

December 4-7, 2018  
 Hyatt House Falls Church/Merrifield  
 8296 Glass Alley  
 Fairfax, Virginia, USA, 22031



**COURSE 122 (OR 123) (1.2 CEUs)**  
**GPS / GNSS Fundamentals & Enhancements**

Days 1 and 2 of Course 346 or Course 356

SAME AS DAYS 1 AND 2 OF COURSE 346. SEE REGISTRATION FORM	
DAY 1	DAY 2
<p><b>Fundamentals of GPS operation. Overview of how the system works. U.S. policy and current status.</b></p> <p><b>GPS System Description</b></p> <ul style="list-style-type: none"> <li>• Overview and terminology</li> <li>• Principles of operation</li> <li>• Augmentations</li> <li>• Trilateration</li> <li>• Performance overview</li> <li>• Modernization</li> </ul> <p><b>GPS Policy and Context</b></p> <ul style="list-style-type: none"> <li>• Condensed navigation system history</li> <li>• GPS policy and governance</li> <li>• Modernization program</li> <li>• Ground segment</li> <li>• Other satellite navigation systems</li> </ul> <p><b>GPS Applications</b></p> <ul style="list-style-type: none"> <li>• Land</li> <li>• Marine</li> <li>• Aviation</li> <li>• Science</li> <li>• Personal navigation</li> <li>• Accuracy measures</li> <li>• Error sources</li> </ul>	<p><b>GPS Principles and Technologies</b></p> <p><b>Clocks and Timing</b></p> <ul style="list-style-type: none"> <li>• Importance for GPS</li> <li>• Timescales</li> <li>• Clock types</li> <li>• Stability measures</li> <li>• Relativistic effects</li> </ul> <p><b>Geodesy and Satellite Orbits</b></p> <ul style="list-style-type: none"> <li>• Coordinate frames and geodesy</li> <li>• Satellite orbits</li> <li>• GPS constellation</li> <li>• Constellation maintenance</li> </ul> <p><b>Satellites and Control Segment</b></p> <ul style="list-style-type: none"> <li>• GPS satellite blocks</li> <li>• Control segment components and operation</li> <li>• Monitor stations, MCS, and ground antennas</li> <li>• Upload operations</li> <li>• Ground control modernization</li> </ul>
<b>Lunch Is On Your Own</b>	
<p><b>Legacy GPS Signals</b></p> <ul style="list-style-type: none"> <li>• Signal structure and characteristics</li> <li>• Modulations: BPSK, DSSS, BOC</li> <li>• Signal generation</li> <li>• Navigation data</li> </ul> <p><b>Measurements and Positioning</b></p> <ul style="list-style-type: none"> <li>• Pseudorange and carrier phase measurements</li> <li>• Least squares solution</li> <li>• Dilution of precision</li> <li>• Types of positioning solutions</li> </ul> <p><b>GPS Receiver Basics</b></p> <ul style="list-style-type: none"> <li>• Types of receivers</li> <li>• Functional overview</li> <li>• Antennas</li> </ul>	<p><b>Error Sources and Models</b></p> <ul style="list-style-type: none"> <li>• Sources of error and correction models</li> <li>• GPS signals in space performance</li> <li>• Ionospheric and tropospheric effects</li> <li>• Multipath</li> <li>• Error budget</li> </ul> <p><b>Augmentations and Other Constellations</b></p> <ul style="list-style-type: none"> <li>• Augmentations: local-area, satellite-based, and regional</li> <li>• Russia's GLONASS</li> <li>• Europe's Galileo</li> <li>• China's Compass (BeiDou)</li> </ul> <p><b>Precise Positioning</b></p> <ul style="list-style-type: none"> <li>• Precise positioning concepts</li> <li>• Reference station networks</li> <li>• RINEX data format</li> </ul>

**JUST NEED THE FUNDAMENTALS?**

Take Course 122, which covers all the major areas of GPS. It is the same as days 1 and 2 of Course 346. (Course 346 drills deeper on days 3 and 4.)

**Instructors**



Dr. Chris Hegarty

**Objectives**

- ◆ To give an comprehensive introduction to GPS technology, system concepts, design, operation, implementation and applications.
- ◆ To provide detailed information on the GPS signal, its processing by the receiver, and the techniques by which GPS obtains position, velocity and time

**Prerequisites**

- ◆ Some familiarity with engineering terms is helpful but not essential.

**Who Should Attend?**

- ◆ Engineers and technical professionals seeking conceptual explanations of GPS / GNSS technology, operation, capabilities, applications, and development trends
- ◆ Professionals in navigation, positioning, and related fields who are concerned with the capabilities, operation and principles of GPS and related GNSS systems.
- ◆ System analysts and specialists who need general information on position data and its use.
- ◆ Managers concerned with GPS, GNSS activities, or the positioning field.

**Materials You Will Keep**

- ◆ A color electronic copy of all course notes will be provided on a USB Drive or CD-ROM. Bringing a laptop to this class is highly recommended for taking notes using the Adobe® Acrobat® sticky notes feature; power access will be provided.
- ◆ A black and white hard copy of the course notes will also be provided.

**Course Fee Entitles You to the Following Books**

Introduction to GPS: *The Global Positioning System*, 2nd ed., Ahmed El-Rabbany, Artech House, 2006., **OR** *Global Positioning System: Signals, Measurement and Performance*, P. Misra and P. Enge, 2nd ed., 2011, or *GPS for Everyone: You are Here*, Pratap Misra, Ganga-Jamuna Press, 2016. (Note: This arrangement does not apply to on-site contracts. Any books for on-site group contracts are negotiated on a case by case basis.)