Department of Civil and Environmental Engineering

CE 200 – Surveying Fall 2017

Instructor: **Dr. Laramie Potts** **Contact:** email lpotts@njit.edu

Office Hours in 2510 GITC: Monday 4:00 – 5:30 pm

Classroom: CULM LEC 2 (Mondays: 2:30 pm – 3:55 pm)

Course Description:

This course will introduced 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 Required:

A: *An Introduction to Geomatics*, 13th 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,** 5th Ed. McGraw Hill Book Co.
b) **Surveying with Construction Applications**, 3rd 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 EDMI
- 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
- Photogrammetry & Remote Sensing
- 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 V. Potts **Date:** 8/06/2017

Course Outline Fall 2017

Week & In-Class Date	Lecture Topic	Reading	Assignment Due in Moodle (Sunday 11 pm)
1 9/11	**Introduction** (Video) • Introduction to Surveying • Modern Spatial Data Collection & Field Notes • Math Review	Chp 1 -2	
2 9/18	**Measurement Errors** (Video) • Surveying Measurements (Terrestrial, Airborne, Space-based) • Theory of Errors	Chp 3	Assign #1
3 9/25	*Quiz 1* **Leveling** (Video) • Introduction to Leveling • Leveling Procedures • Leveling Computations & Adjustments • Profiles	Chp 4-5	Assign #2
4 10/02	**Survey Measurements** (Video) • Principles of Electronic Distance Measurement • Measurement Corrections & Calibration • Optical Measurement - Corrections & Calibration Angles, Azimuth & Bearings	Chp 6 Part III Chp 7	Assign #3
5 10/09	*Quiz 2* **Coordinate Geometry** (Video) • Departures and Latitude • Computations in Rectangular Coordinates	Chp 11	Assign #4
6 10/16	**Geodetic Control** • Traversing (Video) • Traverse Adjustment	Chp 9 & Chp. 10	
7 10/23	**Geodetic Control (contd)** • Intersection • Resection Midterm I: (covering material from Lectures 1-4)		Midterm I
8 10/30	**Horizontal Curves** (Video) • Geometry and Formulae • Curve Layout	Chp 24	Assign #5 Due: 10/28
9 11/06	*Quiz 3* **Vertical Curves** • Geometry and Formulae (Video) • Curve Layout	Chp. 25	Assign #6 Due: 11/07
10 11/13	**Global Positioning System (GPS)** Introduction to GPS (Video) • Theory of GPS (Orbit, Signals, Observations) • Surveying with GPS	Chp 13 Chp 14	
10 11/27	Exam II (covering material from Lecture 5-8)		Midterm II

11 11/21	*Quiz 4* **Elements of Aerial Mapping** • **EMR – and Properties** • **Aerial Optical Imaging Systems and Data Acquisition** • **Elements of Integrated Geospatial Mapping Systems**	Chp 27	Assign #7
12 11/28	**Geographic Information System (GIS) (Video)** • **GIS theory** • **Data models** • **GIS operations**	Chp 28	Assign #8
13 11/30	• **Geodatabase for GIS** • Fundamentals of Geodatabase Design • Applications to Civil & Environmental Engineering		Assign #9
14 12/04	*Quiz 5* **Mapping &Earthworks (Video)** • **Engineering Surveying – Area & Volume Computations** • **Topographical Surveys** **Contours and Gradients**	Chp 16	Assign # 10
15 12/11	**Mapping &Earthworks (Video)** • **Engineering Surveying – Area & Volume Computations** • **Topographical Surveys** • **Contours and Gradients** **Construction Surveys (Moodle)** • **Equipment** • **Construction Surveying Procedures** • **Course Review**	Chp.23 Handout	
16 12/14	**Final Exams (covering material from Lecture 9-15)**		**Final Exam**

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 Geospatial Mapping 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. ***Grading***

- Homework..... 15% (due dates as shown on syllabus)
- Quizzes……..15%
- Exam I …..... 20%
- Exam II……..20%
- Final..... 30%

3. ***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 to 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.*

Your name, class number, and date are to be on homework pages. Homework is to be handed on letter size 81/2 x 11 paper, any other sizes will not be accepted. Neatness will be taken into consideration. The grades for the homework will be a 'check' to indicate that it was handed in. A 'check plus' will be for exceptionable work and a 'check minus' for unsatisfactory work or no credit if it was not done in accordance with the problem assigned.

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

5. 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.

6. The NJIT *Honor Code* will be upheld, any violations will be brought to the immediate attention of the Dean of Students.

7. The students will be informed of any ***changes to syllabus*** at least one week in advance.

8. To schedule consultation ***outside office hours***, send a request via email

Department of Civil and Environmental Engineering
CE 200 - Surveying

Description:

Students study the principles of angle and distance measurement; leveling; topographic mapping; traverse and area computations; horizontal and vertical curves; cross sections; triangulation; state plane coordinates; global positioning system. Emphasis is on the use of the computer for solving typical field and office problems.

Prerequisites: Math 111 - Calculus I Co requisite: CE 200A–Surveying Laboratory

Textbook(s)/Materials Required:

Wolf-Ghilani, Elementary Surveying, An Introduction to Geomatics, Prentice Hall, 10th Edition

Objectives:

4. **Develop an understanding of the basic principles of surveying including the Traditional measurements and representations as well as such modern techniques as Global positioning.**
5. **Integrate CAD techniques and tools into the application of basic surveying principles.**
6. **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 EDMI
Leveling, Leveling procedures and computations
Angular Measurements
Bearings and Azimuths
Traverse computations
Coordinate computations
Areas and Volumes
Topographic surveys and mapping
Horizontal and Vertical Curves
Construction surveys
State Plane Coordinate Systems
Photogrammetry
Global Positioning Systems
Introduction to Geographic Information Systems
Hydrographic surveys

Schedule: Lecture/Recitation- 1-1/2 hour class, twice per week.
Laboratory- none (see co requisite, CE200A)

Professional Component: Engineering Topics

Program Objectives Addressed: 1

Prepared By: Prof. Greenfeld Date: 10/23/06

Course Objectives Matrix - CE 200 Surveying

Strategies and Actions	Student Learning Outcomes	Outcomes (a-k)	Prog. Object.	Assessment Methods/Metrics
Course Objective 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.				
Introduce the theory of measurements and related errors.	Learn the geometric aspects of surveying and basic statistical tools to understand errors and how to account for them.	a, k	1, 2	Homework, quizzes and exams.
Examine aspects of Geographic Information System (GIS) and Global Positioning System (GPS).	Understand the basic concepts of positioning with GPS and mapping with GIS.	a, j, k	1, 2	Homework, quizzes and exams.
Discuss surveying theory as applied to engineering projects.	Learn about the applications of surveying in site planning and construction.	a, c, h	1, 2	Homework, quizzes and exams.
Course Objective 2: Integrate CAD techniques and tools into the application of basic surveying principles.				
Introduce the theory of mapping and CAD.	Learn the elements of mapping and how to perform them with CAD.	a, k	1, 2	Homework, labs, quizzes and exams.
Demonstrate surveying equipment and its proper use.	Knowledge of the mechanical and electronic make-up of surveying equipment.	k	1	Homework, quizzes and exams.
Use Geographic Information System (GIS) as a mapping tool.	Recognize the difference between CAD and GIS.	a, j, k	2	Homework, quizzes and exams.
Course Objective 3: Gain an appreciation for the importance of the survey database in all phases of a project.				
Introduce the control network as a basis for mapping.	Understand the requirements and design of control surveys.	a, c, k	1	Homework, labs, quizzes and exams.
Practice computations associated with route and construction surveys.	Become familiar with stationing, cross-section, area and volume computations.	k	1	Homework, labs quizzes and exams.

Combine mapping with CAD.	**Learn how to convert field notes into a CAD map.**	**a, j, k**	**1, 2**	**Mapping project, quizzes and exams.**

CEE Mission, Program Objectives and Program Outcomes
The mission of the Department of Civil and Environmental Engineering is:

- **to educate a diverse student body to be employed in the engineering profession**
- **to encourage research and scholarship among our faculty and students**
- **to promote service to the engineering profession and society**

Our program objectives are reflected in the achievements of our recent alumni.

<u>1 – Engineering Practice:</u> Recent alumni will successfully engage in the practice of civil engineering within industry, government, and private practice, working in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.

<u>2 – Professional Growth:</u> Recent alumni will advance their skills through professional growth and development activities such as graduate study in engineering, professional registration, and continuing education; some graduates will transition into other professional fields such as business and law through further education.

<u>3 – Service:</u> Recent alumni will perform service to society and the engineering profession through membership and participation in professional societies, government, civic organizations, and humanitarian endeavors.

Our program outcomes are what students are expected to know and be able to do by the time of their graduation:
(a) ability to apply knowledge of math, science, and engineering
(b) ability to design and conduct experiments, as well as interpret data
(c) ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of ethical and professional responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) ability to use techniques, skills and modern engineering tools necessary for engineering practice

Revised 8/28/13