Course guide
205121 - 205121 - Industrial Wireless Communication Systems

Last modified: 02/04/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN SPACE AND AERONAUTICAL ENGINEERING (Syllabus 2016). (Optional subject).

Academic year: 2024 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Bertran Albertí, Eduard

Others:

TEACHING METHODOLOGY

It will be assumed that the students have previously enrolled in the course of Fundamentals of Industrial Wireless Communications.

The theoretical sessions (large groups) belonging to the first syllabus module are based on traditional lectures, where the formal explanation of the professor is combined with previous student's motivations, aiming to motivate the problem to be solved and to prepare the acquisition of the basic concepts. It will be ensured that the expository cadence is assumable by students, adapting the teaching of the different points of the module among different taxonomies, comprised between teaching (operation capability) and showing (knowledge and language), according to the time and the relevance of each particular topic regarding the objectives of the course. The second module has a more disseminator profile, where the knowledge acquired throughout the course is applied, consolidated and, occasionally, expanded.

In the application / laboratory sessions, students can work individually or in couples, either doing work from simulation programs, professional documentation (standards and catalogs) or radio-communication (hardware) products.

LEARNING OBJECTIVES OF THE SUBJECT

This subject is a continuation, in a more practical approach, of the previous subject of FUNDAMENTALS OF INDUSTRIAL WIRELESS COMMUNICATION. This new subject goes on with the study and evaluation of equipment, subsystems and structures constitutive of a radio-communication system, and case-studies from regulations, standards and real products are developed. This will include evaluating whether a radio-communication equipment/system complies with regulations in order to face its homologation, or for its allowable use in the public radio-electric spectrum. Simulation of communications equipment and subsystems is carried out, and an SDR receiver is started up and experimented with.

STUDY LOAD

Type	Hours	Percentage
Self study	48,0	64.00
Hours large group	27,0	36.00

Total learning time: 75 h

CONTENTS

Module 1: Radiommunication equipment and subsystems

Description:
• Communications electronics. Differences with low frequency. Device models. Need for impedance matching. Cables: reflections. S parameters (interpretation). Reading of Smith's chart.
• Non-linearities and derived problems: IMR, ACPR, dynamic margins, harmonic zones. Measures. Physical layer: transmission masks.
• Radio links and propagation mechanisms. Power levels. Frequency bands according to applications and licenses. QoS.
• Fundamental parameters to buy or specify RF equipment: - Related to power amplifiers (bandwidths, powers, intermodulations, consumption / energy efficiency). Standing waves and protections. - Related to receiver front-end (noise, sensitivity, filtered stability, auto-couplings).
• Antennas. Fundamental concepts. Polarization. Types and parameters (antenna engineering). Baluns. Antenna’s placement. Commercial antennas and antennas in airport environments. Commercial cables and connectors.

Related activities:
- Theoretical lectures with examples.
- Practice 1. Simulations: 4nec2, RFSIM, smithchart.net ...
- Practice 2: Radio link computation - link budget (Radio Mobile program).

Full-or-part-time: 46h
Theory classes: 16h
Self study : 30h

Module 2: Radio standards for industry applications

Description:
Practical lectures: introduction and discussion of some radio-communications standards: PMR, TETRA, industrial radio buses, NFC / RFID, Bluetooth, Zigbee, WiFi and other standards of the IEEE, GSM, UMTS, LTE, 5G, ...

Related activities:
Practice 3: Evaluation / comparison of the physical layer of chipsets (type Bluetooth, Zigbee, 802.11ac, LoRa, ...)

Full-or-part-time: 12h
Theory classes: 4h
Self study : 8h

Module 3: Applications (guided projects)

Description:
(individually or in couples). A work to be chosen among:
- Start-up and experimentation of an SDR receiver, type RTL2832U.
- Programming a WiFi connection by means of Arduino UNO WIFI
- Searching a commercialized emitter and / or a receiver suitable(s) for a certain application (to be chosen). Evaluate the technical characteristics and foresee the difficulties that could arise from the points of view of QoS and product acceptance.
- Finding a set of integrated circuits allowing the necessary functions to be carried out for a certain standard (LoRa, Bluetooth, ...), in the way they can be integrated on the same printed circuit board where there is, for example, the electronic controller of an industrial product.
- Select and advance into someone of the other topics covered along the course.

Related activities:
Application’s development

Full-or-part-time: 17h
Theory classes: 7h
Self study : 10h

GRADING SYSTEM

What is sought in the course is to acquire knowledge at the level of understanding, analysis and evaluation, more at the qualitative level than at the quantitative one. So, the evaluation will be based on the reports of the works and practices. The final work will have a weight of 40%, being the rest of work individually weighted at 20%.