COURSE OUTLINE

CIV227	STRUCTURAL STEEL DESIGN	3
Course Number	**Course Title**	**Credits**

2/3	CIV106/CIV229	January 2008
Hours: Lecture/Lab/Other	**Prerequisite/Co-requisite**	**Implementation sem/year**

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 2009

Course coordinator: **Jim Maccariella, 609-570-3462**
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Information resources: N/A

Other learning resources: N/A

I. Course Competencies/Goals

Students should be able to…

- Apply the principles of "mechanics of materials" to the study of structural steel components.
- Apply the principles of basic engineering mechanics to the design of more complicated steel structures, i.e. trusses and building floor systems.
- Use of the AISC Manual of Steel Construction.
- Design structural steel members under tensile, compressive, or flexural loads.
- Design riveted, bolted and welded connections.
- Become familiar with the various types of structures, construction techniques, and methods of structure failure

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. Introduction

The student at this point (prior to taking this course) should be able to…

- 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)

The student must be able to…

- 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)

The student must be able to…

- 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)

The student should be able to…

- 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)

The student should be able to…

- 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.

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

Tests 1, 2, 3	50%
Final Exam	25%
Homework, Attitude, Interest	5%
Lab project	20%

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).

X. 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. Mrs. Stinson can be reached at (609) 570-3525.

LECTURE SCHEDULE

Week

1, 2	**Introduction** AISC Manual and Codes. Review of Principles of Equilibrium 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**

CIV227 LAB

STRUCTURAL STEEL DESIGN

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, columns and trusses.
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 spandrel beam for the second and third floors (2 beams in all).
    d. A minimum of one exterior column.
    e. A minimum of one interior column.
5. Prepare detailed fabrication drawings for one filler beam and one girder beam.

Note: For students to receive a grade above "B" the following additional objectives are required:

A. Design three riveted truss connections.
B. Design beams around stairways and elevator.
C. Prepare detail fabrication drawings for an exterior column and an 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. The minimum size of the building is to be 75' x 100' (center to center of exterior columns).

B. The third floor is to be used as an auditorium. Interior columns are to stop at the third floor and the roof is to be supported by trusses.

C. Dead and Live Loads.

1. The "use" for determination of live loads is left to the student. However, a minimum of two uses with different live loads shall be chosen (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.

D. Stairways and one elevator are to be provided.

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

F. Channel purlins shall support the roofing material. Purlins shall be spaced so as to fall at truss panel points.

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

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

- filler 30 plf
- girder 45 plf
- spandrel 45-55 plf