Course guides
230680 - GPS - GPS and Galileo Data Processing: From Fundamentals to High Accuracy Navigation

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree:
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

Academic year: 2019
ECTS Credits: 5.0
Languages: English

LECTURER

Coordinating lecturer: Hernandez Pajares, Manuel

Others:

PRIOR SKILLS

Basic knowledge on Physics and Mathematics.

REQUIREMENTS


TEACHING METHODOLOGY

Learning based on recent international Global Navigation Satellite Systems (GNSS) research projects.

LEARNING OBJECTIVES OF THE SUBJECT

To introduce the fundamental concepts of satellite positioning under the guideline of recent international research projects. The material has been refined in recent international post-graduate schools in Germany, Argentina, Brazil and Pakistan. To provide experience in GPS data processing for precision applications. To study some applications of GPS to geodesy and other Earth sciences. Basic contents of the course are the following. GPS observables. Reference systems and time. Orbit determination. Absolute positioning. Differential positioning. Ionosphere and troposphere modelling.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>26,0</td>
<td>20.80</td>
</tr>
<tr>
<td>Hours small group</td>
<td>13,0</td>
<td>10.40</td>
</tr>
<tr>
<td>Self study</td>
<td>86,0</td>
<td>68.80</td>
</tr>
</tbody>
</table>

Total learning time: 125 h
## CONTENTS

1. Introduction to space geodesy
   
   1.1. Space geodesy and GPS.
   
   1.2. Basic concepts and historical development

2. Global positioning system
   
   2.1. Introduction.
   
   2.2. Space segment.
   
   2.3. Control segment.
   
   2.4. Principles of signal structure and observation.
   
   2.5. GPS ephemeris and message structure

3. Orbital movement of a satellite
   
   3.1. Trajectory of a satellite in the Earth’s gravitational field.
   
   3.2. Elliptical movement of a satellite
   
   3.3. Orbital elements.
   
   3.4. Perturbed movement of a satellite.
3.5. Orbit determination

4. Fundamentals of physics

4.1. Topics of reference.

4.2. Weather.

4.3. Electromagnetic signal propagation

5. GPS observables and data processing

5.1. Observables

5.2. Parameter estimation.

5.3. Data reprocessing.

5.4. Least squares.

5.5. The Kalman filter.

5.6. Fast GPS methods.

5.7. GPS navigation

6. Errors and corrections

6.2. Apparent geometry of constellations.

6.3. Orbits and clocks.

6.4. Signal propagation.

6.5. Reception systems.

6.6. System integrity

7. Applications

7.1. Ionosphere modelling.

7.2. Troposphere modelling

ACTIVITIES

Answers in the Lab sessions.

Specific objectives:
Learning from Actual GNSS Data (LeGAD).

Material:
Book with scripts for laboratory sessions, software and questionnaires in the fundamental GNSS aspects. Slides with new teaching software for additional fundamental GNSS aspects.

Full-or-part-time: 40 h
Theory classes: 27h
Laboratory classes: 13h
**Academic-ITT**

**Description:**
Design of a proposal following the model of the European Space Agency (ESA).

**Specific objectives:**
(1) To become familiar with the procedure of application to European research projects. (2) To be aware about open scientific and technical problems associated with GNSS.

**Material:**
List of scientific and technical GNSS open problems.

**Full-or-part-time:** 5 h
Guided activities: 5h

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**GRADING SYSTEM**

- Laboratory assignments: 15%
- Academic Intended To Tender (ITT, ESA-like proposal): 30%
- Synthesis test: 55%

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**BIBLIOGRAPHY**

**Basic:**

**Complementary:**

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**RESOURCES**

**Other resources:**