COURSE OUTLINE

CIV 101	Surveying I
Course Number	**Course Title**
3	**2/3**
Credits	**Lecture/Laboratory Hours**

COURSE DESCRIPTION

Introduces the three basic surveying tools are introduced – the tape, level and transit/theodolite – along with proper field procedures for basic surveying which include taking field notes, taping and EDM, leveling, bearings and azimuths, topography, and mapping.

Text (s): **Reference Division Booklist**

Prerequisites:

Co-requisites: **MAT115 or MAT110 or approved equivalent;**
ENT116 or prior drafting experience

Course Coordinator: John Santosuosso **Latest Review: 2006**

I. METHOD OF PRESENTATION

A lecture-discussion approach is used and transparencies taken from the course text are used, as well as printed handouts made by the instructor. Class participation is emphasized by asking the students questions on their reading assignments, homework problems, or actual field experiences. Transparencies will also be used to review test problems.

II. EVALUATION

A test is given at the end of the first unit, second unit, third unit, and fourth unit. The length of the test is approximately one hour, and it will be either multiple choice, or problems (4-6) covering the material of the respective units(s).

A quiz of approximately five minutes in length will also be given every week. These quizzes will include the material covered in the homework and reading assignments. Homework assignments could be collected periodically and graded instead of giving a weekly quiz.

The laboratory grade will be based on the student's general attitude and participation as a member of his surveying team in the lab. He will also be graded on his lab projects, as well as his laboratory field book. Approximately one third of your lab grade is based on the final topographical mapping project. On occasion, there could be a final exam in the lab which would be brief (5-10 minutes) oral exam covering the principles involved in one or more of the lab experiments covered throughout the semester.

III. GRADING

(1) Quizzes (10%): [No make-ups.] Drop 20%

(2) Lab (30%): Field Book, Map, Attendance

(3) Tests (45%) - 3 Tests: Unit 1 (Taping-EDM)
Unit 2 (Leveling)
Unit 3 (Transit-Theodolite

[No make-ups.]

(4) Final Exam (15%) – If final is higher than lowest of three test grades, I will count double and I will drop your lowest test grade. It will include material from Unit 4 (Topography and Stadia-Mapping) as well as material from all previous units.

***Attendance** - 2% could be deducted from your final grade for every class that you miss.

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).

IV. REFERENCES

1. Surveying, Kissam - McGraw Hill Book Company
2. Surveying, Foote and Davis - McGraw Hill
3. Standard Handbook for Civil Engineers
4. Fundamentals of Surveying, Rayner and Schmidt - Van Nostrand Reinhold

V. GENERAL OBJECTIVES

1. To understand the use of three basic surveying tools: the tape, the level, and the transit (theodolite).
2. To apply geometric and trigonometric principles to basic surveying calculations.
3. To become efficient in keeping accurate, legible and complete notes in a well-prepared field book.
4. To understand field procedures in basic types of surveys, and the responsibilities of a surveying team.
5. To acquire an awareness of the limitations of the basic surveying instruments and the possible errors that could arise.
6. To apply drawing techniques in the development of a topographic map.

VI. SPECIFIC OBJECTIVES

UNIT I (3-1/2 weeks) INTRODUCTION, TAPING

1. The student should be able to define:
    a. Plane and geodetic surveys
    b. Types of surveys
    c. Sources of errors - natural, instrumental, personal
    d. Types of errors - systematic, accidental
    e. Direct and indirect measurements

2. The student should be able to perform the duties of a rear and head chairman in a field party.

    He will complete both versions of a taping problem in the field; that is, he will measure a line between two fixed points, and he will lay off a distance from one fixed point. If necessary, he will break chain to complete this problem.

3. He should be able to keep the necessary field notes which include five points.
    a. accuracy
    b. integrity
    c. legibility
    d. arrangement
    e. clarity

4. He will know the four types of notes that are kept in practice: sketches, tabulations, descriptions, and combinations.

5. He should be able to convert to inches, feet, or any other unit of measurement a surveyor may work with.

6. He will determine his pace and be able to pace distances to within a degree of error of 3% on level ground. He will use the surveyor's tape (100') and the necessary surveying accessories to complete this problem (plumb bobs, pins, range poles, surveyors, tacks, etc.).

VI. SPECIFIC OBJECTIVES (cont'd)

UNIT I (3-1/2 weeks) INTRODUCTION, TAPING

7. He should be able to calculate actual lengths of lines by making corrections for temperature, alignment, sag, length and pull, to recorded distances.

8. He will know that a surveying team (party or crew) is made up of normally two or more individuals, including a party chief. Each member is assigned to specific tasks, but each member must be aware of the job at hand and all of the team's responsibilities.

9. He will be aware of the Electronic Distance Measuring Devices (EDM) available to the surveyor and the advantages and disadvantages of the EDM equipment vs. a surveyor's tape.

UNIT II (3-1/2 weeks) LEVEL

1. The student will define basic terms required when leveling. These definitions include vertical line, level surface and level line, horizontal surface and horizontal line, datum, mean sea level, elevation, benchmark, turning point and vertical control.

2. He should know when to take into consideration the effect of the curvature of the earth and refraction of the sun's light rays using this formula; h = 0.574 M2 or h = .0206 F2.

3. He will know the four methods of determining differences in elevations. These are:
   a. by taping
   b. by a leveling instrument
   c. by a barometer
   d. indirectly by trigonometric leveling.

4. He will know how to operate the automatic type levels as well as the hand level.

5. He will be required to operate the Philadelphia Leveling Rod. He will know how to set the vernier (target) of the rod to 1,000th of a foot, and also how to set high rod.

6. The student should be able to perform the following types of leveling procedures: differential leveling, profile leveling, and borrow pit leveling.

7. He will use hand signals to communicate between personnel when extreme distances or noise from traffic make it impossible to communicate by voice or radio.

8. He should be able to adjust a simple level circuit which is within the allowable closure.

Allowable Closure Formula

C = K M — C = allowable closure in feet

K = .01 - 1st order
.035 - 2nd order
.05 - 3rd order

K = a constant (US coast & Geodetic Survey)

M = distance, in miles

UNIT III (4-1/2 wks) THEODOLITE & TOTAL STATION

1. In making measurements, he will keep in mind the relationship between angles and distances. He will know the three basic requirements in the determination of an angle: (1) the base or starting line, (2) the direction of turning, and (3) the angular distance.

   Examples: 1 minute of angular measurement in a sight distance of 300 feet = 1 inch of arc length.

2. He will operate the American transit and know that it has three main parts: (a) upper plate, (b) lower plate, and (c) leveling head.

3. He will read horizontal angles and vernier to the nearest minute and on some instruments to the nearest 20 seconds. He will be able to compute the least count of a vernier.

4. In addition, he will use the transit and theodolite to:
   a. layout corners of buildings (right angles)
   b. prolong a straight line (double center or principle of reversion)
   c. measure direct angles by repetition
   d. close the horizon (sum of angles are equal to 360 degrees)
   e. lay off an angle.

5. He will know how to prolong a straight line past an obstacle by one of four methods:
   a. equilateral-triangle method
   b. right-angle offset method (most common)
   c. measured offset method
   d. equal-angle method

6. He should be able to “balance in” or “wiggle in” a line between two points already established.

7. He will know the advantages and disadvantages of the American Transit compared to a theodolite.

8. He will measure vertical angles with the American Transit (plus angles--angle of elevation) (minus angles--angle of depression).

9. He should know how to compute the index error (if any) when turning vertical angles.

10. He should know that the theodolites measure the zenith angle (not the vertical angle).

11. The student will know some of the various sights and marks commonly used of plane surveys which include range poles, chaining pins, plumb bobs, tacks, targets, etc.

12. He will define:
    a. meridian
    b. geographic pole (true) (meridian)
    c. magnetic pole (magnetic meridian)
    d. bearing (magnetic and true)
    e. azimuth
    f. traverse (open and closed)
    g. deflection angles

UNIT III (4-1/2 wks) THEODOLITE & TOTAL STATION (cont'd)

13. He should be able to compute bearings or azimuths from a given closed or open traverse. (Vice-versa)

14. He should be able to use a compass (transit) to find the magnetic bearing of a particular line. He will also be aware of the other compasses available to the surveyor.

15. He will define:
    a. declination (magnetic)
    b. isogonic line
    c. agonic line

16. He will be able to use a chart of the distribution of magnetic declinations in the United States in the solution of surveying problems.

17. He will be aware of the variations in magnetic declination which include:
    a. secular change
    b. daily change
    c. annual change
    d. irregular changes

    however, that the most important change is secular (obtained by charts and tables).

18. The student will solve typical problems in compass surveys that require the conversion
    a. true bearings to magnetic bearings
    b. magnetic bearings to true bearings
    c. magnetic bearings to magnetic bearings

    for the declinations at different dates.

UNIT IV (3-1/2 weeks) TOPOGRAPHY

1. The student will define stadia and see that it was a rapid and efficient way to measure distances (horizontal and vertical). However, it is eventually going to be eliminated because of the use of the total-station theodolite and data collectors.

2. He will use the transit and level rod and obtain measurements by stadia for horizontal and inclined sights.

3. He will also define:
    a. stadia interval factor ($\frac{f}{i} = 100$)
    b. stadia constant C = 0 or 1
    c. h_i = (distance from ground to center of instrument)
    d. Rod intercept (R)

4. He will solve for the horizontal distances and vertical distances in stadia by the following formulas:
    a. Horizontal Sight $H = R\left(\frac{f}{i}\right) + C$ (12 - 1)
    b. Inclined Sights (1) $H = KR - KR \sin + C$
       (2) $V = KR \sin \cos + C \sin$

UNIT IV (3-1/2 weeks) TOPOGRAPHY (cont'd)

5. He should know that there is special stadia equipment that may be used to facilitate computations and obtaining data (Beaman Arc, Cox Stadia Computer, Stadia Rods, and Allidades).

6. The student will draw a topographic map and know that it is a scaled representation, obtained by means of conventional methods, of a portion of the earth's surface, showing the culture, relief, hydrography, and perhaps vegetation.

7. He should know that the first requirement of any topographic survey is both horizontal and vertical control.

8. He will be told seven methods of locating points in the field (section 16-4). The method of one angle and adjacent distance will be used exclusively in the location of topo details for the topographic map.

9. He will define:
    a. contour
    b. contour interval
    c. characteristics of contours that are fundamental in their location and plotting (section 16-7).

10. He should know that there are six methods of obtaining topography:
    a. radiation method
    b. stadia method
    c. plane table
    d. coordinate squares (grid)
    e. offsets from a center line
    f. photogrammetry

    He will cover in detail two methods--coordinate squares and transit stadia.

11. Topographic maps will be drawn by the coordinate square and stadia-method.

12. He will use his drawing techniques and obtain additional techniques (interpolation, plotting a traverse, (topographic symbols--Chapter 17) so that he can finally draw a detailed topographic map for a portion of the MCCC campus.

****

WEEKLY LAB SCHEDULE

Week	
1	Introduction to taping (and pacing)
2	Breaking Chain (traverse)
3	Demonstration of EDM.
4-7	Introduction to Leveling
	Differential Leveling (1 to 1 1/2 weeks)
	Profile Leveling (sewer line)
	Laser Leveling
8-11	Introduction to theodolite & transit (Right angles and double centering)
	Transit traverse (Double Direct Angles)
	Vertical Angles (heights of TV tower)
12-15	Introduction to radial traverse for Topographic Map (MCCC)
	Map Data (1 1/2 weeks)
	Topographic Map (MCCC)