Course guide
240273 - 240AU130 - Telematics

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

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2019). (Optional subject).

Academic year: 2023  ECTS Credits: 6.0  Languages: Spanish

LECTURER
Coordinating lecturer: Francisco José Rico Novella
Others: Josep Paradells Aspas

REQUIREMENTS
The course is based on the knowledge about communication systems already seen in previous courses, and goes into detail on specific systems for the automotive industry.

TEACHING METHODOLOGY
Lectures
Application classes
Individual work (non-presential)
Group work (non-presential)
Short response tests (control)
Short answer tests (test)
Long Answer Tests (Final Exam)

LEARNING OBJECTIVES OF THE SUBJECT
The course is divided into two parts that are taught in parallel, but in a coordinated manner, since the knowledge offered in each part is reused by the other.

One part aims to describe the communications used in the vehicles, including internal (communication buses) and external communications (driver, other vehicles and service platforms). The latter can be bi-directional such as those relating to access to information, or unidirectional such as those used by GNSS (Global Navigation Satellite System) systems for location purposes.
These communications have different requirements such as delay or speed, but mainly safety. Communications should be prevented from being inspected (privacy violation) or altered in such a way that the physical safety of the passengers or the vehicle itself may be compromised. Given the importance of security, the other part of the course is dedicated to this topic. Knowledge of communication security mechanisms and techniques are provided.
The course combines a theoretical and a practical part, both dedicated to study the communication systems and their security. The course is based on the knowledge about communication systems already seen in previous courses, and goes into detail on specific systems for the automotive industry. In the same way, safety concepts are introduced and exemplified in automotive communications. There are two types of classes: theoretical and application. In the first ones, the basic principles are presented and in the second ones, the knowledge is particularized to real automotive use, with the opportunity to visualize this knowledge in demonstration classes or by means of exercises.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>96.0</td>
<td>64.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>54.0</td>
<td>36.00</td>
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</tbody>
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Total learning time: 150 h

CONTENTS

Security part (Theory: 19 h, Application: 6, Autonomous learning: 48h)

Description:
1. Introduction to cryptography (Theory: 2h. Autonomous learning: 4h)
   Security Services
   Classic vs. modern cryptography
2. Symmetric key cryptography (Theory: 5h + 1h Application. Autonomous learning: 8h)
   Stream ciphers
   Block ciphers
   Encryption modes
   Applications
3. Public key cryptography (Theory: 8h + 3h Application. Autonomous learning: 21h)
   Definitions
   Complexity theory
   Diffie-Hellman
   RSA
   Other encryption methods
   Digital Signature
   Elliptic curve cryptography
   Implications of Quantum Computing
4. Tamperproof systems (Theory: 2h. Autonomous learning: 4h)
   Application to the security element
5. Examples in automotive (Theory: 4h + 2h Application. Autonomous learning: 11h)
   Jamming and spoofing
   Security algorithms in RFID: Crypto1
   Rolling Codes
   Relay attack
   Use of certificates in vehicular communications

Full-or-part-time: 25h
Theory classes: 25h
### In-vehicle communication part (Theory: 20h, Application: 5h, Autonomous learning: 48)

**Description:**
1. Services that require connection in a vehicle (Theory: 2h. Autonomous learning: 4h)
   - Maintenance
   - Location
   - Access
   - Saving on cable
   - Safe driving
   - Information and entertainment
   - Remote steering
2. Satellite based location services (Theory: 2h. Autonomous learning: 4h)
   - GNSS Systems
   - Assistance
3. Mobile phone connection with the vehicle (Theory: 4h + Application 2h. Autonomous learning: 10h)
   - Bluetooth
   - Profiles
   - Platforms (Google Android Auto, Apple CarPlay and MirrorLink)
4. Access to the vehicle (Theory: 4h + Application 2h. Autonomous learning:8h)
   - Digital keys
   - Immobilizer
   - RFID
   - Wireless keys
   - Access Control
   - Wake-up systems
   - Location system
5. Saving cable (Theory: 1h. Autonomous learning: 2h)
   - Tyre pressure monitoring
6. Cellular systems (Theory: 3h + Application 1h. Autonomous learning: 8h)
   - 4G and 5G
   - eCall
7. Vehicle to vehicle communications (Theory: 4h Autonomous learning: 12h)
   - IEEE802.11p
   - C-V2X
   - Protocol architectures

**Full-or-part-time:** 25h

Theory classes: 25h

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**GRADING SYSTEM**

**BIBLIOGRAPHY**

**Basic:**

**Complementary:**