

## 230655 - MTP - Management of Telecommunications Projects

Coordinating unit:	230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit:	701 - AC - Department of Computer Architecture
Academic year:	2019
Degree:	MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Compulsory) MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Compulsory) MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Teaching unit Optional) MASTER'S DEGREE IN INFORMATION AND COMMUNICATION TECHNOLOGIES (Syllabus 2009). (Teaching unit Optional) MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits:	5
Teaching languages:	English

### Teaching staff

Coordinator:	Prof. Carles Puente (CP) Consultant an Program Coordinator
Others:	Prof. Sebastián Blanch (SB) Consultant Antenna and RF hardware. Optics and RF Labs. Prof. Adolfo Comerón (AC) Consultant Optical Free Space Communications, Photonics and RF hardware. Optics and RF Labs. Prof. Juan A. Chávez (JC) Consultant Electronics/Embedded systems. Electronics Labs. Prof. Manuel Domínguez (MD) Consultant - Electronics/Embedded systems. Electronics Labs. Prof. José A. Lázaro (JL) Consultant - Optical Communications, Photonics Hardware. Prof. Josep Paradells (JPa) Consultant Telecom protocols, Telematics. Prof. Josep Pegueroles (JPe) - Consultant Telecom protocols, Telematics. Prof. Carles Puente (CP) Consultant an Program Coordinator Project and Team management. Antennas. Optical communications. Prof. Josep Solé Pareta (JS) Consultant Digital systems and Multiple Access (MAC) protocols. Prof. Anna Umbert (AU) Consultant Radiocommunications and Systems. Radio Spectrum Regulations.

### Degree competences to which the subject contributes

#### Specific:

- CEE26. Ability to identify funding sources and prepare innovative projects in the area of electronic companies.
- CEE1. Ability to understand and apply the principles of operation of power electronic systems in regulation, undulation and amplification applications.
- CEE16. Ability to specify and develop embedded systems using RTOS.
- CEE22. Ability to characterize deterministic and random signals in time or space, and in the frequency domain.
- CEE25. Ability for the development, direction, coordination, and technical and financial management of electronic focused ICT projects.
- 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).
- CE10. Ability to design and manufacture integrated circuits
- CE15. Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader

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and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.

CEE11. Ability to evaluate the quality and safety of electronic products including reliability, physical testing, electrical safety and electromagnetic compatibility.

CEE15. Ability to apply synchronization techniques and use standard buses considering electrical aspects and protocols.

CEE19. Ability to apply low-power techniques to integrated circuits (ICs).

CEE7. Ability to design signal conversion circuits between the analog and digital domains, selecting the optimal approach depending on the specifications, resolution extension techniques and high speed conversion.

CEE14. Ability to establish a relationship between an electronic device and its fabrication technology, and to understand its design process.

CE2. Ability to develop radio-communication systems: antennas design, equipment and subsystems, channel modeling, link dimensioning and planning.

CE11. Knowledge of hardware description languages for high-complex circuits.

CEE23. Ability to analyze, model, identify and simulate linear systems, especially digital filters and adaptive systems.

CE6. Ability to model, design, implement, manage, operate, administrate and maintain networks, services and contents

CE13. Ability to apply advanced knowledge in photonics, optoelectronics and high-frequency electronic

CE14. Ability to develop electronic instrumentation, as well as transducers, actuators and sensors.

CEE2. Ability to understand and apply the principles of operation of the current control method and its application to battery charging, supply for LED lighting, power factor correction, and "Low Power supplies"

CEE12. Ability to use semiconductor devices taking into account their physical characteristics and limitations.

CEE13. Ability to analyze and evaluate the performance at the physical level of the main devices and sensors, the relations between magnitudes in their terminals and their equivalent circuits.

CEE21. Ability to process continuous variable signals using digital techniques.

CE3. Ability to implement wired/wireless systems, in both fix and mobile communication environments.

CEE3. Ability to apply state control techniques to the design of controllers for power electronic systems.

CEE5. Ability to conceive and design electronic circuits for signal amplification, for low and high (radio) frequencies, depending on the type of application and targeting specific consumption, noise, linearity, stability, impedance and bandwidth figures.

CEE8. Ability to deploy distributed instrumentation systems and advanced sensor networks including self-powered systems based on energy harvesting from the environment.

CEE9. Ability to design, implement and operate high performance laboratory electronic instrumentation, with emphasis on error analysis, calibration and virtual control.

CEE17. Ability to design digital systems based on multi-processors, configurable processors and FPGAs with HDL languages and CAE tools.

CEE18. Ability to design CMOS digital and analog integrated circuits of medium complexity.

CEE20. Ability to design for testability and test schemes for ICs.

CE1. Ability to apply information theory methods, adaptive modulation and channel coding, as well as advanced techniques of digital signal processing to communication and audiovisual systems.

CE4. Ability to design and dimension transport, broadcast and distribution networks for multimedia signals

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CE5. Ability to design radio-navigation and location systems, as well as radar systems.

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

CE16. Ability to develop, direct, coordinate, and technical and financial management of projects in the field of: telecommunication systems, networks, infrastructures and services, including the supervision and coordination of other's subprojects; common telecommunications infrastructures in buildings or residential areas, including digital home projects; telecommunication infrastructures in transport and environment; with corresponding energy supply facilities and assessment of electromagnetic emissions and electromagnetic compatibility.

CEE4. Ability to design continuous and discrete time controllers for power electronic systems.

CEE6. Ability to design nonlinear electronic circuits for signal processing and synthesis, including frequency shifting, active filtering, oscillators and phase locked loops.

CEE10. Ability to integrate instrumentation systems on mobile devices.

CEE24. Ability to identify and evaluate innovative ideas and products in the area of electronic technology.

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.

### Transversal:

CT1a. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding how companies are organised and the principles that govern their activity, and being able to understand employment regulations and the relationships between planning, industrial and commercial strategies, quality and profit.

CT2. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

### Teaching methodology

The aim of this course is to train students in the management of telecom projects by experiencing the development of an entire telecom system in the context of a team competition. Students will be arranged in teams of 6-10 people with the purpose of designing and developing a portable device capable of transmitting and receiving information from a peer device.

### Learning objectives of the subject

To experience the management of a goal driven telecom project.

To manage the complexity of competing while cooperating in the context of teamwork environment.

To obtain a practical, simple yet complete perspective of the architecture of a telecom system by developing one from scratch.

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To manage conflicts and take decisions in a competitive environment.

To develop teamwork and goal oriented skills.

To develop entrepreneurial and leadership skills by facing the challenge of creating and innovating from scratch.

### Study load

Total learning time: 125h	Hours large group:	39h	31.20%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	86h	68.80%

### Content

Management of Telecom Projects	Learning time: 1h Theory classes: 1h
<p>Description:</p> <p>The aim of this course is to train students in the management of telecom projects by experiencing the development of an entire telecom system in the context of a team competition. Students will be arranged in teams of 6-10 people with the purpose of designing and developing a portable device capable of transmitting and receiving information from a peer device. Through several competing rounds, teams will compete to achieve both the highest Tx+Rx data rate and the highest Tx+Rx data rate per unitary cost (Bit/?) with their systems. Subject to a few constrains on the features of their portable devices, the teams will have freedom to chose from a wide range of available technologies and components to develop their devices from scratch. Teams will need to organize themselves and plan accordingly to set their goals and strategies for the competition. Although not strictly necessary, cooperation between teams will be allowed in terms of system standardization.</p>	



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### Planning of activities

The Telecom Competition	Hours: 1h Theory classes: 1h
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### Description:

#### Project and Competition Goals

The aim of the project is to develop a portable device including a transceiver system which is able to read/write information from/to a computer and transmit it reliably to another one through a peer device.

The competition goal is double: to maximize the total delivered information within a fixed period of time (e.g. 2 minutes), and to maximize the cost efficiency, expressed as the ratio between the total delivered information and unitary cost of the device.

#### Competition Modes and Categories:

The competition will take place in 8 categories within 4 modes:

1) Short range, individual mode. In this category each team will run their telecom link independently of other teams, all teams competing sequentially and isolated from each other. All teams will test their systems in the same 70 m range scenario at Campus Nord. The amount of received information during a fixed period of time will be measured. The winning team will be that with the largest quantity of delivered information (as specified in the rules).

2) Short range, multiple-access mode. Teams will transmit and receive information as in the first mode (1), but all teams will have to operate their systems simultaneously, eventually coping with interference. The winning team will be that with the largest quantity of delivered information (as specified in the rules).

3) Mid range, individual mode. In this category each team will run the telecom link independently of other teams, all teams competing sequentially and isolated from each other. All teams will test their systems in the same 250 m range scenario at Campus Nord. The amount of received information during a fixed period of time will be measured. The winning team will be that with the largest quantity of delivered information (as specified in the rules).

4) Mid range, multiple-access mode. Teams will transmit and receive information as in the third mode (3), but all teams will have to operate their systems simultaneously, eventually coping with interference. The winning team will be that with the largest quantity of delivered information (as specified in the rules).

In addition of the total delivered information, all teams will compete in each category for the highest total delivered information vs. unitary cost ratio. So a total of 8 competition categories will be available for winning.

All members within a winning team will get a bonus in the form of extra grade in their final grades (see details in the grading section). Bonuses are cumulative, so that a team that wins in several categories gets a bonus in each of them.

#### Competing Teams:

? Each team will include 6 to 10 members, depending on the number of students enrolled in the course.

? Teams will include graduate students from both Telecom and Electronics master programs, together with last-year undergraduate students and foreign students from equivalent/similar degrees. Teams should be as diverse and multidisciplinary as possible to cover a diverse and complementary set of skills and know-how.

? Students will self-arrange to make a proposal to the program coordinator on the composition of the teams. The coordinator will try to respect as much as possible the proposal but will be able to make changes in the teams if that is considered convenient for the learning experience.

? Each team will designate a team leader after a unanimous decision.

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Descriptions of the assignments due and their relation to the assessment:

Each team will need to deliver:

A 20' presentation of the design they have done, explaining the system architecture, the main solutions adopted for the each OSI level (if any), the main key decision points for the design, and the results they obtained in the tests before the competition. The presentation will include include a list of lessons learned to be shared and discussed with the rest of students and professors.

- A slide set of the presentation.
- A Project Definition, a Project Plan and a completed Action Item List.
- A PDF with the BoM including all invoices and receipts.
- The system and the device will need to be available for demonstration and inspection.
- The 4 received files (1 for each round).

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### Qualification system

Each team will need to deliver:

A 20' presentation of the design they have done, explaining the system architecture, the main solutions adopted for the each OSI level (if any), the main key decision points for the design, and the results they obtained in the tests before the competition. The presentation will include a list of lessons learned to be shared and discussed with the rest of students and professors.

- A slide set of the presentation.
- A Project Definition, a Project Plan and a completed Action Item List.
- A PDF with the BoM including all invoices and receipts.
- The system and the device will need to be available for demonstration and inspection.
- The 4 received files (1 for each round).

The grades will be given according to the following criteria:

- 70% of the grade will be based on the presentation of the design and the obtained results in the tests and the competition (i.e. the performance grade)
- 30% of the grade will be based on an internal appraisal by colleagues (i.e. the appraisal grade) in the following way:
  - o Each team member will propose a grade (an integer number within 0-10) for the project leader and for the rest of the team members and submit it to the Program Coordinator.
  - o Each project leader will propose a grade for each team member (an integer number within 0-10) and submit it to the Program Coordinator.
  - o A grade will be given based on the proposal, but the professor(s) might modify the grade based on their own appraisal. In case of a significant discrepancy between the team grades and the appraisal grade, the professor(s) might decide to normalize proportionally the appraisal grade taking as a reference the performance grade.
  - o The intra-team grading will be an individual and private exercise, no agreement on grades are allowed. The grades proposed by the project leader can not be all the same.
  - o In addition, the project leader will propose whether a team member deserves qualifying for the bonus (see below) or not. Disqualifying a team member should be a rather exceptional measure to be applied when the team member has been showing a poor commitment to the team.
    - Those cheating or otherwise infringing the rules might be entitled to a fail the course according to the professor(s) criteria.

In addition to the grades below, an automatic bonus will be given according to the following scheme:

- Each project leader gets a +1 point bonus on its final grade just for the sake of being a project leader.
- Upon the approval of the project leader, each team and team member will get a +1 point for each win on each competition mode (up to a maximum of +4) in the highest data rate categories.
- Upon the approval of the project leader, each team and team member will get a +0,5 points for each win on a cost-efficiency category (up to a maximum of +2 points).
- All final grades will be rounded to a maximum of 10', but those achieving a higher grade will qualify as candidates to an Honors grade (i.e., Matricula d'Honor) to be granted according to the ETSETB rules.

### Bibliography