Course guide
230378 - GNSS - Big Gns Data: From Remote Sensing to Space Weather

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

Degree:
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2022). (Optional subject).

Academic year: 2023  ECTS Credits: 3.0  Languages: English

LECTURER
Coordinating lecturer: Consultar aquí / See here:
https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignat

Others: Consultar aquí / See here:
https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

REQUIREMENTS
Basic knowledge of Mathematics and Physics (at the level of secondary education)

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE5. Ability to design radio-navigation and location systems, as well as radar systems.
CEE13. Ability to analyze and evaluate the performance at the physical level of the main devices and sensors, the relations between magnitudes in their terminals and their equivalent circuits.
CE15. Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.

Transversal:
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

TEACHING METHODOLOGY
Application lectures
Expositive lectures
Personal work (non classroom)
Short-answer questions (Test)
LEARNING OBJECTIVES OF THE SUBJECT

To introduce the basic concepts of Remote Sensing and Space Weather with the Global Navigation Satellite Systems (GNSS)

Learning outcome:
He/she expresses clearly the process of planning and solving exercises and problems that require the use of GNSS.
He/she understands and masters the most useful methods to solve problems in the area of this subject.
He/she addresses numerical description and formulation of problems with descriptive description.
He/she makes use of more than one source and uses it in a complementary manner to observe the events described in the main text.
He/she identifies problems and models from open situations and explores alternative resolutions.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>14,0</td>
<td>18.67</td>
</tr>
<tr>
<td>Self study</td>
<td>51,0</td>
<td>68.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>10,0</td>
<td>13.33</td>
</tr>
</tbody>
</table>

Total learning time: 75 h

CONTENTS

1) Introduction to GNSS

Description:
1.1 Concept, signals and formats
1.2 Segments
1.3 Basic and precise models

Related competencies:
CEE13. Ability to analyze and evaluate the performance at the physical level of the main devices and sensors, the relations between magnitudes in their terminals and their equivalent circuits.
CE15. Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.
CE5. Ability to design radio-navigation and location systems, as well as radar systems.
CTS. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Full-or-part-time: 19h
Theory classes: 4h
Self study: 15h
GNSS tropospheric remote sensing

Description:
2.1 Tropospheric delay estimation with GNSS
2.2 Application to the monitoring of extreme weather events (hurricanes, sudden river rise)

Related competencies :
CEE13. Ability to analyze and evaluate the performance at the physical level of the main devices and sensors, the relations between magnitudes in their terminals and their equivalent circuits.
CE15. Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.
CE5. Ability to design radio-navigation and location systems, as well as radar systems.
CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Full-or-part-time: 10h
Theory classes: 2h
Self study : 8h

GNSS ionospheric remote sensing

Description:
content english

Specific objectives:
3.1 Ionospheric delay estimation with GNSS
3.2 Practical lectures of introduction to Linux and IonSAT-tools
3.2 Medium Scale Travelling Ionospheric Disturbances
3.3 Tsunami warning and monitoring

Related competencies :
CEE13. Ability to analyze and evaluate the performance at the physical level of the main devices and sensors, the relations between magnitudes in their terminals and their equivalent circuits.
CE15. Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.
CE5. Ability to design radio-navigation and location systems, as well as radar systems.
CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Full-or-part-time: 21h
Theory classes: 2h
Laboratory classes: 8h
Self study : 11h
Space Weather with GNSS

**Description:**
4.1 Geomagnetic storm footprint in GNSS
4.2 Solar flare detection and measurement with GNSS
4.3 Achievement in Feb. 2020: Stellar flare detection and measurement with GNSS

**Related competencies:**
CEE13. Ability to analyze and evaluate the performance at the physical level of the main devices and sensors, the relations between magnitudes in their terminals and their equivalent circuits.
CE15. Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.
CE5. Ability to design radio-navigation and location systems, as well as radar systems.
CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

**Full-or-part-time:** 22h
Theory classes: 4h
Laboratory classes: 2h
Self study: 16h

### ACTIVITIES

**Presentations of Academic ITT proposal**

**Description:**
Presentations of the Academic-ITT proposal

**Related competencies:**
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

**Full-or-part-time:** 2h
Theory classes: 1h
Self study: 1h

**Final exam**

**Description:**
Final test

**Full-or-part-time:** 2h
Theory classes: 2h
**GRADING SYSTEM**

The assessment is based on:

a) The answers to the questionnaire of the lab session at point unit 3 (20%)

b) The proposal the students have to submit individually (or in pairs) and defend (30%), as an answer to an "Academi Intended To Tender" (aITT) posed by the teacher, emulating the European Space Agency (ESA)

c) Final exam (50%)

In this subject the generic competences will be evaluated:

- Autonomous learning (Elementary level)
- Ability to identify, formulate and solve engineering problems (Elementary level)

**BIBLIOGRAPHY**

**Basic:**


- Singh, T., Hernández-Pajares, M., Monte, E., García-Rigo, A., & Olivares-Pulido, G. "GPS as a solar observational instrument: real-time