

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

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2019
Degree: MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Teaching unit Optional)
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: Hernandez Pajares, Manuel

Opening hours

Timetable: Wednesday, 11h-13h

Prior skills

Basic knowledge on Physics and Mathematics.

Requirements

Degree related with Global Navigation Satellite Systems (GNSS).

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.



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Study load

Total learning time: 125h	Hours large group:	26h	20.80%
	Hours medium group:	0h	0.00%
	Hours small group:	13h	10.40%
	Guided activities:	0h	0.00%
	Self study:	86h	68.80%

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Content

1. Introduction to space geodesy

Degree competences to which the content contributes:

1.1. Space geodesy and GPS.

Degree competences to which the content contributes:

1.2. Basic concepts and historical development

Degree competences to which the content contributes:

2. Global positioning system

Degree competences to which the content contributes:

2.1. Introduction.

Degree competences to which the content contributes:

2.2. Space segment.

Degree competences to which the content contributes:

2.3. Control segment.

Degree competences to which the content contributes:

2.4. Principles of signal structure and observation.

Degree competences to which the content contributes:

2.5. GPS ephemeris and message structure

Degree competences to which the content contributes:

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3. Orbital movement of a satellite

Degree competences to which the content contributes:

3.1. Trajectory of a satellite in the Earth's gravitational field.

Degree competences to which the content contributes:

3.2. Elliptical movement of a satellite

Degree competences to which the content contributes:

3.3. Orbital elements.

Degree competences to which the content contributes:

3.4. Perturbed movement of a satellite.

Degree competences to which the content contributes:

3.5. Orbit determination

Degree competences to which the content contributes:

4. Fundamentals of physics

Degree competences to which the content contributes:

4.1. Topics of reference.

Degree competences to which the content contributes:

4.2. Weather.

Degree competences to which the content contributes:

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4.3. Electromagnetic signal propagation

Degree competences to which the content contributes:

5. GPS observables and data processing

Degree competences to which the content contributes:

5.1. Observables

Degree competences to which the content contributes:

5.2. Parameter estimation.

Degree competences to which the content contributes:

5.3. Data reprocessing.

Degree competences to which the content contributes:

5.4. Least squares.

Degree competences to which the content contributes:

5.5. The Kalman filter.

Degree competences to which the content contributes:

5.6. Fast GPS methods.

Degree competences to which the content contributes:

5.7. GPS navigation

Degree competences to which the content contributes:

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6. Errors and corections

Degree competences to which the content contributes:

6.1. Basic considerations: precision versus exactitude.

Degree competences to which the content contributes:

6.2. Apparent geometry of constellations.

Degree competences to which the content contributes:

6.3. Orbits and clocks.

Degree competences to which the content contributes:

6.4. Signal propagation.

Degree competences to which the content contributes:

6.5. Reception systems.

Degree competences to which the content contributes:

6.6. System integrity

Degree competences to which the content contributes:

7. Applications

Degree competences to which the content contributes:

7.1. Ionosphere modelling.

Degree competences to which the content contributes:

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7.2. Troposphere modelling

Degree competences to which the content contributes:

Planning of activities

Answers in the Lab sessions.	Hours: 40h Laboratory classes: 13h Theory classes: 27h
<p>Support materials: Book with scripts for laboratory sessions, software and questionnaires in the fundamental GNSS aspects. Slides with new teaching software for additional fundamental GNSS aspects.</p> <p>Specific objectives: Learning from Actual GNSS Data (LeGAD).</p>	
Academic-ITT	Hours: 5h Guided activities: 5h
<p>Description: Design of a proposal following the model of the European Space Agency (ESA).</p> <p>Support materials: List of scientific and technical GNSS open problems.</p> <p>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.</p>	

Qualification system

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

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Bibliography

Basic:

Hernández-Pajares, M.; Juan, J.M.; Sanz, J. GPS data processing: code and phase algorithms, techniques and recipes [on line]. Barcelona: Centre de Publicacions del Campus Nord, 2008 [Consultation: 01/10/2015]. Available on: <http://gage.upc.edu/sites/default/files/TEACHING_MATERIAL/GPS_BOOK/ENGLISH/PDGPS/BOOK_PDGPS_gAGE_NAV_08.pdf>. ISBN 8493223050.

Hernández, M.; Juan, J.M.; Sanz, J. Tratamiento de datos GPS: prácticas de laboratorio [on line]. Barcelona: Edicions UPC, 1997 [Consultation: 04/03/2015]. Available on: <<http://hdl.handle.net/2099.3/36420>>. ISBN 8483012146.

Complementary:

Wells, D. Guide to GPS positioning. Fredericton: Canadian GPS Associates, 1986. ISBN 0920114733.

Seeber, G. Satellite geodesy. 2nd compl. rev. and ext. ed. Berlin [etc.]: Walter de Gruyter, 2003. ISBN 3110175495.

Hofmann-Wellenhof, B.; Lichtenegger, H.; Collins, J. Global positioning system: theory and practice. 5th rev. ed. Wien [etc.]: Springer-Verlag, 2001. ISBN 3211835342.

Others resources: