Course guide
230618 - WAN - Wireless Access Networks

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 744 - ENTEL - Department of Network Engineering.

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

Academic year: 2022  ECTS Credits: 5.0  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

- Local Area Networks
- TCP/IP Protocol Architecture

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>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>86,0</td>
<td>68.80</td>
</tr>
<tr>
<td>Hours small group</td>
<td>13,0</td>
<td>10.40</td>
</tr>
<tr>
<td>Hours large group</td>
<td>26,0</td>
<td>20.80</td>
</tr>
</tbody>
</table>

Total learning time: 125 h

CONTENTS

1. Introduction to Wireless Access Networks

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

Full-or-part-time: 11h
Theory classes: 2h
Laboratory classes: 1h
Self study: 8h

2. Resources Allocation Strategies

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

Full-or-part-time: 11h
Theory classes: 2h
Laboratory classes: 1h
Self study: 8h
3. LPWAN Networks.

Description:
- Sigfox.
- Lora.

Full-or-part-time: 11h
Theory classes: 2h
Laboratory classes: 1h
Self study: 8h

4. Point to Multipoint Systems.

Description:
- WiMAX.

Full-or-part-time: 11h
Theory classes: 2h
Laboratory classes: 1h
Self study: 8h

5. Trunking Systems.

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

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

6. Delay Tolerant Networks (DTN).

Description:
- Architecture.
- Routing.
- Applications.

Full-or-part-time: 11h
Theory classes: 2h
Laboratory classes: 1h
Self study: 8h
### 8. Satellite Systems.

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

**Full-or-part-time:** 11h  
Theory classes: 2h  
Laboratory classes: 1h  
Self study: 8h

### 8. Multi-Hop Access Networks.

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

**Full-or-part-time:** 37h  
Theory classes: 10h  
Laboratory classes: 5h  
Self study: 22h

### ACTIVITIES

#### LABORATORY

**Description:**  
- LoRa Networks analysis.  
- Implementation and analysis of ad-hoc and mesh networks with Linux embedded devices.

**Full-or-part-time:** 7h  
Laboratory classes: 7h

#### EXERCISES

**Description:**  
- Design, dimensioning and evaluation exercises focused on the technologies studied during the course.

**Full-or-part-time:** 6h  
Laboratory classes: 6h
SHORT ANSWER TEST (CONTROL)

Description:
1st Mid term control.
2nd Mid term control.
Final exam.

Full-or-part-time: 7h
Theory classes: 7h

GRADING SYSTEM

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

BIBLIOGRAPHY

Basic: