



## **COURSE OUTLINE SPRING 2009**

**CIV216**  
**Course Number**

**Highway Engineering**  
**Course Title**

**3**  
**Credits**

**2/2**  
**Lecture/Laboratory Hours**

### **COURSE DESCRIPTION**

Explores the planning, design, construction, and characteristics of highways and city streets, including layout, traffic requirements, safety and control, drainage, sub-grade structure, base courses, and surface pavements. Problems to be solved include geometric design, traffic volume, channelization, and hydrology. Lab projects involve roadway designing. Spring offering.

Text (s):     **Highway Engineering**  
                  By Oglebsy  
                  Publisher: Wiley & Sons, Latest Edition

Prerequisites: **ENT116**

Co-requisites: **CIV102, DRA190 or divisional permission.**

**Course Coordinator: John Santosuosso**

**Latest Review: 2009**

## **I. GENERAL OBJECTIVES**

Students will gain:

1. An understanding of highway terminology.
2. An understanding of the design requirements for roads and highways.
3. An understanding of the construction and inspection requirements of roads.
4. An understanding of safety, traffic analyses and vehicle abilities in the design of roads.
5. An understanding of drainage design for roads.
6. An understanding of the relationship between surveying, and highway design and layout.

## **II. SPECIFIC OBJECTIVES**

### **UNIT I (3 Weeks): INTRODUCTION; TERMINOLOGY; HIGHWAY PLANNING AND ECONOMY; PARKING**

1. List and describe the major areas of study and analysis for highway development.
2. List and describe the different types of governmental highway systems, and give real examples of each.
3. Discuss the Interstate Highway system.
4. List and describe the highway types.
5. List and describe several highway organizations and associations.
6. List and describe the various classes of data that must be compiled in highway planning.
7. List and describe the costs to be included in highway economy studies.
8. Compute motor vehicle operating costs to the highway user.
9. Describe the requirements for a small shopping center parking lot as to space dimensions and angles, driveway widths and turning radii.

### **UNIT II (3 Weeks): DRIVER, VEHICLE AND ROAD CHARACTERISTICS; HIGHWAY DESIGN**

1. Define “perception time” and “reaction time,” and give recommended design values.
2. List and differentiate between the four methods of estimating future traffic volumes.
3. Define and calculate service volumes of highways considering the effects of sight distance, obstructions, grades, land widths and commercial vehicles.
4. Using the “benefit cost ratio” method, determine if it is economically feasible to construct a particular highway alignment.
5. List the factors that reduce highway capacity.
6. Compute safe stopping and passing distances for level roadways and for vertical curves in crest or sag.
7. Compute super-elevation requirements for horizontal curves considering design speed, friction and radius in the calculations. Describe the meaning of “runout” as it applies to super-elevation of horizontal curves.
8. Compute stations and elevations along horizontal and vertical curves.
9. Sketch typical cross sections and profiles of highways.
10. List the values of typical lane widths, grades and design speeds.
11. Determine the minimum vertical curve length to provide safe stopping sight distance and safe passing sight distance.
12. Determine the appropriate speed degree of curvature and/or radius for horizontal curves.

### **UNIT III (1 Week): TRAFFIC ENGINEERING**

1. Describe various channelizing devices.
2. List and describe the general types of intersections at grade and grade separated, and list the advantages and disadvantages of each.
3. Draw a space-time diagram between two intersections given the traffic signal cycles.
4. Calculate the ideal distance between the intersections given the space-time diagram and the roadway design speed.
5. Calculate the ideal speed between two intersections given the distance and traffic signal cycles.
6. State the advantages and disadvantages of traffic signals.
7. Define traffic actuated and fixed time signals.
8. Describe the general contents of the "Manual of Uniform Traffic Control Devices."
9. List and describe the various types of traffic control devices.

### **UNIT IV (3 Weeks): HIGHWAY DRAINAGE**

1. Compute the water runoff from a drainage area, given the storm frequency, character and slope of ground surface using available charts and graphs and the "rational formula": i.e. ( $Q = Aci$ ).
2. Explain the meaning of each parameter in the "rational formula."
3. Design a circular pipe, trapezoidal culvert and rectangular culvert to efficiently carry a particular water flow, under free flow conditions, using available charts and graphs and the Manning Formula.
4. Analyze a given storm drain system for various flow parameters, such as velocity and flow using the Manning Formula.
5. Set-up in tabular form the necessary chart for completely analyzing or designing a simple storm drain system.
6. List and describe various drainage structures such as manholes, inlets, end-walls and headwalls.
7. Classify sub-critical and supercritical flow.

### **UNIT V (2 Weeks): HIGHWAY SUB-GRADES, BASE COURSES, AND SURFACE COURSES**

1. Sketch a cross section of a roadway including a description of "surface courses," "base course," "sub-base" and "sub-grade."
2. List and describe the soil characteristics which influence the quality of sub-grades under highway pavements.
3. Describe the different types of base courses.
4. Describe the correct procedures for constructing base courses.
5. Contrast and compare rigid and flexible pavements.
6. List and/or define the methods for the design of flexible pavements.
7. Design a flexible base pavement using the AASHO Method.
8. Compare and contrast "elastic," "consolidation" and "plastic" deformations as they apply to loadings of flexible pavements.

## UNIT VI (2 ½ Weeks): BITUMINOUS MATERIALS AND PRODUCTION PROCESSES

1. Explain the procedure for manufacture of “asphalt cements” and “rapid curing,” “slow curing,” “medium curing” and emulsified asphalt binders.
2. Compare and contrast the uses of the various materials listed in number (1).
3. List and define the various methods for testing the stability of bituminous concrete mixtures.
4. Explain the correct construction procedure for the spreading and compacting of bituminous concrete base and surface courses.
5. Explain the various steps in the preparation of bituminous concrete mixtures in a “batch type” plant.
6. Define the various types of surface treatments used to restore existing bituminous concrete and stone roads.
7. List the items that an inspector should look for at the site of bituminous concrete construction.

### III. REVIEW

**Time: 1/2 Week**

### IV. EVALUATION

2 Tests and a Final Examination will be given.

Objective questions (closed book), and analytical problems (open book) are given. Each test is approximately 2 hours in duration.

#### 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)).

### V. GRADE WEIGHT

2 Tests	35 - 40%
Final Examination	20 - 25%
Laboratory Projects, including written report and oral presentation	25 - 30%
Homework, attitude toward learning, class participation and interest, and attendance	10%
	<b>100%</b>

### VI. WRITTEN REPORT/ORAL PRESENTATION

A written report on a topic approved by the instructor will be required. Students will be expected to research library periodicals and textbooks. At least three sources must be included in the bibliography section of the report. An oral presentation of the report will be required.

## LECTURE SCHEDULE

### Week

- 1            **Introduction:**  
The field of highway engineering  
**Terminology:** Highway systems, types and organizations  
                         Parking lot requirements
- 2            **Highway Planning:**  
                 Road inventory  
                 Rural traffic surveys  
                 Urban travel studies  
                 Highway financing  
                 Vehicle ownership and use  
                 Special studies  
                 Traffic Forecasting
- 2, 3        **Highway Economy:**  
                 Terminology  
                 Cost of the highway user
- 4, 5, 6    **Driver, Vehicle and Road Characteristics:**  
                 Highway Capacity  
                 Highway Design  
                 Geometry of Roads  
                 Highway standards  
                 Design speeds  
                 Cross sections  
                 Profiles  
                 Sight distance  
                 Vertical curves  
                 Horizontal curves  
                 Channelization and Traffic Control Devices
- 7            **Traffic Engineering**
- 8,9,10    **Highway Drainage:**  
                 Hydrology  
                 Methods of runoff analysis  
                 Rational method of runoff analysis  
                 Design of drainage structures

## LECTURE SCHEDULE

### Week

- 11, 12     **Highway Sub-grades:**  
                    Design of flexible base pavements
- 12         **Base Course**
- 13         **Surface Courses**
- 14         **Bituminous Pavements:**  
                    Binder  
                    Aggregate
- 15         **Review**

### Laboratory

Laboratories will be used for design projects. Slides and films will be used for stimulating discussion of highway construction techniques. Guest lecturers might be invited to discuss specific topics.

### TWO MAJOR DESIGN PROJECTS WILL BE UNDERTAKEN

1.         **Parking Lot**

Layout of property lines, fencing, curb, aprons, ingress, and egress, parking stalls, details of curb, pavement, etc. Students may be expected to produce this drawing using SOFTDESK/AUTOCAD civil engineering and drafting computer techniques.

2.         **Highway Design**

The reconstruction and redesign of a major traffic artery requiring calculations for width of roadway, intersections, drainage, pavement, alignment and quantity estimates. A set of drawings will be prepared. Students may be expected to produce drawings using SOFTDESK/AUTOCAD civil engineering and computer drafting techniques.

### REFERENCES

1. Highway Engineering Handbook, K. Woods, McGraw Hill, 1st Edition
2. Traffic Engineers Handbook, H. Evans
3. Highway Engineering, Ritter & Paquette, Ronald Press
4. Route Surveying, C. F. Meyer, International Textbook Company
5. Data Book for Civil Engineers, E. E. Seelye, J. Wiley & Sons
6. Open Channel Hydraulics, V. T. Chow, McGraw Hill

7. A Policy of Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials (AASHTO) 1984
8. Principles of Pavement Design, E. Yoder, J. Wiley & Sons
9. Standard Specifications for Road and Bridge Construction, NJ State Department of Transportation (1989)
10. Highway Research Record: Before 1961 - Highway Research Board Bulletins; after 1961 - Highway Research Board Proceedings
11. Highway Research News
12. Highway Research Circular
13. Highway Research Board Special reports
14. Standard Specifications for Highway Bridges, 10th Edition, American Association of State Highway and Transportation Officials (T6310.A6)
15. Various State and Federal announcements and publications

### **Addresses of Highway Associations**

1. Highway Research Board  
2101 Constitution Avenue  
Washington, DC 20418
2. American Association of State Highway & Transportation Officials  
444 North Capitol Street, N. W.  
Suite 225  
Washington, DC 20001  
(202) 624-5800
3. The Asphalt Institute Building  
College Park, Maryland 20740

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### **Special Needs**

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 LB216, and she can be reached at (609) 570-3525.