Mobile Communications

Academic Year: (2022 / 2023) **Review date: 09-05-2022**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: BIELSA LOPEZ, GUILLERMO

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Digital Communications
Telecommunication Systems

OBJECTIVES

The student will acquire knowledge about the principles of contemporary and future mobile communication systems. He/She will learn about the architectures, the main elements and how to design and plan this type of systems. The student will acquire the ability to analyze and design mobile communication systems according to the fundamental quality parameters and requirements. He/She will also be able to evaluate the pros and cons of different technological alternatives.

Working in the laboratory the student will become familiar to the instrumentation used in these systems and will acquire the ability to make measurements over real systems and to analyze the outcome of the measurements.

Also, the student will be capable of communicating efficiently in written and oral form, the procedure followed to solve problems of design of mobile communication systems.

DESCRIPTION OF CONTENTS: PROGRAMME

1.- Origin and evolution of mobile communication systems: generations of mobile communications and adaptation to the service requirements.
1.1. Mobile communications: introduction
1.2. Mobile communication systems: historical review

2.- GSM and 2.5G systems: architecture, components and design.
2.1. GSM architecture
2.2. GSM physical layer
2.3. GSM plannification
2.4. 2.5G Architecture
2.5. GPRS, EGPRS

3.- UMTS system: principles, WCDMA, architecture and components.
3.1. UMTS architecure
3.2. UMTS access network: UTRAN

4.- Evolution of mobile communication systems: HSPA
4.1. Enabling techniques for 3.5G
4.2. HSDPA
4.3. HSUPA

5.- 4G mobile communications: HSPA+, LTE, LTE-A
5.1. HSPA+
5.2. 4G architecture: EPS
5.3. Enabling techniques for LTE
5.4. Access network (E-UTRAN): physical layer
5.5. LTE-A
5.6 LTE plannification

6.- 5G systems

6.1. Enabling technologies
6.2. 5G Architecture: 5G NSA vs 5G SA
6.3. 5G New Radio

LEARNING ACTIVITIES AND METHODOLOGY

Three types of learning activities will be used: theory lectures, problems and practical work in the lab.

ECTS credits include the work to be carried out by the student either personally or in groups.

THEORY LECTURES (3ECTS)
Theory lectures are taught using the blackboard or other audiovisual media in order to illustrate some concepts.
In these sessions the theoretical concepts will be illustrated with practical exercises.
In these lectures the student will acquire the basic knowledge of the course. It is important to highlight that these sessions will require the initiative and participation from the student (some concepts will have to be studied personally with some indications, particular cases will have to be developed, etc.)

PROBLEMS (1 ECTS)
The students will be given the problems to be solved in advance.

The resolution of problems will allow the student to acquire the concepts taught in the theory lectures in a more applied context and to self-evaluate his/her acquired knowledge.

PRACTICAL WORK (2 ECTS)
The students will work in the laboratory to generate, measure and analyze the signals of real mobile communication systems using the instrumentation that is of widespread use when implementing and operating mobile communication systems.

The practical work will be based on the systems studied in the theory lectures and will contribute to the comprehension of the theoretical concepts and their practical implications.

ASSESSMENT SYSTEM

The assessment consists in:

- 2 intermediate exams.
- Practical work in the lab.
- Case study assignments.

% end-of-term-examination:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

BASIC BIBLIOGRAPHY

- Coord. Ramón Agusti, varios autores LTE: NUEVAS TENDENCIAS EN COMUNICACIONES MOVILES, Fundación Vodafone, 2010
- E. Dahlman, S. Parkvall, J. Skold, and P. Beming. 3G evolution: HSPA and LTE for mobile broadband. , 2010, Academic Press.
- E. Dahlman, S.Parkvall, J. Skold 5G NR: The next generation wireless access technology, Academic Press., 2018
- H. HOLMA, A. TOSKALA WCDMA for UMTS, John Wiley & Sons, Ltd, 2000
- J. M. HERNANDO RÁBANOS Y OTROS Comunicaciones Móviles GSM, Fundación Airtel, 1999
- S. Sesia, I. Toufik, M. Baker LTE: the UMTS Long Term Evolution, John Wiley & Sons, 2009
- T. HALONEN, J. ROMERO, J. MELERO GSM, GPRS AND EDGE performance. Evolution towards 3G/UMTS, John Wiley & Sons, Ltd, 2002
- T. S. RAPPAPORT Wireless Communications, Prentice Hall, 1996

ADDITIONAL BIBLIOGRAPHY

- E. Bjornson, J. Hoydis, L. Sanguinetti Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency, Foundations and Trends in Signal Processing: Vol. 11, No. 3- 4, pp 154¿655. DOI: 10.1561/2000000093., 2017
- J.M. HERNANDO Y C. LLUNCH (Coord.) ¿GPRS Tecnología, Servicios y Negocios¿, Ed. Telefónica Móviles, 2002
- M. MOULY, M-B PAUTET ¿GSM System for Mobile Communications¿, Ed. Cell & Sys, 1992

BASIC ELECTRONIC RESOURCES

- . 3GPP: http://www.3gpp.org/About-3GPP