Course guide
230257 - TELESP - Space Telecommunications

Last modified: 09/11/2022

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Academic year: 2022       ECTS Credits: 6.0       Languages: English

LECTURER

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

PRIOR SKILLS

Digital communications. RF circuits and techniques. Radio links and antennas.

REQUIREMENTS

INTRODUCTION TO COMMUNICATIONS - Prerequisite
RADIATION AND PROPAGATION - Prerequisite

TEACHING METHODOLOGY

Lectures and proposed activities.

LEARNING OBJECTIVES OF THE SUBJECT

To provide students with a good knowledge of the most widespread techniques used in satellite communications. Basic contents of the course are the following. Description of a space radio link and its power balance. Multiple access and packet radio techniques. VSAT systems. Satellite-based mobile communications systems.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Hours large group</td>
<td>39,0</td>
<td>26.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>13,0</td>
<td>8.67</td>
</tr>
<tr>
<td>Self study</td>
<td>98,0</td>
<td>65.33</td>
</tr>
</tbody>
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Total learning time: 150 h
## CONTENTS

1. **Introduction**

   **Description:**
   Introduction to space communications

2. **A study of the environment in space.**

   **Description:**
   2.1 Introduction
   2.2 Orbital principles and orbits
   2.3 Limitations of the space communications
   2.4 Different orbits used in satellite communications
   2.6 Satellite launch

3. **Payload.**

   **Description:**
   3.1 Introduction to the satellite subsystems
   3.2 Payload description
   3.2.1 Transponder
   3.2.2 High Power Amplifier (non-linear HPA)
   3.3 Antenna subsystem

4. **Satellite channel.**

   **Description:**
   4.1 Propagation in free space conditions
   4.2 Atmospheric impairments
   4.3 Interferences
   4.4 Multipath in satellite systems (Land Mobile Satellite Channel)
   4.5 Noise in satellite communications

5. **Link budget**

   **Description:**
   5.1 Propagation loss
   5.1.1 Transmission equation. PIRE
   5.1.2 Atmospheric gases attenuation
   5.1.3 Rain attenuation
   5.2 Noise
   5.2.1 Temperature of antenna
   5.2.2 Atmospheric noise
   5.2.3 G/T factor
   5.3 Link budget: some examples
   5.4 Link budget in deep space communications
6. PHY in satellite communications.

**Description:**
6.1 Introduction to PHY Layer
6.2 Modulations (a satellite communications perspective)
6.3 Channel coding (a satellite communications perspective)

7. MAC in satellite communications.

**Description:**
7.1 Introduction to MAC techniques
7.2 FDMA / TDMA / CDMA
7.3 Random access techniques
7.4 Review of MAC techniques (a satellite communications perspective)


**Description:**
9.1 Recent and future ESA / NASA projects
9.2 Satellite Laser Communications
9.3 High Throughput Satellites (HTS)
9.4 Deep Space Comunications

8. Networks and digital satellite services.

**Description:**
8.1 Broadcast Satellite Services
DVB-S, DVB-S2, DVB-SH
8.2 Return link with satellite.
DVB-RCS. Example Amheris.
8.3 VSAT networks.
VSAT link.
8.4 Mobile Satellite Services (MSS)
Examples: Inmarsat, Iridium, Globastar.
8.5 IP satellite
Examples Inmarsat BGAN and ASTRACconnect.

**GRADING SYSTEM**

- Final exam : 50 %
- Midterm exam : 30 %
- Practical sessions ans proposed activities: 20%
BIBLIOGRAPHY

Basic:

Complementary:

RESOURCES

Other resources:
Classroom slides. Collection of exercises and exams (with solutions).