230618 - WAN - Wireless Access Networks

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 744 - ENTEL - Department of Network Engineering
Academic year: 2017
Degree: DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 1992). (Teaching unit Optional)
DEGREE IN ELECTRONIC ENGINEERING (Syllabus 1992). (Teaching unit Optional)
MASTER'S DEGREE IN NETWORK ENGINEERING (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN INFORMATION AND COMMUNICATION TECHNOLOGIES (Syllabus 2009).
(Teaching unit Optional)
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: English

Teaching staff
Coordinator: Cruz Llopis, Luis Javier De La
Others: Paradells Aspas, Jose

Degree competences to which the subject contributes

Specific:
1. Ability to develop radio-communication systems: antennas design, equipment and subsystems, channel modeling, link dimensioning and planning.
2. Ability to implement wired/wireless systems, in both fix and mobile communication environments.

Transversal:
3. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
4. 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
- Lectures
- Application classes
- Individual work
- Group work
- Exercises
- Short answer test

Learning objectives of the subject

Learning objectives:
The aim of this course is to introduce new subjects and technologies related to wireless communication systems, focusing on those used as access networks. The main objective is to introduce concepts and technologies and to offer the analytical tools to understand its performance and to be able to dimension its capacity.

Learning results:
- Ability to design radio systems for providing voice and data services, at any time and place.
- Ability to understand the behaviour and dimension certain wireless systems used commonly.
## Study load

<table>
<thead>
<tr>
<th></th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total learning time:</strong></td>
<td>125h</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>26h</td>
<td>0h</td>
<td>13h</td>
<td>0h</td>
<td>86h</td>
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<tr>
<td></td>
<td>20.80%</td>
<td>0.00%</td>
<td>10.40%</td>
<td>0.00%</td>
<td>68.80%</td>
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</table>
## Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time: 11h</th>
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</thead>
</table>
| 1. Introduction to Wireless Access Networks | Theory classes: 2h  
Laboratory classes: 1h  
Self study : 8h |

**Description:**
- Parts of a network.
- Wireless Access Networks.
- Radioelectric spectrum.
- Spectrum division techniques: TDMA, FDMA, CDMA, OFDMA.
- Duplexing techniques: TDD and FDD.

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<tr>
<th>Section</th>
<th>Learning time: 11h</th>
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</table>
| 2. Resources Allocation Strategies. | Theory classes: 2h  
Laboratory classes: 1h  
Self study : 8h |

**Description:**
- Frequency reuse.
- Code reuse.
- Optimized systems.
- Examples of use.

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<tr>
<th>Section</th>
<th>Learning time: 11h</th>
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| 3. LPWAN Networks. | Theory classes: 2h  
Laboratory classes: 1h  
Self study : 8h |

**Description:**
- Sigfox.
- Lora.

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<th>Section</th>
<th>Learning time: 11h</th>
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| 4. Point to Multipoint Systems. | Theory classes: 2h  
Laboratory classes: 1h  
Self study : 8h |

**Description:**
- WiMAX.
## 5. Trunking Systems.

**Description:**
- Analog technologies.
- Digital technologies. TETRA.
- Dimensioning.

**Learning time:** 22h
- Theory classes: 4h
- Laboratory classes: 2h
- Self study: 16h

## 6. Delay Tolerant Networks (DTN).

**Description:**
- Architecture.
- Routing.
- Applications.

**Learning time:** 11h
- Theory classes: 2h
- Laboratory classes: 1h
- Self study: 8h


**Description:**
- GEO (Geostationary Orbit).
- MEO (Medium Earth Orbit).
- LEO (Low Earth Orbit).

**Learning time:** 11h
- Theory classes: 2h
- Laboratory classes: 1h
- Self study: 8h


**Description:**
- Topologies and advantages.
- Ad-hoc networks and mesh networks.
- Routing protocols.
- Application examples.

**Learning time:** 37h
- Theory classes: 10h
- Laboratory classes: 5h
- Self study: 22h
# Planning of activities

<table>
<thead>
<tr>
<th>LABORATORY</th>
<th>Hours: 7h</th>
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<tbody>
<tr>
<td>Description:</td>
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<tr>
<td>- LoRa Networks analysis.</td>
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<tr>
<td>- Implementation and analysis of ad-hoc and mesh networks with linux embedded devices.</td>
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<tr>
<th>EXERCISES</th>
<th>Hours: 6h</th>
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<tr>
<td>Description:</td>
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<tr>
<td>- Design, dimensioning and evaluation exercises focused on the technologies studied during the course.</td>
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<tr>
<th>SHORT ANSWER TEST (CONTROL)</th>
<th>Hours: 7h</th>
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<tr>
<td>Description:</td>
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<tr>
<td>1st Mid term control.</td>
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<tr>
<td>2nd Mid term control.</td>
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<tr>
<td>Final exam.</td>
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| Theory classes: 7h |

## Qualification system

Final exam: 60%
Midterm controls: 25%
Individual assessments: 15%

## Bibliography

**Basic:**


