

SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ON

COURSE OUTLINE

COURSE TITLE: HIGHWAY ENGINEERING

CODE NO: CIV316-4 SEMESTER: VI

PROGRAM: CIVIL ENGINEERING TECHNOLOGY

AUTHOR: VERDUN VENN

DATE: JANUARY 1994 PREVIOUS OUTLINE DATED:

APPROVED: _____
Dean, School of Engineering Tech.

Date

COURSE NAME: HIGHWAY ENGINEERING

CODE NO. CIV316-4

TOTAL CREDIT HOURS:

PREREQUISITE(S): SUR101-4
SUR235-5
SUR201-5

I. PHILOSOPHY/GOALS:

This course is a senior surveying course related to Highway Engineering. Previously taken courses in the Civil Technology program for the most part dealt with instrumentation, field notes and application to the measurement of lengths, columns, and areas. The present course continues the application of these skills at a senior level and directs them toward highway engineering.

A greater emphasis will be placed on design and control in both construction and highway engineering.

II. STUDENT PERFORMANCE OBJECTIVES:

Upon successful completion of this course the student will:

1. Give the characteristics and classification of roads in Ontario.
2. Recognize elements involved in functional design and drainage requirements of highways.
3. Calculate earth work quantities incorporating swell and shrinking factors and prepare and interpret mass-haul diagrams.
4. Interpret and establish design criteria for a road based on current municipal and provincial standards and conditions of use including cross sections, grades, curves and drainage.
5. Recognize the Universal Transmercator UTM projection grid as a basis for geographic information system data and convert data from other coordinates and geographic daterm systems.
6. Explain the need for vertical and horizontal controls in construction and highway work.
7. Discuss thickness design for flexible and rigid pavements.
8. Recognize the legal implications of surveying related to public lands and severance.

III. TOPICS TO BE COVERED:

1. General Review
2. Culvert and Bridge Construction
3. Control Surveys
4. Highway Curves
5. Earth Work Operations
6. Highway Construction Surveys
7. Intersections
8. Thickness and Design for Flexible and Rigid Pavements
9. Stabilization of Road Bases
10. Public Lands Survey

LEARNING ACTIVITIES

- 1.0 General Review
- 1.1 Bearings, Azimuths, Meridians, Grade Lines
- 2.0 Sewer Construction Surveys
Upon completion of this unit, the student will be able to:
 - 2.1 Set up off set grade stakes parallel to the planned direction of the sewer. Prepare a grade sheet showing stake to better board distances. Employ a grade rod to set sewer invert elevation.
 - 2.2 Prepare a plan and profile map of planned sewer to guide construction.
- 3.0 Culvert and Bridge Construction
Upon completion of this unit, the student will be able to:
 - 3.1 Interpret topographic plans as to the placement of culvert and determine the skew number.
 - 3.2 By means of off-set stakes set sewer pipe line and grade.
 - 3.3 Calculate and layout, using offset dimensions, abutments and piers.
 - 3.4 Verify the dimensions set out.
- 4.0 Construction Control Surveys
Upon completion of this unit, the student will be able to:
 - 4.1 Discuss the history of vertical controls from Clarke 1866, Nad 1927, Nad 1983 to G.P.S 1994.
 - 4.2 State the orders of accuracies and explain primary and secondary control.

REQUIRED RESOURCES

- Text - Instructors notes and handouts

- Text - Surveying With Construction Application Activities
Read and study chapter 10, Art 10.1, 10.2, 10.3 to Art 10.7 inclusive.
Complete teacher assigned problems.

- Text: Surveying With Construction Applications
Activities: read Chapter 10, p. 274, Art 10.1 to 10.7 inclusive.

- Text: Surveying with Construction Applications
Activities: Read Chapter 8, Art 8.1 to 8.3 inclusive.

- TEST

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LEARNING ACTIVITIES

5.0 Coordinate Grids

Upon completion of this unit, the student will be able to:

- 5.1 Explain the use of and plot points using latitudes and departures.
- 5.2 Explain and use the Universal Transmercator System.
- 5.3 Explain and apply elevation scale factors.
- 5.4 Explain convergence.
- 5.5 Describe Project Controls.
- 5.6 Explain the use of Global Positioning Systems

6.0 Highway Construction Surveys

Upon completion of this unit the student will be able to:

- 6.1 Explain the use of ties.
- 6.2 Describe the types of highways in use and how design is a criteria related to use.
- 6.3 Will be able to read sections and plans related to highway design.
- 6.4 Locate centre lines.
- 6.5 Be able to locate slope stakes from sections.
- 6.6 Will be able to explain and use of grade rods and ground rods to locate the toe of slopes.
- 6.7 Proceed with an "As Built" Survey.

RESOURCES REQUIRED

Read Chapter 8, Art 8.5 to 8.9 inclusive.
Problems as assigned by instructor.

Text: Surveying with Construction Applications

Activities: Study Chapter 13, Art 13.1 to 13.8

Hand outs and assigned problems from Instructor's file.

LEARNING ACTIVITIES

- 7.0 Highway Curves - Horizontal
Upon completion of this unit the student will be able to:
- 7.1 Employ circular curve geometry to calculate curve components, deflection angles, chords, beginning and end of curves.
- 7.2 Employ both degree curves and equal radius methods in metric calculation.
- 7.3 Describe the methods used to move up on a curve.
- 7.4 Employ offset stakes as required to avoid construction machinery.
- 7.5 Explain the Geometry of compound and Reversed curves and their application.
- 8.0 Highway Curves - Vertical
Upon completion of this unit, the student will be able to:
- 8.1 Employ the geometry of the parabola to calculate the components of vertical curves, both crest and sag.
- 8.2 Compute the high and low point on a curve.
- 8.3 Compute elevations on grade lines and offset distances to the curve.
- 8.4 Employ design criteria such as stop site distances and grade limits to ultra curve design.

REQUIRED RESOURCES

Text: Surveying with Construction Applications

Activities: Read Chapter 12, Art 12.1 to 12.10

Assigned Problems
12-1 to 12-10

Complete a Highway Alignment Survey

Read Chapter 12, Art 10.11

Text: Surveying with Construction Applications

Activities: Read Art 12.12 to 12.16 inclusive.

Assigned problems: 12.15, 16.17 inclusive.

A vertical curve design problem requiring drafting laboratory facilities will be assigned.

Test

LEARNING ACTIVITIES

- 9.0 Highway Curves - Spiral
Upon completion of this unit, the student will be able to:
- 9.1 Employ pertinent mathematical formula to derive the components of spiral curves.
- 9.2 Employ tables to determine the design of curves, given basic design criteria.
- 9.3 Calculate the elevations attendant to superelevations for the inside and outside of the curves.
- 10.0 Earth Work Operations
Upon completion of this unit, the student will be able to:
- 10.1 Complete cut and fill measurements.
- 10.2 Calculate volumes using the prismoid formula, average end area, Trapezoid formula, and Simpsons Rule.

REQUIRED RESOURCES

Text: Surveying with Construction Applications

Activities: Read 12.18 through 12.25.

Test

Text: Surveying with Construction Applications

Activities: Assigned problems from text 15.1 to 15.6 inclusive.

Read Chapter 15, Art 15.1 to 15.8.

Lab Assignment - cut and fill.

V. EVALUATION METHODS: (INCLUDES ASSIGNMENTS, ATTENDANCE REQUIREMENTS ETC.)

A final grade will be derived from the results of four teacher-assigned tests and assignments as follows:

Tests	60%
Assignments	40%
Total	100%

The grading system used will be as follows:

A	90% - 100%
B	80% - 89%
C	70% - 79%
I	Incomplete
R	Repeat
X	A temporary grade limited to situations with extenuating circumstances.

VI. REQUIRED STUDENT RESOURCES

Text: Surveying with Construction Applications by Barry F. Kavanagh: SV-Glenn Bird, Prentice Hall.

VII. ADDITIONAL RESOURCE MATERIALS AVAILABLE IN THE COLLEGE LIBRARY:

Book Section (title, publisher, edition, date, library call number if applicable - see attached example)

Periodical Section (Magazines, Articles)

Audiovisual Section (Videotape, Filmstrips, Transparencies)

VIII. SPECIAL NOTES

Students with special needs (eg. physical limitation, visual impairments, hearing impairments, learning disabilities) are encouraged to discuss required accommodations confidentially with the instructor.

Your instructor reserves the right to modify the course as he/she deems necessary to meet the needs of the students.

Several of the assignments will require drafting facilities and drafting equipment. Most of which, if not all, should have already been purchased by the student for previous engineering courses.

The last week of the course will involve field work, weather permitting.