Course guides
230150 - XSF - Wireless Networks

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

Degree: BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Optional subject).

Academic year: 2015  ECTS Credits: 6.0  Languages: Catalan

LECTURER

Coordinating lecturer: ANNA CALVERAS

Others: Calveras Auge, Ana M.
Paradells Aspas, Jose
Casademont Serra, Jordi

PRIOR SKILLS

C programming and linux knowledge

REQUIREMENTS

Enginyeria Telemàtica o Ciències and Tecnologies de Telecomunicació o Enginyeria de Sistemes de Telecomunicació.

TEACHING METHODOLOGY

- Lectures.
- Classes of application.
- Laboratory classes.
- Group work (learning).
- Individual (learning).
- Oral presentations.
- Exercises.
- Short answer tests.
- Testing long answer.

LEARNING OBJECTIVES OF THE SUBJECT

- Introduce a new vision of communication networks based on ubiquitous networks and low power consumption. An example: sensor networks.
- Introduce what is known as the Internet of Things, and Internet of Things (IOT), presenting the protocols used.
- Offering a new vision of communication networks where simplicity is the key to reducing power consumption and price.
- To complement the theoretical concepts with practical concepts.
- Allow different degree of participation in the course.
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>26.0</td>
<td>17.33</td>
</tr>
<tr>
<td>Hours small group</td>
<td>26.0</td>
<td>17.33</td>
</tr>
<tr>
<td>Self study</td>
<td>98.0</td>
<td>65.33</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

1. Organization course. Motivation. focus

Description:
Organization, motivation and focus of the course.

Full-or-part-time: 2h
Self study : 2h

2. Apps

Description:
Key applications of wireless networks such as wireless: home automation and building, agriculture, infrastructure monitoring, "smart cities", logistics,

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

3. Platforms

Description:
- Architecture of a wireless sensor node: Microcontroller, memory, actuator and transducer, transceiver, antennas, power (batteries, hardvesting).
- Operating systems (Contiki presentation). Trading platforms: Elements; SoC SIP modules and platforms. Presentation Platform Zolertia (Z1).
- Lab 1: Configuring and "Hello World". Configuration programming environment based on a virtualized Debian system that can run on Windows or Mac in September. Compilation and execution of the example "Hello World."
- Lab 2: Ports, LEDs, timers and buttons. use buttons, LEDs and timers in the system Contiki.

Full-or-part-time: 16h
Theory classes: 4h
Laboratory classes: 4h
Self study : 8h
### 4. Systems

**Description:**
Description of existing commercial systems such as Z-Wave, EnOcean, Insteon, ZigBee and IETF proposal (6LoWPAN/IPv6/UDP/CoAP).

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

### 5. Sensors and Actuators

**Description:**
- Review of different devices that can be connected to convert physical quantities to electrical and vice versa. Existing interfaces

**Full-or-part-time:** 8h
Theory classes: 2h
Laboratory classes: 2h
Self study: 4h

### 6. Interface radio and implications

**Description:**
MAC level topology control, organization of nodes. Types of access control mechanisms to the environment. Support periods "idle."

**Full-or-part-time:** 8h
Theory classes: 4h
Self study: 4h

### 7. IEEE802.15.4

**Description:**
- Description of the radio interface and MAC protocol most used currently in wireless sensor networks. Types of nodes. Frame formats, frame rates, access mechanisms. Use "beacons." Services. Improvements: IEEE802.15.4e, IEEE802.15.4a.

**Full-or-part-time:** 8h
Theory classes: 2h
Laboratory classes: 2h
Self study: 4h
8. Mid term exam

**Description:**
Mid term exam

**Full-or-part-time:** 8h
Practical classes: 2h
Self study: 6h

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9. IPv6

**Description:**
- Addressing and packet format.
- ICMPv6 and Neighbor Discovery.
- 6LoWPAN: adaptation layer between IEEE802.15.4 and IPv6. Header compression, fragmentation and reassembling.

**Full-or-part-time:** 12h
Theory classes: 6h
Self study: 6h

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10. Routing Protocols

**Description:**
- Basic Ideas routing in WSN. Proactive. Reactive Diffusion Geographic.
- Example: ROLL.
- Lab 5: Routing. Creating the network and routing.

**Full-or-part-time:** 12h
Theory classes: 4h
Laboratory classes: 2h
Self study: 6h

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11. Transport Protocols

**Description:**
- Lab 6: End-to-end connectivity. TCP and UDP communication in a multi-hop network.

**Full-or-part-time:** 8h
Theory classes: 2h
Laboratory classes: 2h
Self study: 4h

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12. REST based solutions

**Description:**
- HTTP COAP. Using proxies and gateways. Other alternatives.
- Lab 7: Access to information COAP sensor.

**Full-or-part-time:** 6h
Theory classes: 2h
Laboratory classes: 1h
Self study: 3h
### 13. Project

**Description:**
Construction of a complex system combining parts that were seen throughout the course: sensors and actuators, wireless communication, use of the Internet protocols (IPv6, UDP / TCP, HTTP / COAP). Groups of 3 or 4 people using at least two sensors data, an actuator and a server connected to the Internet. Must demonstrate sensing data, communication, processing, Internet connectivity and performance as a result of a specific process.

**Full-or-part-time:** 47h  
Self study : 47h

### 14. Presentation of selected projects

**Description:**
Presentation of selected projects

**Full-or-part-time:** 7h  
Theory classes: 5h  
Self study : 2h

### ACTIVITIES

#### PRACTICAL SESSIONS

**Description:**
7 laboratory sessions spread over the course detailed in the syllabus.

**Full-or-part-time:** 14h  
Theory classes: 14h

#### ORAL PRESENTATIONS

**Description:**
Oral presentation of the project developed during the course.

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

#### (ENG) CONTROLS DE RESPOSTA CURTA

**EXAM**

**Description:**
Evaluation Intermediate / Final.

**Full-or-part-time:** 1h 30m  
Theory classes: 1h 30m
**GRADING SYSTEM**

Final exam: 40%
Partial examination and controls: 15%
Exercises and monitoring of classes: 15%
group project: 15%
laboratory practice: 15%

**BIBLIOGRAPHY**

**Basic:**