

**Información del Plan Docente**

<b>Academic Year</b>	2016/17
<b>Academic center</b>	110 - Escuela de Ingeniería y Arquitectura
<b>Degree</b>	438 - Bachelor's Degree in Telecommunications Technology and Services Engineering
<b>ECTS</b>	6.0
<b>Course</b>	
<b>Period</b>	Second semester
<b>Subject Type</b>	
<b>Module</b>	---

**1.Basic info****1.1.Recommendations to take this course****1.2.Activities and key dates for the course****2.Initiation****2.1.Learning outcomes that define the subject****2.2.Introduction****3.Context and competences****3.1.Goals****3.2.Context and meaning of the subject in the degree****3.3.Competences****3.4.Importance of learning outcomes****4.Evaluation****5.Activities and resources****5.1.General methodological presentation**

The learning process that is designed for this subject is based on the following: The teaching-learning methodologies to be undertaken to achieve the proposed learning results are as follows: **Participatory lecture** (45 hours). Presentation by the teacher of the main contents of the subject, combined with the active participation of students. This activity will take place in the classroom in person. This methodology, supported with the individual student's study is designed to provide students with the theoretical foundations of the subject content. **Problem-based learning sessions** in the classroom (12 hours). Problem solving and practical cases proposed by the teacher, with the possibility of exposing them by students individually or in groups authorized by the teacher. This activity will take place in the classroom in person, and may require preparatory work by students. **Two tutored practical works** (30 hours). This activity will advance all proposed

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learning outcomes. Follow-up sessions will be conducted by the teacher in which each student will present their work. **External visit** (3 hours). A visit to the company TELTRONIC.S.A.U., manufacturer of mobile communications equipment for the professional market will be held.

**Personalized attention to students through tutorials. Assessment tests. Personal work of the student .**

### 5.2.Learning activities

1 Theoretical/practical sessions in the classroom practices, whose main contents are organized as described in detail in the next section.

2 tutored practical work aimed at solving practical cases analysis, design, dimensioning and planning of mobile networks by applying techniques and procedures seen in theoretical and problem sessions. The evolution of the work will be presented periodically to the teacher and an explanatory final report of solving methodology followed by the student and justification of the proposed solution will be delivered. 3 External visit to the Company TELTRONIC.S.A.U, located in the Malpica Industrial Estate in Zaragoza, and dedicated to the design and manufacture of terminals, network equipment and applications for professional mobile communications (public security, fire, etc.).

### 5.3.Program

#### Block 0. Introduction .

- *Course presentation .*
- *General concepts:* Introduction to mobile networks. Mobility implications

#### Block 1. Fundamentals of Mobile Communications Networks.

- *Cellular networks. General functions. Mobile network architecture: Access networks and core network.*
- *Spectrum, standardization and regulation.*
- *Effects of radio channel and transmission systems: Propagation losses, shadowing, fast fading, Doppler shift. Environments classification. Co-channel interference, adjacent channel interference, non-linear distortion.*
- *Radio engineering techniques: Physical layer: Modulation, channel coding, interleaving, diversity, channel equalization. Duplexing* Técnicas de ingeniería radio: Nivel físico: Modulación, codificación de canal, entrelazado, diversidad, ecualización de canal. Duplexing (FDD and TDD). Multiple Access (FDMA, TDMA, CDMA, OFDMA).
- *Technologies, services and applications.*

#### Block 2. Mobile Network Functions.

- *Mobility Management: Location procedures, paging, handover. Radio Resource Management. Quality of Service Management.*
- *Network Architectures: Mobile network functional elements. Network topology. 2G, 3G and 4G networks. Other wireless access networks. Cellular networks (GSM, UMTS, LTE, TETRA)*

#### Block 3. Second Generation Mobile Networks.

- *GSM and GPRS networks:*
- *Air interface structure. Physical and logical channels definition and organization.*
- *Network functions implementation on the air interface.*

#### Block 4. Third Generation Mobile Networks.

- *Fundamentals of CDMA based mobile networks.*
- *Dimensioning of third generation CDMA based mobile networks. Access and core networks.*
- *Third generation mobile networks: UMTS, HSDPA/HSUPA:*
- *Evolution towards fourth generation mobile networks: LTE*
- *Air interface structure. Physical and logical channels definition and organization.*
- *Network functions implementation on the air interface.*

### 5.4.Planning and scheduling

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The schedule of the course will be defined by the EINA in the academic calendar of the corresponding course. The date of the external visit will be agreed during the course.

### 5.5. Bibliography and recommended resources

#### Basic bibliography

- Eberspächer, J.. GSM - Architecture, Protocols and Services / J. Eberspächer, H.J. Vögel, C. Bettstetter, C. Hartmann Ed. Wiley, 2008
- Heine, G. GPRS: Gateway to Third Generation Mobile Networks / G. Heine, H. Sagkob Artech House, 2003
- Pérez Romero, J. Radio Resource Management Strategies in UMTS / J. Pérez Romero, O. Sallent, R. Agustí, M. A. Díaz-Guerra Wiley, 2005.

#### Further reading.

- WCDMA for UMTS - HSPA evolution and LTE / edited by Harri Holma and Antti Toskala . - 4th ed., repr. Chichester (England) : John Wiley & Sons, 2008
- Dahlman, E. 3G Evolution: HSPA and LTE for Mobile Broadband / E. Dahlman, S. Parkvall, J. Sköld, P. Beming. Academic Press- Elsevier, 2008.