The connected vehicle:

Name of the subject (English): The connected vehicle
Name of the subject (Català): El vehicle connectat
Name of the subject (Español): El vehículo conectado

Coordinating unit: ETSETB - Escola Tècnica Superior d'Enginyeria de Telecomunicació de Barcelona

Teaching unit: Telematics Engineering Department; Electronical Engineering Department

Study programme:
- Master in Telecommunications Engineering
- Master in Electronic Engineering
- Telecommunications Engineering (Pla92)
- Electronic Engineering (Pla92)

ECTS credits: 2.5

Type of subject (compulsory, elective, seminar): Elective

Type of learning (face-to-face, semi-distance learning, distance learning): Face-to-face

Weekly hours of theory and laboratory (3T+0L, 2T+1L, 1T+2L, 0T+3L): 3T+0L

Pre-requisites: -
Co-requisites: -

Coordinator: Josep Paradells

Other teaching staff: Ferran Silva

Capacity of the course: 20

Classroom: --

Laboratory: --

Capacity of the laboratory: -

Master competences to which the subject contributes:

Specific competences:
- CE3: Ability to implement wired and wireless systems, in both fix and mobile communication environments.
- CE4: Ability to design and dimension transport, broadcast and distribution networks for multimedia signals.
- CE6: Ability to model, design, implement, manage, operate, administrate and maintain networks, services and contents.
- CE7: Ability to plan networks and decision-making about services and applications taking into account: quality of service, operational and direct costs, implementation
plan, supervision, security processes, scalability and maintenance. Ability to manage and assure the quality during the development process.

- CE8: Ability to understand and to know how to apply the functioning and organization of the Internet, new generation Internet technologies and protocols, component models, middleware and services.

- CE9: Ability to deal with the convergence, interoperability and design of heterogeneous networks with local, access and core networks, as well as with service integration (telephony, data, television and interactive services).

- CE12: Ability to use programmable logical devices, as well as to design analog and digital advanced electronics systems. Ability to design communication devices, such as routers, switches, hubs, transmitters and receivers in different bands.

- CE15: Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.

Transversal competences:

- CT1: Entrepreneurship and Innovation. To know and understand the organization of a company and the sciences that define its activity, ability to understand business rules and relationships between planning, industrial and commercial strategies, quality and profit.

- CT4: Solvent use of information resources. Managing the acquisition, structure, analysis and visualization of data and information in the field of the speciality and critically evaluate the results of this effort.

- CT5: Third language. Learning a third language which shall preferably be English, with an appropriate level of oral and written form and in line with the future needs of the graduates.

Teaching methodology:

- Lectures
- Laboratory classes
- Laboratory practical work
- Extended answer test (Final Exam)

Learning objectives and results of the subject:

Learning objectives of the subject:
At present, electronics and telematics are taking a relevant role in the car. Communications are used to connect the different elements in the car, to interact with the smartphone of the user, to connect to Internet or even to other vehicles. Internet has reached all the places and
it is starting to be present in cars. This seminar focuses on the real possibilities of communications in the car and the technologies that are available for doing so.

During classes, laboratory activities will be described that can be done at home as a complementary activity. It is mandatory to carry out two of these so called “at home lab” per student, delivering a report up to one week after the finishing of the seminar.

Learning results of the subject:
- The seminar introduces the different technologies used in a vehicle, ranging from the internal wired buses, remote keys, NFC to identify the driver in front of the car, Bluetooth to interact with the audio and the telephone system, to the DSRC for communicating with the road and other vehicles.

Study load:
Total learning time: 62,5h
- Large group/Theory classes: 20h
- Guided study: 22,5h
- Self study: 20h

Content:
Day 1:
Description:
- Part B: Automotive Buses.
Dedication: 5h
- Large group/Theory classes: 3h
- Self study: 2h

Day 2:
Description:
- Part A: Automotive Buses. CAN bus.
- Part B: Automotive Buses. LIN and FlexRay.
Dedication: 5h
- Large group/Theory classes: 3h
- Self study: 2h
Day 3
Description:
- Part B: Remote keys. Tire monitoring.
Dedication: 5h
- Large group/Theory classes: 3h
- Self study: 2h

Day 4
Description:
- Part A: RFID and applications.
- Part B: NFC.
Dedication: 5h
- Large group/Theory classes: 3h
- Self study: 2h

Day 5
Description:
- Part A: Bluetooth
- Part B: Cellular communications. eCall initiative
Dedication: 5h
- Large group/Theory classes: 3h
- Self study: 2h

Day 6
Description:
- Part A: Wireless LAN. DSRC.
- Part B: Internet access.
Dedication: 5h
- Large group/Theory classes: 3h
- Self study: 2h

Day 7
Description:
- Part B: Exam.
Dedication: 10h
- Large group/Theory classes: 2h
- Self study: 8h
Laboratory at home (home lab): The student has to carry out 2 assignments to choose among the following:

- CAN bus at home lab proposal
- NFC at home lab proposal.
- Bluetooth at home lab proposal
- WLAN at home lab proposal.
- Mobile IP at home lab proposal.
- Remote terminal at home lab proposal.

Dedication: 22,5h
- Guided study: 22,5h

**Planning of activities:**

Classes will be organized in two parts (Part A and Part B) of 1h30min, except the last day where each part will last 1h.

**Qualification system:**

Final examination: 60%
Participation in class: 15%
Individual assessments (At home lab assignments, at least 2 of the offered): 25%

**Bibliography:**

**Basic:**

G. Held, “Inter- and Intra- Vehicle Communications”, Auerbach Publishers Inc. 2007
