



UNIVERSITA' degli STUDI di ROMA
TOR VERGATA
Dipartimento di Ingegneria delle Telecomunicazioni e Microelettronica

Course Code

Satellite Navigation System

Day(s), Time, Place

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Radio Labs

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This is a tentative outline and schedule and may subject to change with prior notification.

Course Description:

Global Navigation Satellite System (GNSS) is widely used for Position, Navigation, and Timing (PNT) across the globe. The use of GNSS is foreseen in a wide range of applications such as Location Based Services (LBS), energy, agriculture, and transportation to name a few. The list of applications relying on the use of GNSS is certain to grow, and is limited only by the imaginations of innovative entrepreneurs and service providers. This course will cover principles of satellite navigation, error sources contributing to the quality of navigation solution, GNSS signal tracking and acquisition, advanced methods for improving positioning accuracy and integrity, and GNSS Software Defined Radio.

Prerequisite(s):

Credit Points: 7.5

Text(s): *Global Positioning System: Signals, Measurements, and Performance*, 2nd Edition
Author(s): Pratap Misra and Per Enge; **ISBN:** 0-9709544-1-7

Reference(s): *Understanding GPS: Principles and Applications*, 2nd Edition
Editor(s): Elliot Kaplan and Christopher Hegarty ; **ISBN:** 978-1-58053-895-4

Course Policies:

- **General**
- **Labs and Assignments**

Tentative Course Outline:

The weekly coverage might change as it depends on the progress of the class. However, you must keep up with the reading assignments.

Week	Content	Lecturer	Reading Chapters
Week 1	<ul style="list-style-type: none"> • Introduction to Global Navigation Satellite Systems (GNSS) • Markets and Applications • Modernization of GNSS 	Dr. Stallo	1(Text), 1(Reference)
Week 2	<ul style="list-style-type: none"> • Global Coordinate Frames • Time Reference and GPS Time • GPS Orbits and Satellite Position Determination 	Dr. Stallo	3 (Text), 2 (Reference)
Week 3	<ul style="list-style-type: none"> • GNSS Measurements and Error Sources • Control Segment Errors • Signal Propagation Errors • Receiver Errors • User Receiver Error Budget 	Dr. Stallo	5 (Text), 7(Reference)
Week 4	<ul style="list-style-type: none"> • Estimation of Position, Velocity, and Time (PVT) • Linear Model for Position Estimation • Position Estimation using Kalman Filter • Satellite Dilution of Precision • Accuracy Metrics 	Dr. Stallo	6 (Text), 2, 7 (Reference)
Week 5	<ul style="list-style-type: none"> • Lab exercise • GPS Point Position Calculation (MATLAB) • Pseudorange Processing • RINEX, RTCM, and NMEA Format 	Bilal	
Week 6	<ul style="list-style-type: none"> • GNSS Signals • GNSS Signal Tracking • GNSS Signal Acquisition 	Dr. Stallo	9,11,12 (Text), 4,5 (Reference)
Week 7	<ul style="list-style-type: none"> • GNSS Integrity • Satellite Based Augmentation System (SBAS) • Receiver Autonomous Integrity Monitoring (RAIM) 	Dr. Ronchini	7 (Reference)
Week 8	<ul style="list-style-type: none"> • Introduction to GNSS Software Defined Radio (SDR) • GNSS SDR Concepts and Definitions • GNSS Front-Ends 	Dr. Capua	
Week 9	<ul style="list-style-type: none"> • Introduction to GNSS Precise Point Positioning (PPP) • PPP Methods • GNSS Carrier Phase Processing and Ambiguity Resolution • Real Time Correction Services 	Dr. Capua	7 (Text)
Week 10	<ul style="list-style-type: none"> • GNSS Receiver Threats - Multipath • GNSS Receiver Threats - Interference and Spoofing 	Dr. Dosis	13 (Text), 6 (Reference)
Week 11	<ul style="list-style-type: none"> • Navigation Gateway: An Innovative approach To The Provision of Localization Services 	Plaia	