230054 - RCOMSISTEL - Radio Communications

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications
Academic year: 2018
Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2010).
(Business unit Compulsory)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: Perez Romero, Jorge
Others: Casadevall Palacio, Fernando-Jose
Perez Romero, Jorge
Sallent Roig, Jose Oriol

Degree competences to which the subject contributes

Generical:
12 CPE N3. They will be able to identify, formulate and solve engineering problems in the ICC field and will know how to develop a method for analysing and solving problems that is systematic, critical and creative.

Teaching methodology

Lectures
Exercises and problems
Short answer tests (Control)
Long answer test (Final Exam)

Learning objectives of the subject

Objectives:
- Study the fundamentals of the communication systems that make use of the radioelectric spectrum as a support for the communication
- Study, design and evaluation of mobile communications systems, wireless systems and fixed radio links.

Result of the learning stage:
- To be able of designing and evaluating the techniques that constitute the basis for networks, services and telecommunication applications in mobile environments, wireless systems and radio link communications, from the perspective of the communications.
- To be able to identify and model complex radiocommunications systems.
- To understand the management process of the radioelectrical spectrum and the frequency allocation
- To carry out quantitative and qualitative analysis and to evaluate the influence of approximations
- To apply the acquired competence to carry out a task in an autonomous way
- To identify the need for continuous learning and to develop an own strategy to carry it out.
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### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 65h</th>
<th>43.33%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study:</td>
<td>85h</td>
<td>56.67%</td>
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</tbody>
</table>

Total learning time: 150h

85h

43.33%
## Content

<table>
<thead>
<tr>
<th>1. Introduction</th>
<th>Learning time: 4h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Self study: 2h</td>
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</tbody>
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### Description:
- **1.1.-** Definition
- **1.2.-** Scope
- **1.3.-** Mobile communications systems and technologies

<table>
<thead>
<tr>
<th>2. Radio channel characterisation</th>
<th>Learning time: 23h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 10h</td>
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<tr>
<td></td>
<td>Self study: 13h</td>
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</tbody>
</table>

### Description:
- **2.1.-** Introduction
- **2.2.-** Propagation in mobile environments
  - **2.2.1.-** Propagation losses
  - **2.2.2.-** Slow fading
  - **2.2.3.-** Multipath propagation
    - **2.2.3.1.-** Proximity echoes: Fast fading
    - **2.2.3.2.-** Distant echoes: distortion
  - **2.2.4.-** Second order statistics
  - **2.2.5.-** Measurements
- **2.3.-** Propagación en fixed radio links
  - **2.3.1.-** Propagation losses
    - **2.3.1.1.-** Diffraction
    - **2.3.1.2.-** Refraction
    - **2.3.1.3.-** Antenna height
  - **2.3.2.-** Attenuation due to rain
  - **2.3.3.-** Fading due to refraction
- **2.4.-** Noise
- **2.5.-** Interference
### 3.- Radio link budget

**Description:**
- 3.1.- Quality objectives
- 3.2.- Performance model of the radio channel
  - 3.2.1.- Gaussian channel
  - 3.2.2.- Rayleigh channel
- 3.3.- Power budget
  - 3.3.1.- Mobile systems
  - 3.3.2.- Fixed radio links
- 3.4.- Radio engineering techniques
  - 3.4.1.- Power control
  - 3.4.2.- Equalisation
  - 3.4.3.- Channel coding and interleaving
  - 3.4.4.- Adaptive coding and modulation
  - 3.4.5.- Diversity
  - 3.4.6.- Spatial multiplexing

**Learning time:** 37h  
Theory classes: 16h  
Self study: 21h

### 4.- Mobile radio access

**Description:**
- 4.1.- Introduction
- 4.2.- Multiple access techniques
  - 4.2.1.- FDMA
  - 4.2.2.- TDMA
  - 4.2.3.- CDMA
  - 4.2.4.- OFDMA
- 4.3.- Duplexing techniques
  - 4.3.1.- FDD
  - 4.3.2.- TDD
- 4.4.- Radio access management
  - 4.4.1.- TDMA access
  - 4.4.2.- CDMA access
  - 4.4.3.- OFDMA access

**Learning time:** 40h  
Theory classes: 17h  
Self study: 23h
5.- Cellular systems

**Description:**
- 5.1.- Model of a cellular system
- 5.2.- Control and management of cellular systems
- 5.3.- Dimensioning of a cellular system
- 5.4.- Dimensioning of FDMA/TDMA cellular systems
  - 5.4.1.- Deployment of resources
  - 5.4.2.- Traffic characterisation
  - 5.4.3.- Dimensioning process
- 5.5.- Dimensioning of CDMA cellular systems
  - 5.5.1.- Deployment of resources
  - 5.5.2.- Traffic characterisation
  - 5.5.3.- Dimensioning process
- 5.6.- Multi-layer cellular structures
- 5.7.- Radio resource management in cellular systems
  - 5.7.1.- FDMA/TDMA systems
  - 5.7.2.- CDMA systems
  - 5.7.3.- OFDMA systems

**Learning time:** 46h
- Theory classes: 20h
- Self study: 26h

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**Qualification system**
- 60% Final Exam
- 40% Control

**Bibliography**

**Basic:**

**Complementary:**

**Others resources:**
- Radiocommunications: Slides
- Radiocommunications: Exercises
- Radiocommunications: Problems