

## Course guide

# 230386 - 6G-FTMC - The Way to 6g: Future Trends in Mobile Communications

Last modified: 25/05/2023

**Unit in charge:** Barcelona School of Telecommunications Engineering  
**Teaching unit:** 739 - TSC - Department of Signal Theory and Communications.  
**Degree:** MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).  
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).  
**Academic year:** 2023    **ECTS Credits:** 3.0    **Languages:** English

## LECTURER

**Coordinating lecturer:** Consultar aquí / See here:  
<https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura>

**Others:** Consultar aquí / See here:  
<https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma>

## TEACHING METHODOLOGY

Descriptive classes with support material (power point presentations, demonstrations with software tools ...).

## LEARNING OBJECTIVES OF THE SUBJECT

Mobile communications systems have experienced great growth in recent decades. In the near future, an explosion of data traffic is expected, driven by the progressive penetration of 5G networks, the exponential increase in mobile devices, as well as applications that consume a lot of bandwidth, such as the video transmission or mobile games, highly integrated into our daily lives, but also new applications that will be gradually introduced such as virtual and augmented reality, holographic communications or communications to provide intelligence services artificial. In order to support this high demand for data traffic, new and innovative physical layer techniques, with a very high spectral efficiency (for example, using massive MIMO), the exploitation of the new spectrum working at much higher frequencies (e.g. , considering millimeter waves and terahertz bands), the densification of wireless networks, the intensive use of network virtualization techniques and the application of artificial intelligence in the radio interface are some of the proposed techniques.

The aim of this course is to present rationality in order to apply these innovative techniques, as well as the main and most relevant technical aspects behind them. To achieve this goal, the seminar, based on a brief explanation of the main features of 5G systems, understood as a starting point, traces the foreseeable technological evolution to reach 6G systems, with special emphasis on innovative techniques planned for this new generation of mobile communications.

## STUDY LOAD

Type	Hours	Percentage
Self study	51,0	68.00
Hours large group	24,0	32.00

**Total learning time:** 75 h

## CONTENTS

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### Session 1. Introduction

**Description:**

- Context and ecosystem
- Drivers and requirements
- Principles for evolving and expanding the RAN
- Principles for implementing and operating the 5G network
- State of play

**Full-or-part-time:** 4h

Theory classes: 4h

### Session 2. 5G System

**Description:**

- Introduction
- 5G system architecture
- 5G New Radio
- Support of URLLC
- 5G for Industry 4.0

**Full-or-part-time:** 5h

Theory classes: 5h

### Session 3. Beyond 5G

**Description:**

- 3GPP standardization: Essentials and Standardization Roadmap
- Overview of Release 18 features (5G Advanced)
- Overview of Stage 1 work for Release 19

**Full-or-part-time:** 5h

Theory classes: 5h

### Session 4. 6G Wireless Communications Systems

**Description:**

- Introduction: 6G vision and motivation
- Key Performance Indicators (KPIs)
- Use cases
- Technologies under study: Terahertz Communications, Internet of Space Things, Cell-free Massive MIMO Communications...
- Technologies for Beyond 6G
- Tentative timeline for 6G

**Full-or-part-time:** 4h

Theory classes: 4h



#### Session 5. Reinforcement Learning tools for 5G and beyond radio access networks: from concept to implementation

**Description:**

- Machine Learning.
- Applicability of Reinforcement Learning in the RAN.
- Example: Capacity sharing solution for RAN slicing.
- Implementation aspects of the capacity sharing solution.

**Full-or-part-time:** 4h

Theory classes: 4h

#### Exam

**Description:**

Individual exam

**Full-or-part-time:** 2h

Theory classes: 2h

### GRADING SYSTEM

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- Class attendance (50%)
- Exam (50%)