Spring 1-1-2020

SET 200-102: Introduction to Geomatics

Laramie Potts

School of Applied Engineering and Technology

SET200 – Introduction to Geomatics

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

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

Classroom: CKB 212 (Monday: 6:00 pm am – 8:55 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)

Basic concepts on GPS and Remote Sensing technologies and the measurement corrections, reduction and projection from 3D to planar coordinates will be applied to solve surveying problems encountered in construction, earthworks, and environmental engineering. Fundamentals on Geographic Information System (GIS) and geodatabases are introduced as a useful tool for rapid asset mapping and management.

Course Format: This course is taught as Hybrid (self-paced) learning. In-class lectures (see dates on course syllabus indicated in red) will take up 50% of the course teaching and will be conducted on NJIT campus in Newark. The other half of the time is set aside for exploratory learning aided by videos and websites. It is imperative that students attend the face-to-face classes where numerous examples and class exercises will solidify concepts learned from videos and online materials.

Prerequisites: Pre-Calculus **Co requisite:** SET200A–Surveying Laboratory

Textbook(s)/Materials Required:

A: Elementary Surveying: *An Introduction to Geomatics*, 15th Edition, by Charles D. Ghilani, Pearson, 2018, ISBN-13: 978-0134604657

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.

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

1. **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.

2. **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.).

3. **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.

Topics:

- Introduction to surveying and historical developments
- 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
- Photogrammetry & Remote Sensing
- 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 V. Potts **Date:** 1/24/2020

Course Outline Spring 2020

Week	Week of	Assignment	Reading	Topic
2.	**1/27**		Chp 1 -2 Chp 3	**Introduction** **(Video)** • Introduction to Surveying • Math Review & Geodetic Coordinate Systems • Geodetic Datums for Construction • Principles of Geospatial Mapping **Measurements & Errors** • Theory of Errors • Corrections & Calibration • Review of Statistics for Surveying Data **Surveying & Measurements** **(Video - V1** Overview of Statistical Concepts
3.	**2/03**	Review V1 Review V2 **HW #1**	Chp 4-5	**Concepts on Heights** **(Video – V2)** Introduction to Height determination Differential Leveling **Height/Elevation** • Orthometric Height • Differential leveling • Leveling Computations & Adjustments • Trigonometric leveling • Profiles
4.	**2/10**	Review V3 **HW #2**	Chp 11	**Surveying technologies & Measurements** **(Video – V3)** • Distance Measurements & Corrections • Angle Measurements: Conversion to Azimuth & Bearings • Equipment Calibration **Geodetic Datums & Coordinate Geometry** **(Video – V4)** • Basics of Map Projections for Surveying and Mapping • Computations in Rectangular Coordinates
5.	**2/17**	**HW #3** Review V4	Chp 6 Part III Chp 7	**Surveying** • Surveying Technologies (Optical, Laser, Sensors, Imaging) • Surveying Measurement – Corrections, Reductions, Calibration • Optical Measurement - Angles, Azimuth **& Bearing** • **Electronic Distance Measurements** **Surveying Coordinate System** • Geodetic Surfaces and Datums • Planar Coordinates: Departures and Latitude • Computing Coordinates
6.	**2/24**	**HW #4** Review V5	Chp 9 & Chp. 10	**Traverse** **(Video – V5)** Geodetic Control for Mapping Traverse Adjustment
7.	**3/02**	**Exam I - (covering material from Lectures 1-4)**		**Survey Control** • Traverse Adjustment Computation • Triangulation (Intersection & Resection)

8.	**3/09**	Review V6 **HW #5**	chp 24 chp 25	**Horizontal Curves (Video – V6)** Geometry and Formulae Examples of Curve Layout **Vertical Curves (Video –V7)** Geometry and Formulae Examples of Curve Layout
	3/15	***Spring Recess***		
9.	**3/24**	Review V7 **HW #6**		**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
10.	**3/30**	**HW #8**	chp:13-15	**Global Positioning System (GPS)** Introduction to GPS **(Web)** GPS Operation, Systems & Measurements **(Video – V8)**
11.	**4/06**	**Exam II (Material from Lectures 5 - 8)** Review V8		**Surveying with GPS** • Theory of GPS • Orbit, Signals & Observations • Signals & Observations • Numerical Examples
12.	**4/13**	**HW #8**		**Surveying from Imagery** • **Principles of Photogrammetry & Remote Sensing** • **Aerial Imaging Systems and Data Acquisition** • **Photogrammetric Data Processing**
13.	**4/20**	Review V9 **HW #9**	**chp 28**	**Geographic Information System (GIS) (Video – V9)** GIS theory Applications to Engineering, Construction, and Mapping **Construction Surveys (Video – V10)** Equipment & Measurements Construction Surveying Procedures
14.	**4/27**	Review V10		**Geographic Information System (GIS)** • System Overview and Database Management Systems • Data Structures & Format • Examples and Problems • Geospatial database
15.	**5/04**	**HW #10**		**Earthworks & Terrain Analysis** • Area & Volume Computations • Contours, and Gradients **Construction Layout** • Construction Layout **Final Review**
		Final Exam (see Registrar Homepage for schedule details)		

Additional Information:

1. ***Materials Required*** -- Calculator, Computer with internet access.

2 ***Student Activities***

a) ***Homework assignments*** will be administered via Canvas. Homework problems will be submitted in a form of quiz questions and administered via on Canvas. Homework is to be submitted (completed) before 11:59pm Sunday of the week specified in the course syllabus (also posted on Canvas).

b) ***Reviews of Learning Object (Videos)*** is due at 11:59 pm on Sunday of the week. View the learning object in your web browser (e.g., Internet Explorer) automatically. Your review assignment is a short multiple choice quiz.

Eighty percent (80%) of the student assignments must be completed and submitted by the posted deadlines otherwise a grade "F" will be assigned as the final grade for the course.

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**

- Video Reviews……. 15% (due dates as shown on syllabus)
- Homework …..... 15% (due dates as shown on syllabus)
- Exam I …..... 20% (Date shown on syllabus
- Exam II…….. 20% (Date shown on syllabus)
- Final..... 30% (in-class closed book. Date shown on Registrar Webpage)

9. Score Assignment

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