Spring 1-1-2020

SET 200-102: Introduction to Geomatics

Laramie Potts

Follow this and additional works at: https://digitalcommons.njit.edu/saet-syllabi

Recommended Citation
https://digitalcommons.njit.edu/saet-syllabi/74

This Syllabus is brought to you for free and open access by the NJIT Syllabi at Digital Commons @ NJIT. It has been accepted for inclusion in School of Applied Engineering and Technology Syllabi by an authorized administrator of Digital Commons @ NJIT. For more information, please contact digitalcommons@njit.edu.
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).

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:

Supplemental Text: (not required to be purchased)
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

<table>
<thead>
<tr>
<th>Week</th>
<th>Week of</th>
<th>Assignment</th>
<th>Reading</th>
<th>Topic</th>
</tr>
</thead>
</table>
| 2.   | 1/27    |            | Chp 1 -2| **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 |
|      |         |            | Chp 3   |       |
| 3.   | 2/03    | Review V1  | 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 |
|      |         | Review V2  |         |       |
|      |         | HW #1      |         |       |
| 4.   | 2/10    | Review V3  | 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 |
|      |         | HW #2      |         |       |
|      |         | Review V4  |         |       |
| 5.   | 2/17    | HW #3      | Chp 6   | **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 |
|      |         | Part III   | Chp 7   |       |
|      |         | Review V4  |         |       |
| 6.   | 2/24    | HW #4      | Chp 9 & Chp. 10 | **Traverse** *(Video – V5)*  
Geodetic Control for Mapping  
Traverse Adjustment |
|      |         | Review V5  |         |       |
| 7.   | 3/02    | Exam I - (covering material from Lectures 1-4) |         | **Survey Control**  
- Traverse Adjustment Computation  
- Triangulation (Intersection & Resection) |

*Spring*
<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>3/09</td>
<td>Review V6, HW #5, chp 24</td>
<td><strong>Horizontal Curves</strong> <em>(Video – V6)</em>&lt;br&gt;Geometry and Formulae&lt;br&gt;Examples of Curve Layout&lt;br&gt;<strong>Vertical Curves</strong> <em>(Video – V7)</em>&lt;br&gt;Geometry and Formulae&lt;br&gt;Examples of Curve Layout</td>
</tr>
<tr>
<td></td>
<td>3/15</td>
<td><strong>Spring Recess</strong></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>3/24</td>
<td>Review V7, HW #6, chp 25</td>
<td><strong>Horizontal Curves</strong>&lt;br&gt;• Review of Geometry and Formulae&lt;br&gt;• Application and Examples&lt;br&gt;• Practice problems on curve layout&lt;br&gt;<strong>Vertical Curves</strong>&lt;br&gt;• Overview of Geometry and Formulae&lt;br&gt;• Practice problems on curve layout</td>
</tr>
<tr>
<td>11.</td>
<td>4/06</td>
<td>Exam II <em>(Material from Lectures 5 - 8)</em>, Review V8</td>
<td><strong>Surveying with GPS</strong>&lt;br&gt;• Theory of GPS&lt;br&gt;• Orbit, Signals &amp; Observations&lt;br&gt;• Signals &amp; Observations&lt;br&gt;• Numerical Examples</td>
</tr>
<tr>
<td></td>
<td>4/13</td>
<td>HW #8</td>
<td><strong>Surveying from Imagery</strong>&lt;br&gt;• Principles of Photogrammetry &amp; Remote Sensing&lt;br&gt;• Aerial Imaging Systems and Data Acquisition&lt;br&gt;• Photogrammetric Data Processing</td>
</tr>
<tr>
<td>12.</td>
<td>4/20</td>
<td>Review V9, HW #9, chp 28</td>
<td><strong>Geographic Information System (GIS)</strong> <em>(Video – V9)</em>&lt;br&gt;GIS theory&lt;br&gt;Applications to Engineering, Construction, and Mapping&lt;br&gt;<strong>Construction Surveys</strong> <em>(Video – V10)</em>&lt;br&gt;Equipment &amp; Measurements&lt;br&gt;Construction Surveying Procedures</td>
</tr>
<tr>
<td>13.</td>
<td>4/27</td>
<td>Review V10</td>
<td><strong>Geographic Information System (GIS)</strong>&lt;br&gt;• System Overview and Database Management Systems&lt;br&gt;• Data Structures &amp; Format&lt;br&gt;• Examples and Problems&lt;br&gt;• Geospatial database</td>
</tr>
<tr>
<td>14.</td>
<td>5/04</td>
<td>HW #10</td>
<td><strong>Earthworks &amp; Terrain Analysis</strong>&lt;br&gt;• Area &amp; Volume Computations&lt;br&gt;• Contours, and Gradients&lt;br&gt;<strong>Construction Layout</strong>&lt;br&gt;• Construction Layout</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Final Review</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Final Exam (see Registrar Homepage for schedule details)</strong></td>
</tr>
</tbody>
</table>
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**
   
<table>
<thead>
<tr>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-56</td>
<td>D</td>
</tr>
<tr>
<td>57-62</td>
<td>C</td>
</tr>
<tr>
<td>63-69</td>
<td>C+</td>
</tr>
<tr>
<td>70-76</td>
<td>B</td>
</tr>
<tr>
<td>77-84</td>
<td>B+</td>
</tr>
<tr>
<td>&gt; 85</td>
<td>A</td>
</tr>
</tbody>
</table>