JOHN A. REIF, JR. DEPARTMENT OF
CIVIL AND ENVIRONMENTAL ENGINEERING

NJIT New Jersey Institute of Technology

CE 200 - Surveying - Spring 2018

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

Office Hours in 2510 GITC: Monday 3:30 – 5:30 pm; or by appointment (Thursday 2-4 pm)

Classroom: GITC 1400 (Friday: 2:30 pm –5:25 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:

A: *An Introduction to Geomatics*, 15th Edition, by Charles D. Ghilani & Paul R. Wolf, Pearson Prentice Hall, Inc

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
- Introduction to Remote Sensing - Photogrammetry
- Global Positioning Systems
- Introduction to Geographic Information Systems

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

Course Outline (Hybrid) **Spring 2018**

Week	Date	Homework Due	Reading/ Activity	Topics
1.	**19-Jan**	Review V1 Review V2	Chp 1 -2 Chp 3	**Introduction** • **Introduction to Surveying** • **Math Review** • **Geodetic Datums and Coordinate Systems** • **Principles of Geospatial Mapping** **Measurements & Errors** • **Theory of Errors** • **Corrections & Calibration** • **Review of Statistics for Surveying Data** **Surveying & Measurements (Video - V3)** Overview of Statistical Concepts Measurement Correction & Instrument Calibration Electronic Distance Measuring Instrument

2.	**26-Jan**	**ASGN #1** Review V3	Chp 4-5	**Concepts on Heights (Video – V3)** Introduction to Height determination Differential Leveling **Height/Elevation** • **Orthometric Height** • **Differential leveling** • **Leveling Computations & Adjustments** • **Trigonometric leveling** • **Profiles**
3.	**2-Feb**	**ASGN #2** Review V4	Chp 11 ***Quiz 1***	**Surveying Measurements (Video – V4)** • Distance Measurements & Corrections • Angles, Azimuth & Bearings • Equipment Calibration **Geodetic Datums & Coordinate Geometry (Video – V5)** Basics of Map Projections for Surveying and Mapping Computations in Rectangular Coordinates
4.	**9-Feb**	**ASGN #3** Review V5	Chp 6 Part III Chp 7	**Surveying Measurements** • **Distance Measurements and Corrections** • **Angles, Azimuth & Bearings** **Surveying Coordinate System** • **Geodetic Surfaces and Datums** • **Computation of Departures and Latitude** • **Coordinate Computations**
5.	**16-Feb**	**ASGN #4** Review V6	Chp 9 & Chp. 10	**Traverse (Video – V6)** Geodetic Control for Mapping Traverse Adjustment
6.	**23-Feb**	**In class Exam I - (covering material from Lectures 1-4)** Review V7		**Survey Control** • **Traverse Adjustment Computation** • **Triangulation (Intersection & Resection)**
7.	**2-Mar**	**ASGN #5** Review V8	chp 24 chp 25 ***Quiz 2***	**Horizontal Curves (Video - V7)** Geometry and Formulae Examples of Curve Layout **Vertical Curves (Video –V8)** Geometry and Formulae Examples of Curve Layout
8.	**9-Mar**	**ASGN #6** Review V9		**Horizontal Curves** • **Review of Geometry and Formulae** • **Application and Examples** • **Practice problems on curve layout** **Vertical Curves** • **Overview of Geometry and Formulae** • **Practice problems on curve layout**
9.	**16-Mar**	**SPRING RECESS**		
10.	**23-Mar**	**ASGN #7**	chp: 13-15	**Global Positioning System (GPS)** Introduction to GPS **(Web)** GPS Operation, Systems & Measurements **(Video – V9)**

11.	30-Mar	Exam II (Material from Lectures 5 - 8)		**Surveying with GPS** • Theory of GPS • Orbit, Signals & Observations
12.	6-Apr	ASGN #8		**Surveying with GPS (Cont)** • Signals & Observations • Numerical Examples **Photogrammetry (Web)** • Introduction to Remote Sensing **Surveying from Imagery** • Principles of Photogrammetry • Aerial Imaging Systems and Data Acquisition • Photogrammetric Data Processing
13.	13-Apr	ASGN #9 Review V10	*Quiz 3* chp 28	Geographic Information System (GIS) (Video – V10) GIS theory Applications to Engineering, Construction, and Mapping Earthworks (Video) Area & Volume Computations, Contours, and Gradients
14.	20-Apr	ASGN #10		**Geographic Information System (GIS)** • Introduction • Data Structures & Format • Examples and Problems • Geospatial database
15.	27 Apr		*Quiz 4*	Construction Surveys (Video) Equipment & Measurements Construction Surveying Procedures • Technology & Data Processing software • Applications in Engineering & Construction • Final Review
		Final Exam (see Registrar Homepage for schedule details)		

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. ***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. Submit work home and assignments via Moodle as one complete (word or pdf) document (not multiple documents in a zip file). **Note: Sloppy and untidy 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.*

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 81/2 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 score of '10' will assigned for exceptionable work. . *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 and the date are to be on all homework pages.

3. ***Reviews of Learning Object (Videos)*** is due the following class. View the learning object in your web browser (e.g., Internet Explorer) automatically. Your review will have four parts:

a) What is the video about?
b) List three main ideas covered in the Video
c) How does the topic apply to your major (Architecture, Civil Eng., Constr. Eng., etc)

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 request via email

9. Grading

- Homework..... ..10% (due dates are indicated on syllabus)
- Quizzes……10%
- Video Reviews …10%
- 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

CE 200 - Surveying - Spring 2018

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:

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.
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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

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

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Outcomes Course Matrix – CE 200 Surveying

Strategies, Actions and Assignments	ABET Student Outcomes (1-7)	Program Educational Objectives	Assessment Measures
Student Learning Outcome 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.	1	1, 2	Homework, quizzes and exams
Examine aspects of Geographic Information System (GIS) and Global Positioning System (GPS).	7	1, 2	Homework, quizzes and exams
Discuss surveying theory as applied to engineering projects.	1, 2	1, 2	Homework, quizzes and exams
Student Learning Outcome 2: Integrate CAD techniques and tools into the application of basic surveying principles.			
Introduce the theory of mapping and CAD.	1, 7	1, 2	Homework, labs, quizzes and exams
Demonstrate surveying equipment and its proper use.	7	1	Homework, labs, quizzes and exams
Use Geographic Information System (GIS) as a mapping tool.	1, 2, 7	2	Homework, quizzes and exams
Student Learning Outcome 3: Apply the survey database to phases of project control.			
Introduce the control network as a basis for mapping.	1	1	Homework, labs, quizzes and exams.
Practice computations associated with route and construction surveys.	1	1	Homework, labs, quizzes and exams.
Combine mapping with CAD.	7	1, 2	Mapping project, quizzes and exams.

CEE Mission, Program Educational Objectives and Student 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 educational objectives are reflected in the achievements of our recent alumni:

1 – Engineering Practice: Alumni will successfully engage in the practice of civil engineering within industry, government, and private practice, working toward sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.

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

3 – Service: Alumni will perform service to society and the engineering profession through membership and participation in professional societies, government, educational institutions, civic organizations, charitable giving and other humanitarian endeavors.

Our Student Outcomes are what students are expected to know and be able to do by the time of their graduation:

1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Revised: 2/13/18