SUR-SURVEYING

SUR 143. Civil Drafting Fundamentals
3 Credits (2+2P)
Introduction to drafting in the field of Civil Engineering. Drawings, projects, and terminologies related to topographic, contour drawings, plan and profiles, and street/highway layout. Restricted to Community Colleges only. Taught with E T 143 and DRFT 143.
Prerequisite: DRFT 109.
Learning Outcomes
1. Use appropriate drafting/technical terminology.
2. Identify of the different types of Civil Engineering work drawing plan sets.
3. Understanding and the use of the terminologies used in the industry.
4. Use AutoCAD Civil 3D.
5. Enter appropriate data into AutoCAD software in order to retrieve necessary outcomes.
6. Plot/Print different types of civil engineering working plans.
7. Read, interpret and understand engineering drawings.
8. Define and understand the different types of engineering drawings.

SUR 222. Introduction to Geomatics
3 Credits (2+3P)
Theory and practice of geomatics as applied to plane surveying in the areas of linear measurements, angle measurements, area determination, differential and trigonometric leveling, and topographic mapping.
Prerequisite: A grade of C- or better in both, E T 109 and (MATH 1250G or higher).
Learning Outcomes
1. Perform basic distance and angular measurements.
2. Evaluate the quality of collected measurements.
3. Utilize a measuring tape.
4. Determine a plumb line.
5. Set up a level line.
6. Set up a tripod and total station.
7. Utilize a plumb rod.
8. Understand the role of surveying in civil engineering and construction-related fields.
9. Understand new technologies is surveying.

SUR 285. Precise Digital Mapping
3 Credits (3)
Photogrammetric Mapping Principles, digital sensor including optical cameras, terrestrial, surveying control, IMU & GPS integration, stereo photography, analytical triangulation, orthorectification, precision and accuracy of measurement systems, sUAS (Small Unmanned Aerial Vehicles) data collection project fight/pre planning, introduction to laser scanning systems.
Learning Outcomes
1. Understand the basic principles of photogrammetry.
2. Perform photo measurements and computation.
3. Be able to design aerial surveying projects.
4. Define the basic principles of analytical photogrammetry.
5. Explain the different steps in aerial triangulation.

SUR 292. Legal Principles and Boundary Law I
3 Credits (3)
Fundamentals of real property law; principles of land description; survey evidence and procedure in boundary determination, order of importance of conflicting elements; liability, ethical and professional principles in boundary surveying; NM professional practice act; NM Minimum Standards, contemporary issues in boundary determination.
Prerequisite: C- or better in SUR 222.
Learning Outcomes
1. Demonstrate an understanding of surveying boundary laws.
2. Describe procedures for locating real property boundaries.
3. Read, interpret, and write legal descriptions of real property.
4. Perform legal research of case and statutory law.
5. Communicate research findings through written and oral presentations.

SUR 312. Public Land Survey System Boundaries
3 Credits (3)
Fundamentals of the U.S. Public Land Survey System; rules for the survey of the public lands, field surveys; the rectangular system, corners, monuments, evidence; dependent and independent resurveys, corner restoration; plats and field notes, patents.
Prerequisite: A grade of C- or better in SUR 222.
Learning Outcomes
1. Understand how the USPLSS was developed and used.
2. Develop the ability to locate and identify USPLSS survey monuments.
3. Recognize the need for restoring lost corners and apply proportionate methods.
4. Perform computations for simple PLSS section subdivisions.
5. Demonstrate an ability to read, write and interpret USPLSS legal descriptions.

SUR 315. Advanced Mapping Technologies
2 Credits (2)
Advanced applications of airborne sUAS (Small Unmanned Aerial Vehicles) in 3D data acquisition, sensor specifications, selection, and platform compatibility. Principles of lidar data collection, airborne and terrestrial. LiDAR data processing including registration, modeling, and analysis. Point cloud principles, processing, and applications. DEMs principles, processing and analysis. Principles and applications of GPR in surveying.
Prerequisite: SUR 285 and Junior Standing.
Corequisite: SUR 315L.
Learning Outcomes
1. Identify the basic principles and applications of advanced mapping technologies.
2. Compare and contrast different UAS-based aerial surveying techniques for 3D data acquisition principles and applications of Ground Penetrating Radar (GPR).
3. Process, analyze, and interpret point clouds and DEMs.
4. Recognize the principles of terrestrial LiDAR data collection.
5. Explain the principles and applications of Ground Penetrating Radar (GPR).

SUR 315L. Advanced Mapping Technologies Lab
1 Credit (1P)
Hands-on application of using optical and LiDAR UASs in surveying and mapping. Design and conduct UAV surveys, including flight planning and pre-planning with an understanding of sensor limitations, control point configuration, and FAA regulations and restrictions. Applications of terrestrial scanners in collecting accurate 3D models. Process, analyze, and visualize different types of point clouds.

Prerequisite: SUR 285.
Corequisite: SUR 315.
Learning Outcomes
1. Identify lab safety, workflow overview, and liability considerations.
2. Apply UAS technologies in surveying and mapping projects through hands-on flight operations.
3. Develop 3D point clouds for surveying, engineering, and mapping applications.

SUR 328. Construction Surveying & Automation Technologies
3 Credits (2+3P)
Construction Surveying Principles: conventional and machine controlled. Layout alignments, grades, various infrastructure, buildings. Understand error identification, common quality control checks and blunder identification. Alignments and station/off set, types of construction layout of infrastructure: roads, bridges, utilities (including subsurface), buildings, industrial; reading and interpreting construction plans, data management, horizontal, vertical and spiral curves, slope staking, machine control basics, applications and data managements. Use of electronic files and liability issues. Layout alignments, grades, various infrastructure, buildings. Ability to understand data integration in automated machine control, work flow processes.
Prerequisite: A grade of C- or better in both, (SUR 222 or DRFT 222) and (ENGR 190 or MATH 1511G or MATH 1511H).
Learning Outcomes
1. Acquire the ability to answer test questions on professional surveying exams.
2. Develop the ability to appropriately collect, analyze, interpret and apply surveying and surveying-related data.
3. Develop the ability to recognize, analyze, and solve surveying and surveying-related problems.
4. Develop the ability to work on teams.

SUR 328L. Construction Surveying & Automation Technologies Lab
1 Credit (1P)
Hands-on application of surveying equipment such as GNSS and total stations to perform construction stakeout for different types of construction layouts, including buildings, horizontal and vertical alignments. Reading and interpreting construction plans. Integrating machine-controlled surveys in different applications.
Prerequisite: A grade of C- or better in both, (SUR 222 or DRFT 222) and (ENGR 190 or MATH 1511G or MATH 1511H).
Corequisite: SUR 328.
Learning Outcomes
1. Identify lab safety, workflow overview, and liability considerations.
2. Apply surveying technologies in construction stakeout.
3. Recognize different forms of construction plans.

SUR 351. Spatial Data Adjustment I
3 Credits (3)
Theory of random error in observations/measurements. Use of statistics in spatial data analysis, statistical testing, advanced data structures. Emphasis on computer based problem solving and programming to solve spatial data problems.
Prerequisite: A grade of C- or better in the following: (SUR 222 or DRFT 222) and (A ST 311G or MATH 1350G) and (ENGR 190 or MATH 1511G or MATH 1511H).
Learning Outcomes
1. Acquire the ability to answer questions on professional surveying exams.
2. Acquire a sound and fundamental understanding of the mathematical principles underlying surveying measurements and computations.
3. Develop the ability to appropriately analyze, interpret, and apply survey and survey-related data.
4. Develop the ability to recognize, analyze, and solve survey and survey-related problems.

SUR 361. Geodesy/Geodetic Control Surveying
3 Credits (3)
Horizontal and vertical control network design and consideration. Understand ellipsoid, geoid, horizontal and vertical datum, coordinates, precise leveling, astronomic, establishment of state plane zones, understanding reporting. Transform data between geodetic Latitude/Longitude, state plane, ground data, perform geodetic computations, ability to design GPS networks utilizing CORS stations, network adjustments. Perform a control survey, process data, adjust network, and prepare control report with Meta-data.
Prerequisite: A grade of C- or better in the following: (SUR 222 or DRFT 222) and (ENGR 190 or MATH 1511G or MATH 1511H).
Learning Outcomes
1. Define the different coordinate systems and geometric models used to represent the shape of the Earth.
2. Be able to perform surveying computations on the sphere and ellipsoid.
3. Distinguish between the different map projections systems.
4. Explain the effects of gravity in survey measurements, especially in precise leveling.
5. Outline how earth motions affect surveying measurements and the different time systems.
6. Explicitly indicate which of the student outcomes listed in Criterion III or any other outcomes are addressed by the course.

SUR 401. Ethics and Professionalism in Surveying and Mapping
3 Credits (3)
Ethics as applied to the surveying profession. Includes case studies and problems. May be repeated up to 3 credits.
Learning Outcomes
1. An ability to communicate effectively with a range of audiences.
2. An ability to understand ethical and professional responsibilities and the impact of technical and/or scientific solutions in global, economic, environmental, and societal contexts.

SUR 412. Advanced Topics in Boundary Surveying
3 Credits (2+3P)
Advanced land boundary topics including water boundaries, mineral claims, Spanish and Mexican land grants, state and national boundaries. May be repeated up to 3 credits.
Prerequisite: A grade of C- or better in SUR 312.
Learning Outcomes
1. Identify land boundary topics

SUR 440. Geomatics Laboratories
2 Credits (6P)
Layout alignments, grades, various infrastructure, buildings. Performing GNSS surveys including RTK, rapid-static, static data collection and processing. Laser scanning and photogrammetric data collection and processing. Surveying applications in the U.S. Public Land Survey System (PLSS).
Prerequisite: A grade of C- or better in, SUR361, (SUR 222 or DRFT 222) and (MATH 1435 or MATH 1511G).
Prerequisite/Corequisite: SUR 328 and SUR 461.

Learning Outcomes

1. An ability to develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions.
2. An ability to communicate effectively with a range of audiences.
3. An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty.

SUR 450. Senior Project
3 Credits (3)
Research project prepared by student. Includes class presentation. Students will learn how to research after the end of their formal education. Students must be in Senior Standing to enroll.
Learning Outcomes

1. An ability to identify, formulate, and solve broadly defined technical or scientific problems by applying knowledge of mathematics and science and/or technical topics to areas relevant to the discipline.
2. An ability to formulate or design a system, process, procedure or program to meet desired needs.
3. An ability to develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions.
4. An ability to communicate effectively with a range of audiences.

SUR 451. Spatial Data Adjustment II
3 Credits (3)
Rigorous analysis of the theory of observations as applied to spatial data, application of least squares adjustments, ability to perform statistical analysis to determine accuracy of final product, constrained/free geospatial data integration, error ellipses, and pre-analysis of spatial data acquisition procedures.
Prerequisite: A grade of C- or better in SUR 351.
Learning Outcomes

1. Understand the theory of least squares as applied to survey measurements
2. Understand the relevance of weighting survey observations
3. Be able to adjust vertical, horizontal and 3D networks by least squares
4. Be able to transform coordinates between similar coordinate systems
5. Be able to analyze survey errors and detect survey blunders

SUR 452. Surveying Practicum
3 Credits (3)
Surveying practice under the direction of a licensed, professional land surveyor requiring an approved number of hours. Planned work between the student and the surveyor should be designed to be part of a project that integrates spatial data. An individualized syllabus should be developed collaboratively with the industrial partner and approved by the geomatics faculty. The final deliverable must be certified by the licensed professional land surveyor. A written report by the student is required. Credit is given to past work experience in cases where students can demonstrate that requirements for the practicum are met and should be approved by geomatics faculty.
Learning Outcomes

1. Demonstrate a level of technical competency, based upon completing the requirements of a geomatics technology curriculum.
2. Students are expected to successfully and professional complete a "real" project. Additionally, student work is employed to assess most of the program's outcomes for program assess.

SUR 461. GNSS Positioning
2 Credits (2)
Logistics of GNSS data collection, the GPS signal, codes and biases, error sources, differences between relative and autonomous GNSS positioning, code phase carrier phase, DGPS static and RTK surveys. Geodetic and GPS standards and specifications GNSS data processing, network adjustments, and evaluation of spatial data accuracy practical applications of GNSS.
Prerequisite: A grade of C- or better in SUR 361.
Corequisite: SUR 461L.
Learning Outcomes

1. Outline the relationship of geodesy to satellite positioning systems.
2. Describe the procedure of GNSS surveys.
3. Differentiate between different GNSS surveying techniques.
4. Identify GPS standards and specifications.

SUR 461L. GNSS Positioning Lab
1 Credit (1P)
Hands-on experience using different types of surveying-grade GNSS equipment in collected geospatial data for surveying and engineering applications. Mastering field procedures, understanding equipment functionality, and learning to process and evaluate real-world GNSS data. May be repeated up to 3 credits.
Prerequisite: A grade of C- or better in SUR 361.
Corequisite: SUR 461.
Learning Outcomes

1. Identify lab safety, workflow overview, and liability considerations.
2. Conduct different types of GNSS surveys for mapping and engineering applications.
3. Assess the quality and reliability of spatial data collected by different GNSS surveying techniques.

SUR 464. Legal Principles and Boundary Law II
3 Credits (3)
Advanced boundary determination, evaluation of written and field evidence. Advanced application of PLSS subdivision, special surveys (water, mineral, and reservations), NM Standards, and laws. Preparation of boundary survey plats and reports. ALTA/NSPS Surveys and Standards.
Prerequisite: A grade of C- or better in both, SUR 292 and SUR 312.
Learning Outcomes

1. Application of the rules of evidence as concerning to boundary surveys.
2. Demonstrate understanding between original, resurveys, and retracements.
3. Acquire the ability to perform advanced section subdivisions.
4. Understand the issues of professional liability and ethical practice.

SUR 485. Emerging Techniques in Geospatial Technologies
3 Credits (3)
Hydrographic, Altimetry, Space borne Imaging Systems, Mobile Mapping Systems, Mining and Agriculture Surveying Principles, Ranging technologies and applications such as LiDAR, SAR, and Bathymetry. Principles of terrestrial & airborne laser scanning, point cloud data management & extraction, scan registration and processing, and advanced ranging data acquisition systems. Consent of Instructor required.
Prerequisite(s): Senior standing.
Learning Outcomes

1. Outline the different techniques in mapping seabed.
2. Describe the procedure of LIDAR mapping.

3. Outline the remote sensing technologies used in mapping.
4. Recognize the UAV mapping technologies.
5. Produce surveying products from new technologies in geomatics.