ENGR 0180 - ENGINEERING SURVEYING

Catalog Description

Formerly known as ENGR 10
Prerequisite: Completion of MATH 27 with grade of "C" or better
Advisory: Completion with grade of "C" or better or concurrent enrollment in ENGR 151
Hours: 108 (54 lecture, 54 laboratory)
Description: Applies theory and principles of plane surveying: office computations and design; operation of surveying field equipment; and production of engineering plans/maps. Topics include distances, angles, and directions; differential leveling; traversing; property/boundary surveys; topographic surveys/mapping; volume/earthwork; horizontal and vertical curves; land description techniques; and GPS. Extensive field work using tapes, levels, transits, theodolites, total stations, and GPS. (C-ID ENGR 180) (CSU, UC)

Course Student Learning Outcomes

- CSLO #1: Perform distance, angle, and elevation measurements using the instruments and methods of surveying (pacing, chains, tapes and total stations) to analyze and create survey maps for various existing and proposed land use projects.
- CSLO #2: Perform mathematical calculations, based on trigonometry, to solve graphical problems within engineering surveying.
- CSLO #3: Interpret, analyze, and create a legal property description.
- CSLO #4: Compose various forms of surveying maps (including topographical, Plan View, Elevation View, etc.)

Effective Term

Fall 2022

Course Type

Credit - Degree-applicable

Contact Hours

108

Outside of Class Hours

108

Total Student Learning Hours

216

Course Objectives

Lecture Objectives:
I. Explain the a basics of surveying/geomatics
A. Ability to define and describe the profession of surveying/geomatics
B. Explain the difference between geodetic and plane surveys
C. Demonstrate common techniques employed in surveying safety
D. Interpret and analyze land and geographic information systems
E. Define and describe federal and local surveying agencies
F. Define and describe professional organizations associated with the surveying profession
G. Demonstrate mastery in interpreting, analyzing, and reproducing public and private land surveys
H. Compose well kept, detailed and organized records including field notes and computer data
II. Create a property description
A. Analyze deeds, easements, lot and parcel descriptions, parcel and subdivision maps, meters and bounds
B. Calculate and plot boundaries from descriptions
C. Write a legal property description
III. Create specifications for some common survey curves
A. Design and layout a roadway including horizontal curves, showing all calculations, and conforming to state standards
B. Design and layout a roadway including vertical curves, showing all calculations, and conforming to state standards
C. Complete problems including spiral curves
Lab Objectives:
I. Measure distance utilizing common surveying techniques
A. Take distance measurements using the methods of pacing, chains, tapes and total stations
B. Perform distance calculations relating to slope distance, horizontal distance and vertical distance
C. Define and use the relationship between angles and distances for the purpose of routine surveying calculations
II. Measure angles utilizing common surveying techniques
A. Perform mathematical calculations using measured angles
B. Perform horizontal angle measurements with manual and total stations using direct and reverse methods including repetitive measurements to reduce error
C. Perform vertical angle measurements with manual and total stations
D. Construct directions from angle measurements including bearings and azimuths
E. Perform the setting of sights and marks
F. Analyze problems and errors induced by instruments, natural settings and persons
III. Explain the concepts of coordinate geometry
A. Perform calculations of latitudes and departures from angle and distance measurements (including map courses)
B. Calculate coordinates from latitudes and departures
C. Create, calculate and balance a closed traverse using a total station and field notes (traverse calculations including: area within a closed traverse using double meridian distance and coordinate method, bearings and distances between points and intersections)
IV. Apply leveling theory and perform leveling operations
A. Perform a closed loop, differential leveling survey including a known USGS (United States Geological Survey) benchmark and temporary benchmarks with the following equipment: Engineer's level, Philadelphia Rod, and field notes
B. Perform a closed loop, differential leveling survey with the following equipment: total station, computer and field notes
C. Calculate elevations based on fore-site and back-site rod readings
D. Perform differential and trigonometric level measurements
E. Calculate the error for closure of the level loop
V. Create a boundary survey
A. Measure survey markers from a control traverse
B. Translate and rotate the survey to a coordinate system and basis of bearing
C. Create submittal for status review including all calculations and maps
D. Create a new property corner
VI. Create a topographic survey
A. Interpret topographic maps including elevations, contours, spot data, objects, symbols, scales and USGS quad maps
B. Measure topographic points using a total station

C. Create a topographic map including points, surface model (contours), breaklines, drawing objects, correct format and correct labeling
VII. Create a construction survey
A. Analyze and modify construction plans
B. Set a construction survey including cut and fill, offsets, marked staking and horizontal/vertical control
C. Analyze as-built surveys
VIII. Demonstrate knowledge in GPS Surveying
A. Describe and discuss global positioning satellite surveys (GPS surveys) including GPS equipment
B. Interpret reference coordinate systems
C. Process GPS data and interpret errors in GPS
D. Perform grid to ground distance conversions

General Education Information

- Approved College Associate Degree GE Applicability
- CSU GE Applicability (Recommended-requires CSU approval)
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)

Articulation Information

- CSU Transferable
- UC Transferable

Methods of Evaluation

- Problem Solving Examinations
  - Example: Problem Solving Exam (Lecture) Example 1: Given the radius and angle of a chord, calculate the arc length. Example 2: Given a stationary point (monument), declination angle, and measured length, calculate the change in vertical distance (height) Example 3: Based on material presented during class and within the text, write a legal property description that conforms to local and state standards.
- Projects
  - Example: Projects (LAB) Example 1: Create a topographic map, including contour lines, from points measured during a topo survey using a total station. Project is graded on a standard rubric created by the instructor. Example 2: Using the methods of chains, create and then calculate the error on two different closed boundary surveys. Project is graded on a standard rubric created by the instructor. Example 3: Using a total station, measure and and create an "as built" construction project survey. Project is graded on a standard rubric created by the instructor.

Repeatable

No

Methods of Instruction

- Laboratory
- Lecture/Discussion

Lab:

1. The students will be shown demonstrations on modern surveying equipment (for example Nikon Total Stations). This will include a discussion of why engineers use the equipment, what the equipment is capable of measuring, The accuracy of the equipment, how to properly calibrate and use the equipment to perform measurements, and how to use those measurements to create a topographical map. The students will then be required to complete a project where they demonstrate their gained knowledge by using the equipment themselves to create a survey map. For example, students will identify a monument, mark a closed loop traverse using survey equipment, gather data from the traverse and use that data to calculate error. Both lecture and Lab follow this format:
2. Explanation of where this particular skill is used within the field of Civil Engineering.
3. Discussion of the weekly topic; including the mathematical basis for how it works (the theory of how it works) and how to perform the analysis (how to apply the theory).
4. Several examples and/or demonstrations will be given by the instructor.
5. Students will then break into groups and perform analysis and complete problems similar to the previously demonstrated.

Lecture:

1. Lecture: Critical Thinking: Weekly lecture and discussion sessions will be presented to the students with common equipment, theoretical calculations, procedures and techniques used in the field to create the products of Civil Engineering / Surveying. During the lecture portion, the students will be presented with applications, the working theories, the practical calculations, and finally required to solve problems and complete projects within the field of Civil Engineering / Surveying. The problems will be evaluated by the instructor. For example, students will be given location and distance information and then be expected to calculate the layout of a curve. Both lecture and Lab follow this format:
2. Explanation of where this particular skill is used within the field of Civil Engineering.
3. Discussion of the weekly topic; including the mathematical basis for how it works (the theory of how it works) and how to perform the analysis (how to apply the theory).
4. Several examples and/or demonstrations will be given by the instructor.
5. Students will then break into groups and perform analysis and complete problems similar to the previously demonstrated.

Typical Out of Class Assignments

Reading Assignments

Required college level readings from chapters in the textbook assigned weekly. Students are expected to participate in the lecture discussion and complete homework assignments based upon this reading. Sample 1. Read the assigned pages on horizontal curves within the textbook and complete the assigned homework problems. Come to class prepared to discuss the process of constructing horizontal curves. Sample 2. Read the assigned operational manual for specific surveying equipment and demonstrate a working knowledge of the equipment by creating a topographic map of a small portion of the campus.

Writing, Problem Solving or Performance

College level problem solving and writing assignments are given throughout the duration of this course. These skills are critical in the field of surveying. Sample 1. Go into the field and collect survey data points to be used for creating a topographical map. Use this data and special software to create a topo-map of the area under survey. Sample 2. Create a working construction survey and staking that may be used for

a construction crew to grade and then develop a parcel of land (example: parking lot).

Other (Term projects, research papers, portfolios, etc.)

Term Project 1. Perform a topographic survey, including a control loop and benchmark with USGS traceable elevation information, to create a topographic map of a small portion of the campus. Term project 2. Use information obtained during a field survey to calculate the elevation, layout and grade of a mock parking lot to be constructed. Use that data to stake out the parking lot (perform construction staking).

Required Materials

- Elementary Surveying, An Introduction to Geomatics
  - Author: Ghilani and Wolf
  - Publisher: Pearson, Prentice Hall
  - Publication Date: 2018
  - Text Edition: 15th
  - Classic Textbook?:
  - OER Link:
  - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.

1. Field Book - to include field notes for all lab exercises (may be graded). 2. Data storage device - such as a USB flash drive. 3. Engineering Calculator.