

Department of Civil and Environmental Engineering

CE 200 - Surveying

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**Instructor:** Dr. Laramie Potts

**Contact:** email [lpotts@njit.edu](mailto:lpotts@njit.edu)

**Office Hours in 2510 GITC:** Wednesday 2:00 – 5:00 pm

**Classroom:** GITC 1400 on Friday 6:00 pm – 9:05 pm

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**Course Description:**

This course will introduce the fundamentals of surveying measurements to provide a broad overview of the surveying instrumentation (Total Station, Digital Level), procedures, measurement corrections and reductions, survey datums, and computations that are required to produce a topographical map or a site plan for engineering and design projects. This course covers three main themes: 1) terrestrial-based survey measurements, 2) space-based positioning (Global Positioning System (GPS)) and surveying (Remote Sensing) techniques, and automated mapping with Geographic Information Systems (GIS)

Fundamentals of terrestrial surveying measurements include leveling, distances, and angle measurements to compute Orthometric heights relative to a vertical survey datum and 2-D Cartesian coordinates in a horizontal survey datum for engineering projects. Topics on photogrammetry include photography scale, and coordinate computation of features in imagery. Basic elements of map design and production methods are introduced.

Basic concepts on space-based positioning include GPS components and measurements and Remote Sensing technologies for surveying. Concepts on measurement corrections and data reductions for 3-D coordinate computations with respect to a global geodetic reference frame to solve surveying problems encountered in construction, earthworks, and environmental engineering. Simple concepts on Geographic Information System (GIS) database design and data integration are introduced for a perspective on a useful tool for rapid geospatial mapping and data queries.

**Course Format:** This course is taught as Hybrid (self-paced) learning. Half of the lectures (Dates on course syllabus indicated in red) will be in-class (face-o-face) interaction and the other half of the time is set aside for exploratory learning aided by videos and websites (dates in blue). It is imperative that students attend the face-to-face classes where numerous examples and class exercises will solidify concepts learned.

**Prerequisites:** Math 111 - Calculus I

**Co requisite:** CE 200A–Surveying Laboratory

**Textbook(s)/Materials:**

**A:** *An Introduction to Geomatics*, 14<sup>th</sup> Edition, by Charles D. Ghilani & Paul R. Wolf, Pearson Prentice Hall, Inc., 2012, ISBN-13 978-0-13-255434-3

**B:** Study Guide provided by instructor – Access via Moodle

**Supplemental Text:** (not required to be purchased)

- a) **Route Location and Design**, 5<sup>th</sup> Ed. McGraw Hill Book Co.
- b) **Surveying with Construction Applications**, 3<sup>rd</sup> Edition, Prentice Hall 1997.
- c) ASSHTO “**A Policy on Geometric Design of Highways and Streets**” 2004 Edition.

**Objectives:**

1. Develop an understanding of the basic principles of surveying including the Traditional measurements and representations as well as such modern techniques as Global positioning.
2. Integrate CAD techniques and tools into the application of basic surveying principles.
3. Gain an appreciation for the importance of the survey database in all phases of a project.

**Topics:**

- Introduction to surveying and field notes
- Theory of measurements and errors
- Distance measurements with tapes and EDM
- Leveling, Leveling procedures and computations
- Angular Measurements: Bearings and Azimuths
- Traverse computations
- Coordinate computations
- Earthworks: Areas and Volumes
- Topographic surveys and mapping
- Horizontal and Vertical Curves
- Construction surveys
- State Plane Coordinate Systems
- Introduction to Remote Sensing - Photogrammetry
- Global Positioning Systems
- Introduction to Geographic Information Systems
- Hydrographic surveys

**Schedule:** Lecture/Recitation- 3 hour class face-to-face sessions as scheduled and Web-enhanced for self-paced learning.

**Professional Component:** Engineering Topics

**Prepared By:** Dr Laramie Potts

**Date:** 12/2/2015

**Course Outline (Hybrid)**

**Spring 2016**

Week	Date	Homework Due	Reading/ Activity	Topics
1.	22-Jan		A: 1 -2 B: 1 B: 2	<p><b>Introduction</b></p> <ul style="list-style-type: none"> <li>• Introduction to Surveying</li> <li>• Math Review</li> </ul> <p><b>Measurements &amp; Errors</b></p> <ul style="list-style-type: none"> <li>• Theory of Errors</li> <li>• Corrections &amp; Calibration</li> <li>• Review of Statistics for Surveying Data</li> </ul> <p><a href="#">Surveying &amp; Measurements (Video)</a>                      Overview of Statistical Concepts                      Measurement Correction &amp; Instrument Calibration                      Electronic Distance Measuring Instrument  <a href="#">Concepts on Heighting (Video)</a>                      Introduction to Height determination                      Differential Leveling                      Trigonometric Leveling</p>
2.	29-Jan	ASGN #1	A:3 B:3	<p><b>Height/Elevation</b></p> <ul style="list-style-type: none"> <li>• Orthometric Height</li> <li>• Leveling Computations &amp; Adjustments</li> <li>• Profiles</li> </ul>
3.	5-Feb	ASGN #2	A: 4- 7 B: 4 <i>Quiz 1</i>	<p><a href="#">Geodetic Datums &amp; Coordinate Geometry (Video)</a>                      Geodetic Surfaces                      Geodetic Datums and Coordinate Systems                      Basics of Map Projections for Surveying and Mapping                      Computations in Rectangular Coordinates</p>
4.	12-Feb	ASGN #3	A: 10.1-10.7	<p><b>Surveying Measurements</b></p> <ul style="list-style-type: none"> <li>• Distance Measurements and Corrections</li> <li>• Angles, Azimuth &amp; Bearings</li> </ul> <p><b>Surveying Coordinate System</b></p> <ul style="list-style-type: none"> <li>• Geodetic Surfaces and Datums</li> <li>• Computation of Departures and Latitude</li> <li>• Coordinate Computations</li> </ul>
5.	19-Feb	ASGN #4	A: 11 B: 5-6 <i>Quiz 2</i>	<p><a href="#">Traverse (Video)</a>                      Geodetic Control for Mapping                      Traverse Adjustment</p>
6.	26-Feb	<b>Exam I - (covering material from Lectures 1-4)</b>		<p><b>Survey Control</b></p> <ul style="list-style-type: none"> <li>• Traverse Adjustment Computation</li> <li>• Triangulation (Intersection &amp; Resection)</li> </ul>
7.	4-Mar	ASGN #5	A: 24 A: 25	<p><a href="#">Horizontal Curves (Video)</a>                      Geometry and Formulae                      Examples of Curve Layout  <a href="#">Vertical Curves (Video)</a>                      Geometry and Formulae                      Examples of Curve Layout</p>

8.	11-Mar		A: 24 B: 8  A: 25 B: 9	<u>Horizontal Curves</u> <ul style="list-style-type: none"> <li>• Review of Geometry and Formulae</li> <li>• Application and Examples</li> <li>• Practice problems on curve layout</li> </ul> <u>Vertical Curves</u> <ul style="list-style-type: none"> <li>• Overview of Geometry and Formulae</li> <li>• Practice problems on curve layout</li> </ul>
9.	18-Mar	SPRING RECESS		
10.	25-Mar (No Class)	ASGN #6	A: 13 A: 14 A: 15 B: 12	<a href="#">Global Positioning System (GPS)</a> Introduction to GPS (Web) Operation & Systems (Video) GPS measurements (Video)
11.	1-Apr	ASGN #7		<b>Exam II (Material from Lectures 5 - 8)</b> <u>Surveying with GPS</u> <ul style="list-style-type: none"> <li>• Theory of GPS</li> <li>• Orbit, Signals &amp; Observations</li> </ul>
12.	8-Apr			<u>Surveying with GPS (Cont)</u> <ul style="list-style-type: none"> <li>• Signals &amp; Observations</li> <li>• Numerical Examples</li> </ul> <a href="#">Photogrammetry (Video)</a> <ul style="list-style-type: none"> <li>• Introduction to Remote Sensing</li> <li>• EM Spectrum and its Properties</li> </ul> <u>Surveying from Imagery</u> <ul style="list-style-type: none"> <li>• Principles of Photogrammetry</li> <li>• Aerial Imaging Systems and Data Acquisition</li> <li>• Photogrammetric Data Processing</li> </ul>
13.	15-Apr	ASGN #8	Quiz 3  A: 28 B: 13	<a href="#">Geographic Information System (GIS) (Video)</a> GIS theory Applications to Engineering, Construction, and Mapping <a href="#">Mapping and Products (Moodle)</a> Engineering & Topographic Surveys Integrated Geospatial Products & Systems <a href="#">Earthworks (Video)</a> Area & Volume Computations, Contours, and Gradients
14.	22-Apr	ASGN #9	A: 18, B: 14  A: 12, A: 26, A: 18	<u>Geographic Information System (GIS)</u> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Data Structures &amp; Format</li> <li>• Examples and Problems</li> <li>• Geospatial database</li> </ul>
15.	29-Apr	ASGN #10	B: 11 B: 15	<u>Construction Surveys</u> <ul style="list-style-type: none"> <li>• Equipment &amp; Measurements</li> <li>• Construction Surveying Procedures</li> </ul>
16.	3 May		Quiz 4	<u>Terrestrial Mobile and Space-based Mapping</u> <ul style="list-style-type: none"> <li>• Technology &amp; Data Processing software</li> <li>• Mapping Applications in Engineering and Construction</li> <li>• Final Review</li> </ul>
<b>Final Exam (see Registrar Homepage for schedule details)</b>				

## Course Objectives:

By the end of the course you should be able to do the following:

- **Orthometric Heights:** Be able to perform a basic leveling field survey to accurately establish heights for control points in the NAVD88 Datum. Be able to use survey data to compute adjusted elevations for the control points and determine relative precision estimates.
- **Elementary Surveying Computations:** Understand and know how to apply data corrections and reductions from TSI distance and angle measurements. Be able to apply basic trigonometric formulae to compute planar coordinates of survey control points by traverse, intersection, and resection methods. Understand and know how to apply Federal Geodetic Control Commission accuracy standard and survey procedures. Know how to apply formulas for setting out horizontal and vertical curves (i.e., railroads, highways, etc.).
- **Space-based Surveying Technology:** Understand the orbital attributes (and characteristics) and signal structure of GPS technology for point positioning. Understand and know how to compute geodetic coordinates from GPS pseudorange measurements. Understand the geometric and radiometric characteristics of remotely sensed imagery for surveying-based solutions to environmental engineering problems. Be able to generate a digital topographical map using terrestrial and space-based surveying technologies.

## Additional Information:

1. ***Materials Required*** -- Calculator, Engineering Computation Pad.

2. ***Homework*** is due the following class. Late homework will not be accepted. Handout problems may be assigned or substituted. Homework is to be neat and orderly. All calculations of homework problems are to be in an orderly fashion and submitted on [engineering computation pad](#). You are to show all calculations. You are to use one side of a paper and if you need multiple sheets they need to be numbered and stapled. **Note: Sloppy, untidy, or dog-eared submissions will not be accepted.** All written assignments shall be typed (or neat hand writing) and if more than one sheet is necessary they are to be numbered and stapled. *80% of the completed homework should be turned in for a grade otherwise an incomplete "I" grade will be assigned as the final grade for the course.*

The assignment sheet with your name written clearly should be the first page on your homework pages. Homework is to be handed on letter size 8 1/2 x 11 paper, any other sizes will not be accepted. Neatness will be taken into consideration. Homework will be graded as a number from 1 to 10. A '10' will assigned for exceptionable work.

3. You must ***be signed up*** for both the lab classes and lecture classes.

4. Unexcused ***absences*** from more than three classes will result in a grade of F. Being late will count as an absence. Coming to class more than five minutes after the assigned time will be considered late.
5. The NJIT ***Honor Code*** will be upheld, any violations will be brought to the immediate attention of the Dean of Students.
6. The students will be informed of any ***changes to syllabus*** at least one week in advance.
7. To schedule consultation ***outside office hours***, send request via email

8. **Grading**

- Homework..... 15% (due dates are indicated on syllabus)
- Quizzes.....15%
- Exam I .....20%
- Exam II.....20%
- Final.....30%

Final Score Assignment

D=	50-56	points
C=	57-62	points
C+=	63-69	points
B =	70-76	points
B+ =	77-84	points
A >	85	points