Course guide
330531 - TICA - Information and Communication Technologies in the Automotive Industry

Last modified: 04/05/2023

Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Demirkol, Ilker Seyfettin

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE3. Basic knowledge on the use and programming of computers, operating systems, databases and software with application in engineering.
CE16. Applied knowledge of industrial computing and communications in the automotive sector.

Transversal:
1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
2. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
4. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

TEACHING METHODOLOGY

The student learning is achieved through various methods. In the participatory lectures carried out in the classroom, the theoretical contents of the subject are presented and the interaction between the students and the teacher is targeted. Individual or group activities are also proposed to contribute to the learning of the subject.

In laboratory classes, students carry out preliminary work that helps to put in context the work that is intended to be carried out in the laboratory. The laboratory work itself is developed in groups and allows experimenting with certain aspects developed in the subject. The writing of the report and the interaction with the teacher in the laboratory allow working on the oral and written communication skills.

Through the semester project of the subject, students will practice the problem-based learning and the teamwork skills. The project will provide the opportunity to develop a solution to a real engineering problem, without putting too many restrictions on the chosen solution. The writing of the report and the presentation of the project at the end of the course allows to work on the oral and written communication skills.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, the student will be able to:
• Compare key intra-vehicle communication solutions
• Analyze intra-vehicle communication protocol messages
• Contrast the vehicule-to-vehicle networking standards
• Experiment the user-vehicle interface communication solutions
• Describe autonomous vehicle components and their development challenges
• Report security issues of current ICT tecnologies used in vehicles

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours small group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Introduction

Description:
. Technological components of a vehicle
. Connected Vehicles: Connectivity within and between vehicles, to the Internet
. Intelligent Transportation Systems (ITS)
. Communication fundamentals
. Internet architecture, the OSI standard

Related activities:
All the relevant ones.

Full-or-part-time: 20h
Theory classes: 6h
Laboratory classes: 2h
Self study : 12h

Intra-vahicle Networking

Description:
. Standards and protocols
. CAN, LIN, FlexRay, MOST, Ethernet, OBD

Related activities:
All the relevant ones.

Full-or-part-time: 55h
Theory classes: 14h
Laboratory classes: 8h
Self study : 33h

Global Connectivity and Vehicle-User Communication

Description:
. Wireless communication basics
. Communication and vehicle-user interface
. Bluetooth, WiFi HotSpot
. GPS, RFID, eCall
. Remote Keyless Entry

Related activities:
All the relevant ones.

Full-or-part-time: 45h
Theory classes: 14h
Laboratory classes: 4h
Self study : 27h

Vehicle-to-vehicle communication

Description:
. V2X Communication
. LTE C-V2X, 4G / 5G D2D
. DSRC, IEEE 802.11p

Related activities:
All the relevant ones.

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

Principles of autonomous driving

Description:
. Automotive software development
. Software architectures
. Sensors and actuators
. Artificial intelligence for autonomous vehicles
. Cybersecurity

Related activities:
All the relevant ones.

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

ACTIVITIES

Lectures

Description:
In the lectures, the theoretical aspects of the subject will be developed. We will serve teaching methods of cooperative learning and active learning. These methods will allow interaction among the students, and between the student and the teacher.

Specific objectives:
At the end of these activities, the student will be able to:
• Compare intra-vehicle communication solutions
• Analyze intra-vehicle communication protocol messages
• Contrast "vehicle-to-everything" (V2X) network standards
• Experiment different user-vehicle interface communication solutions
• Describe the components of the autonomous vehicle and its development challenges
• Report on the security problems of ICT technologies used in vehicles

Material:
Recommended bibliography
Published teaching material

Delivery:
Regular quizzes will be conducted, which will contribute proportionally to the QUIZ variable.

Full-or-part-time: 46h
Theory classes: 46h

Study of the contents

Description:
The study of the contents is the individual and/or collective activity that leads to understand and assume the knowledge, vocabulary and techniques that are part of the contents of the subject.

Material:
Recommended bibliography
Published teaching material

Full-or-part-time: 80h
Self study: 80h

Laboratory classes

Description:
Laboratory practices will be carried out in groups of two people. The teacher will make a particular follow-up of the evolution of the students.

Specific objectives:
At the end of these activities, the student will be able to:
• Analyze intra-vehicle communication protocol messages
• Experiment different user-vehicle interface communication solutions

Material:
Information of the practice to be carried out.
Laboratory equipment.
Recommended bibliography.
Published teaching material.

Delivery:
Before carrying out the practice, students will do an individual prior study corresponding to the practice to be done.
During the session the achievement of the objectives of each laboratory session will be assessed taking into account the degree of understanding of the work demonstrated by each student.
At the end of each practice each group will provide a report explaining the work done and the knowledge acquired.
The qualification obtained in these activities configures the LAB variable.

Full-or-part-time: 14h
Laboratory classes: 14h

Final Exam

Description:
At the end of the course, a final exam of the acquired knowledge will be carried out.

Material:
Exam announcement
The compilation of the entire course notes

Delivery:
The final exam score defines the variable FIN.

Full-or-part-time: 10h
Self study: 10h

GRADING SYSTEM

The final grade for the course will be obtained as follows:
Final score = 0.25*LAB+ 0.375*QUIZ + 0.375*FIN

EXAMINATION RULES.

. All activities are compulsory.
. If any of the activities of the subject are not carried out, it will be graded as zero.
. Carrying out laboratory activities is a necessary condition to pass the subject.
. The dates, formats and other delivery conditions established will be mandatory.

BIBLIOGRAPHY

Basic:

- Mueck, Markus; Karls, Ingolf. Networking vehicles to everything : evolving automotive solutions. Berlin: deGpress, 2018. ISBN 9781501515729.
- Held, Gilbert. Inter -and intra-vehicle communications [on line]. Boca Raton: CRC Press, 2008 [Consultation: 23/12/2020]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=321835. ISBN 9780367388317.

Complementary:

- Ribbens, William B. Understanding automotive electronics : an engineering perspective [on line]. Eight edition. Oxford: Butterworth-Heinemann, 2017 [Consultation: 30/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=4882541. ISBN 9780128104354.
- Smith, Craig. The Car hacker's handbook : a guide fot the Penetration tester. San Francisco: No Starch Press, 2016. ISBN 9781593277031.
- Staron, Miroslaw. Automotive software architectures : an introduction [on line]. Cham: Springer, [2017] [Consultation: 22/09/2022]. Available on: https://renoir.upc.edu/login/tipus.php?url=https%3A%2F%2Febookcentral.proquest.com%2Flib%2Fupcatalunya-ebooks%2Fdetail.action%3Fpq-origsite%3Dprimo%26docID%3D6510182&logup=false. ISBN 9783319586090.