THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Introduction to GPS: Theory and Applications

CIVILEN 5441

Credit Hours:
3.00 - 3.00

Course Levels:
Undergraduate (1000-5000 level)
Graduate (5000-8000 level)

Course Components:
Lecture
Lab
Field Experience

Course Description:
Introduction to reference systems; fundamentals of GPS design and operation; GPS observables, error analysis and handling; data collection and data processing; interdisciplinary applications of GPS.

Prerequisites and Co-requisites:
Prereq: Math 1172 or 1544 (154) or 2153 (254), and Jr standing or above; or Grad standing; or permission of instructor.

Course Goals / Objectives:
- Early exposure to the operational concept of the Global Positioning System (GPS) and its importance to several areas of science and engineering.
- Basic theory of positioning with satellites and the basic concepts of reference frames and systems, and map projections.
- Theory and practice of various methods of positioning with GPS.
- Theory and practical use of GPS field equipment and the data processing software, and will master planning, management and operational skills in field operation and data processing and interpretation.
- Fundamentals of GPS applications in mapping, remote sensing, GIS, air, land and personal navigation, construction engineering, structural monitoring, environmental monitoring, precision farming, atmospheric studies.

Course Topics:

- Fundamentals of Reference Systems and Frames: Geodetic and Cartesian coordinate system; principles of coordinate transformation; GPS reference system WGS84; basic concept of map projections.
- Basic Principles of GPS Operations: Ranging from space; satellite, control and user segments; GPS satellite navigation message; GPS time, fundamental and derived frequencies.
- Basic Types of GPS Observable: Pseudoranges(PR) and carrier phases(CP).
- GPS Error Sources and Error Handling Procedures: Atmospheric effects, clock and orbital errors, multipath, anti-spoofing and selective availability, etc; interference and jamming.
- Position estimation with CP/PR: minimum constellation and over-determined case; concept of dilution of precision (DOP factors); point positioning and differential mode; differential services; principles of ambiguity resolution; cycle slips.
- User Equipment: Single vs. dual frequency receivers; navigation vs. geodetic quality; antenna types; primary equipment and software products.
- Data Collection and Field Procedures: Data transfer, processing and result interpretation; residual and covariance analysis; Static vs. Kinematic GPS applications.
- Integration with other sensors: inertial navigation systems (INS) and imaging sensors, such as LiDAR and digital cameras; use of integrated systems supported by GPS in remote sensing applications.
- GPS applications in surveying, mapping, GIS, air, land and personal navigation, and assessment with modern remote sensing techniques supported by GPS; environmental monitoring, precision farming, atmospheric studies.
- GPS applications in construction engineering, structural monitoring, bridge crack inspection, building and road monitoring GPS in intelligent transportation and fleet management; remote sensing applications in transportation.

Designation:

Elective
Required