computational procedures. Lab work involves the design of a building. Fall Offering.

### Required texts/other materials:
- **Applied Structural Steel Design**
  - By Spiegel
  - Prentice Hall Publishers

- **Manual of Shapes & Specifications**
  - By Santosuosso
  - MCCC

### Last revised:
Fall 2017

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

### Information resources:
N/A

### Other learning resources:
N/A
I. **Course Competencies/Goals**

*Students will be able to:*
1. Demonstrate basic engineering terminology.
2. Demonstrate the relationship between external forces member reactions.
3. Analyze various types of materials problems.
4. Generate and interpret loading diagrams.
5. Solve problems in a well-organized and logical manner.

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

**General Education Knowledge Goals**

**Goal 1. Communication.** Students will communicate effectively in both speech and writing.

**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.

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

III. **Introduction**

*(Course Competency 1, 2, 3, 4, 5, 6 & 7; Gen Ed Goals 1, 2 & 3; Core Skills A, B & F).*

- List and describe the different types of force systems.
- Calculate resultants and resolve a force into components.
- Analyze truss systems for member loads.
- Draw free body diagrams and calculate reactions using the three equilibrium equations.
- Calculate centroids and moments of inertia of inertia for geometric and structural composite shapes.

IV. **Specific Objectives**

*Units of Study in Detail.*

**Unit I: Review of Principles of Equilibrium; Moments of Inertia of Structural Sections; Analysis of Tension Members; Types of Steels (3 1/2 Weeks)**

*(Course Competency 1, 2, 3, 4, 5, 6 & 7; Gen Ed Goals 1, 2 & 3; Core Skills A, B & F).*

- Describe the various types of steels with special emphasis on their yield points.
- Determine the yield point for A242, A440 and A441 steel members using the AISC Code.
- Describe the various structural elements, i.e. tension, compression and flexure.
• Use the AISC Manual to find various properties of steel sections.
• Calculate the moment of inertia for various combinations of structural members using the AISC Manual. (The centroidal axes can be determined through inspection).
• Calculate the net area of a tension member using the AISC Manual.
• Analyze tension members using the AISC Manual, i.e. allowable load or actual stress.
• Calculate the net area for tension members with staggered holes.

Unit II: Design of Tension Members; Loadings on Building Floor System; Design of Beams (4 1/2 Weeks)

(Course Competency 1, 2, 3, 4, 5, 6 & 7; Gen Ed Goals 1, 2 & 3; Corse Skills A, B & F).
• Design a structural steel angle, double angle or channel tension member using the AISC Manual.
• Determine the live and dead loadings in pounds per square foot for a given use.
• Draw the beam-loading diagram for any beam in a given building floor system.
• Analyze an A36, A242, A440 or A441 steel wide flange section using flexure as the only criterion when the requirements of adequate lateral support and compactness are met.
• Design a wide flange section for flexure consisting of A36, A242, A440 or A441 steel when the requirement of adequate lateral support and compactness are met.
• Design a wide flange section for flexure consisting of A36, A242, A440 or A441 steel when the requirement of adequate lateral support only is met.
• Analyze an A36, A242, A440 or A441 steel wide flange section using flexure as the only criterion when the requirements of adequate lateral support and/or compactness are not met.

Unit III: Beam Failures; Shear; Web Crippling; Deflection; Compression Members (4 Weeks)

(Course Competency 1, 2, 3, 4, 5, 6 & 7; Gen Ed Goals 1, 2 & 3; Corse Skills A, B & F).
• List and describe the various types of beam failure.
• Analyze A36, A242, A440 and A441 steel wide flange sections using the criteria of shear, web crippling and deflection.
• Design A36, A242, A440 and A441 steel wide flange sections for the critical condition of shear.
• Calculate the length of bearing required for transmitting a concentrated loader end reaction safely to the flange of wide flange section using the criterion of web crippling.
• Calculate the critical slenderness ratio (KL/r) for a compression member.
• Calculate the critical load for a compression member using the Euler Formula or F/A = P, whichever governs.
• Analyze A36, A242, A440 and A441 steel compression members for the allowable concentric axial load.
• Design A36, A242, A440 and A441 concentrically loaded steel compression members.
Unit IV: Riveted, Bolted and Welded Connections (3 Weeks)

(Course Competency 1, 2, 3, 4, 5, 6 & 7; Gen Ed Goals 1, 2 & 3; Corse Skills A, B & F).

- Differentiate between bearing type and friction type high strength bolted connections.
- Analyze riveted, ordinary bolted and high strength bolted connections for allowable load using the AISC Manual.
- Analyze fillet-welded connections for the allowable load using the AISC Manual.
- Calculate the number of rivets or bolts needed for a lap or butt joint riveted or bolted connection given the load.
- Design fillet welded connections using the AISC Manual.
- Describe the different types of welds used in structural steel construction.

V. Laboratory

The laboratory sessions are primarily used for problem sessions, and the application of principles learned to the design of a structural steel building. The student is expected to prepare a set of calculations for the design of a structure considering dead and live loads only. Structural steel detail drawings will also be required of several structural components.

One laboratory session will be used to perform experiments on riveted connections. An informal laboratory report will be required. (Course Competency 1, 2, 3, 4, 5, 6 & 7; Gen Ed Goals 1, 2 & 3; Corse Skills A, B & F).

VI. Method of Presentation

The lecture/discussion approach is used with transparencies and handouts presented for the more complicated problems and formula derivations. Class participation is emphasized by asking the students questions. Practical examples encountered in everyday construction involving both structures in general, and specific steel structures are introduced in the lecture and laboratory. The AISC Manual of Steel Construction is adhered to as the primary specification, but reference is made to AASHTO and AREMA specifications. The textbook and handouts are used for homework assignments.

VII. 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 building design.

Oral Report

Students will be expected to give a 10-minute oral presentation of their building design project during the last week of class.
VIII. **Grades Weights**

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<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Tests 1, 2, 3</td>
<td>50%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>25%</td>
</tr>
<tr>
<td>Homework, Attitude, Interest</td>
<td>5%</td>
</tr>
<tr>
<td>Lab project</td>
<td>20%</td>
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IX. **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](http://www.mccc.edu/admissions_policies_integrity.shtml).

X. **Special Needs Students Statement**

Mercer County Community College is committed to ensuring the full participation of all students in all activities, programs, and services. Please refer to the Student Handbook to review accommodations available for Students with Special Needs.
LECTURE SCHEDULE

Week

1, 2  **Introduction**
    Types of Steels
    Moments of Inertia

3  **Tension Member** (Analysis)
    Staggered holes

3  **Tension Member** (Design)

4  **Loadings on Building Floor Systems**

5  **Review of Shear and Bending Moment Diagrams**

6, 7  **Beams** (Analysis)

8  **Beams** (Design)

9, 10  **Beams** (Types of Failures)
    Shear
    Web Yielding
    Deflection

11, 12  **Compression Members**
    Analysis
    Design

13  **Riveted Connections**

14, 15  **Bolted Connections & Welded Connections**
LABORATORY PROJECT

BUILDING DESIGN

Professor J. Maccariella
I. PURPOSE

The purpose of this project is to have the student:

1. Proceed through the stages of structural analysis and design of a steel building.
2. Prepare detail fabrication drawings of several structural steel components.
3. Prepare a well-organized set of calculations.

II. OBJECTIVES

1. Determine the live and dead loadings on beams and columns.
2. Analyze the loading conditions on various structural members.
3. Design the following structural steel members:
   a. A minimum of three different filler beams for the second and third floors (6 beams in all).
   b. A minimum of two different girder beams for the second and third floors (4 beams in all).
   c. A minimum of one exterior column.
   e. A minimum of one interior column.

   (All beam computations shall be done by hand AND using the provided spreadsheet)

4. Prepare detailed fabrication drawings for one filler beam, one girder beam, one exterior column, and one interior column.

III. FORMAT

The finished set of calculations is to be submitted to the instructor during the last laboratory period of the semester. An MCCC report folder shall be used to contain the calculations. A diazo print of the drawings shall be made, folded and placed in the report folder.

All calculations are to be done on 8-1/2 x 11 cross-section paper. Detail drawings are to be done one size "B" vellum paper.

IV. GRADING OF LABORATORY PROJECT

Grades will be based on the following:

a. Completeness (attainment of objectives).
b. Accuracy.
c. Organization and neatness.
d. Participation in laboratory sessions.
V. GIVEN CRITERIA

Finish floor/roof elevations:

- Ground floor  Elevation 100.00
- Second floor   Elevation 110.00
- Third floor    Elevation 120.00
- Roof           Elevation 150.00

A. Dead and Live Loads.

1. The "use" for determination of live loads is left to the student. (use the A.I.S.C. Code).

2. Choice of floor, wall and roofing material is left to the student (use the A.I.S.C. Code for weights of materials).

3. The roof snow load is 40 pounds/square foot.

B. Stairways and one elevator are to be provided.

C. Neglect any loadings due to wind, seismic, mechanical and electrical equipment.

D. Neglect interior partitions (Assume their weight is included in the live load for the particular use).

E. Assume the following for the weight of the beam:

- filler  30 plf
- girder  45 plf