Fall 2018

CE 200-101: Surveying

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CIVIL AND ENVIRONMENTAL ENGINEERING

NJIT New Jersey Institute of Technology

CE 200 - Surveying **Fall 2018**
Section: 101

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Office Hours: email for appointment
Classroom: Kupfrian Hall 116 (Thursday 6:00 pm - 9:00 pm)

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 a lecture class, which will be in-class (face-o-face) interaction. It is imperative that students attend the face-to-face classes where numerous examples and class exercises will solidify the concepts to be learned.

Prerequisites: MATH 111 or ENGR 101.

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

Professional Component: Engineering Topics

Prepared By: Allison Lapatka, PE, PLS

Schedule:

Class	Topics	Assignment Due	Text
1	**Introduction** • Introduction to Surveying • Math Review **Measurements & Errors** • Theory of Errors • Corrections & Calibration • Review of Statistics for Surveying Data • Overview of Statistical Concepts • Measurement Correction & Instrument Calibration • Electronic Distance Measuring Instrument		Chapters 1 – 3
2	**Geodetic Datums** • Geodetic Surfaces • Geodetic Datums & Coordinate Systems • Basics of Map Projections for Surveying & Mapping **Height/Elevation** • Introduction to Height determination • Orthometric Height • Differential Leveling • Trigonometric Leveling • Leveling Computations & Adjustments • Profiles **Distance Measurement** • Distance Measurements & Corrections • Distance Measurements by Taping • Electronic Distance Measurements	Assignment #1	Chapters 4 - 6
3	**Angle Measurement** • Angles, Azimuth & Bearings • Total Stations & Angle Observation • Geodetic Control For Mapping	Assignment #2	Chapters 7 - 8
4	**Exam 1**	Assignment #3	
5	**Angle Measurement** • Traverse Adjustment Computation • Computation of Departures and Latitudes • Coordinate Computations • Triangulation (Intersection & Resection)	Assignment #4	Chapters 9 - 11
6	**Horizontal Curves** • Geometry and Formulae • Examples of Curve Layout • Application & Examples • Practice problems	Assignment #5	Chapter 24
7	**Vertical Curves** • Geometry and Formulae • Examples of Curve Layout • Application & Examples • Practice problems	Assignment #6	Chapter 25
8	**Exam 2**	Assignment #7	
9	**Global Positioning System (GPS)** • Introduction & Theory of GPS • Orbit, Signals & Observations • Operation & Systems		Chapters 13 - 15

	• GPS Measurements • Numerical Examples		
10	**Photogrammetry** • Principles of Photogrammetry • Aerial Imaging Systems & Data Acquisition • Introduction to Remote Sensing • EM Spectrum and its properties • Photogrammetric Data Processing	Assignment #8	Chapter 27
11	**Geographic Information System (GIS)** • GIS Theory & Introduction • Data Structures & Format • Applications to Engineering, Construction, and Mapping • Examples and Problems		Chapter 28
12	**Mapping and Products** Engineering & Topographic Surveys Integrated Geospatial Products & Systems **Earthworks** Area & Volume Computations, Contours, & Gradients	Assignment #9	Chapters 17 & 18, 26
13	**State Plane Coordinates & Other Map Projections** **Boundary Surveys** **Surveys of the Public Lands** **Construction Surveys** • Equipment & Measurements • Construction & Surveying Procedures		Chapters 20 - 23
14	**Terrestrial Mobile & Space-based Mapping** • Technology & Data Processing software • Mapping Applications in Engineering & Construction • Final Review	Assignment #10	
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 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 (instructor's handout) with your name written clearly should be the first page on your homework pages. Homework is to be handed in 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 be 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 the syllabus at least one week in advance.

7. To schedule consultation outside office hours, send request via email.

Grading:
Homework…….30% (due date as indicated on syllabus)
Exam 1……..20%
Exam 2……..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

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 an ability to acquire and apply new knowledge as needed, using appropriate learning strategies
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Revised: 2/13/18