

## 240216 - 240AU054 - Connected Vehicle

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering  
Teaching unit: 744 - ENTEL - Department of Network Engineering  
Academic year: 2019  
Degree: MASTER' S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2019). (Teaching unit Compulsory)  
ECTS credits: 6 Teaching languages: Catalan, Spanish

### Teaching staff

Coordinator: De La Cruz Llopis, Luis Javier  
Others: Casademont Serra, Jordi

### Teaching methodology

Lectures  
Application classes  
Laboratory classes  
Laboratory sessions  
Individual work (not presential)  
Group work (not presential)  
Short-answer tests (Control)  
Short-answer tests (Test)  
Extended-response tests (Final Exam)

### Learning objectives of the subject

This subject aims to provide attendees with the basic knowledge of different infrastructures and communication systems used by vehicles, both for internal communications between their own electronic systems and for external communications with other vehicles or with other devices on the road. To do this, the theory classes are combined with several laboratory sessions.

The course starts with basic concepts of transmission systems and communication networks, provides a global view of the more used protocol hierarchies, and finish with a detailed description of the ETSI standards for intelligent transport systems.

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### Content

Lesson 1. Basic concepts.	Learning time: 11h Theory classes: 4h Laboratory classes: 0h Self study : 7h
Description: Channels and nodes in communications networks. Multiplexing of transmission channels. Network topologies. Switching modes. Protocol architectures.	
Lesson 2. Data link.	Learning time: 45h 30m Theory classes: 6h Laboratory classes: 6h Self study : 33h 30m
Description: Flow control and error control. Medium access control techniques. Vehicle internal communication buses. Local area networks.	
Lesson 3. TCP / IP protocol architecture	Learning time: 36h 30m Theory classes: 8h Laboratory classes: 3h 30m Self study : 25h
Description: Basic network protocols (IP, ARP, ICMP). Transport protocols (UDP, TCP).	
Lesson 4. Cellular networks.	Learning time: 36h Theory classes: 5h Laboratory classes: 2h Self study : 29h
Description: Cellularization Control and management functions of a cellular system: transfer, search, location. Cellular systems: Evolution, LTE, 5G.	

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Lesson 5. Intelligent transport systems.	Learning time: 21h Theory classes: 4h Laboratory classes: 2h Self study : 15h
Description: Protocol architecture ETSI-G5. Facilities. Basic transport protocol. GeoNetworking. Access 802.11p and C-V2X.	

### Qualification system

- This subject has theory (60%) and laboratory (40%) evaluation.
- Both the theory part and the laboratory part have continuous evaluation, consisting of two mid term controls for each part. The value of each mid term control is 50% of its corresponding part (theory or laboratory). The subject can be passed directly with the continuous assessment.
- In case of not passing the theory part with the continuous evaluation, a final theory exam has to be carried out.
- To pass the subject, the attendance to laboratory class must be 100%, except cases justified in writing.

### Bibliography

#### Basic:

Forouzan, Behrouz A. Data communications and networking. 5th ed. New York: McGraw-Hill, 2013. ISBN 9780071315869.

European Telecommunications Standards Institute. Intelligent Transport Systems (ITS) : Communications Architecture [online]. V1.1.1. Sophia Antipolis: ETSI, 2010 [Consultation: 28/06/2019]. Available on:  
 <[https://www.etsi.org/deliver/etsi\\_en/302600\\_302699/302665/01.01.01\\_60/en\\_302665v010101p.pdf](https://www.etsi.org/deliver/etsi_en/302600_302699/302665/01.01.01_60/en_302665v010101p.pdf)>.