

Course guide

230709 - 5GMCS - 5G Mobile Communications Systems

Last modified: 11/04/2025

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: 2025 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: JORGE PEREZ ROMERO

Others: Primer quadrimestre:
JORGE PEREZ ROMERO - 10

PRIOR SKILLS

Basic knowledge of wireless communications

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

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

Transversal:

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

- Lectures
- Team work on the development of a use case
- Oral presentations
- Questionnaires and exercises
- Final exam

LEARNING OBJECTIVES OF THE SUBJECT

- Present the mobile communications systems that compose the so-called 5th Generation (5G) resulting from the evolution of LTE technology and the integration of the new radio interface (5G New Radio).
- Analyze the characteristics and functionalities of 5G systems to provide services to new application domains, such as Internet of Things, vehicular communications, etc.

Learning results of the subject:

- Ability to analyse, model and design and implement the newest architectures, protocols and communication interfaces for mobile communication systems.
- Ability to analyse, model and apply advanced mobile communication techniques.

STUDY LOAD

Type	Hours	Percentage
Hours large group	39,0	31.20
Self study	86,0	68.80

Total learning time: 125 h

CONTENTS

1.- Introduction

Description:

- 1.1.- Mobile Communications technology evolution
- 1.2.- Drivers to increase network capacity
- 1.3.- 5G requirements and use cases
- 1.4.- Standardisation process

Full-or-part-time: 8h

Theory classes: 3h

Self study : 5h

2.- 5G system architecture

Description:

- 2.1.- Introduction
- 2.2.- LTE system architecture
- 2.3.- Reference model of the 5G system architecture
- 2.4.- 5G Core network functions
- 2.5.- Next Generation Radio Access Network (NG-RAN)
- 2.6.- Quality of Service (QoS) model
- 2.7.- Procedures
- 2.8.- Network slicing
- 2.9.- Private 5G networks

Full-or-part-time: 36h

Theory classes: 12h

Self study : 24h

3.- 5G System Radio Interface

Description:

- 3.1.- Introduction
- 3.2.- Radio Interface Protocol stack
- 3.3.- Logical, transport and physical channels
- 3.4.- Basic physical layer concepts (OFDMA, SC-FDMA, multi-antenna techniques)
- 3.5.- E-UTRAN physical layer
- 3.6.- 5G NR physical layer
- 3.7.- Transport channel processing
- 3.8.- Procedures
- 3.9.- Radio interface techniques
 - 3.9.1.- Carrier aggregation
 - 3.9.2.- Dual connectivity
 - 3.9.3.- Unlicensed spectrum use
 - 3.9.4.- Device-to-Device (D2D) communications
 - 3.9.5.- Integrated Access and Backhaul (IAB)

Full-or-part-time: 45h

Theory classes: 15h

Self study : 30h

4.- Technologies for supporting specific use cases

Description:

- 4.1.- Cellular Internet of Things (IoT) technologies
- 4.2.- Broadcast and multicast communications
- 4.3.- Cellular vehicular communications (V2X)
- 4.4.- Development of use cases of the 5G technology

Full-or-part-time: 36h

Theory classes: 9h

Self study : 27h

GRADING SYSTEM

Team work on the development of a use case: 30%

Questionnaires and exercises: 30%

Final exam: 40%

BIBLIOGRAPHY

Basic:

- Dahlman, E.; Parkvall, S.; Skold, J. 5G NR: the next generation wireless access technology [on line]. Amsterdam: Academic Press, 2018 [Consultation: 18/05/2020]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=5493036>. ISBN 9780128143230.
- Chandramouli, D.; Liebhart, R.; Pirskanen, J. 5G for the connected world. Hoboken, NJ: John Wiley & Sons, Inc, 2019. ISBN 9781119247081.
- Dahlman, E.; Parkvall, S.; Sköld, J. 4G, LTE-advanced pro and the road to 5G [on line]. Third edition. London: Academic Press, [2016] [Consultation: 14/06/2021]. Available on: <https://www.sciencedirect.com/science/book/9780128045756>. ISBN 9780128046111.

Complementary:

- Marsch, P.; Bulakci, Ö.; Queseth, O.; Boldi, M. 5G system design: architectural and functional considerations and long term



research. Hoboken, New Jersey: Wiley, 2018. ISBN 9781119425120.

- Dahlman, E.; Parkvall, S.; Skold, J.; Beming, P. 3G evolution: HSPA and LTE for mobile broadband. 2nd ed. Amsterdam: Elsevier, 2008. ISBN 9780123745385.

- Agustí, R.; Bernardo, F.; Casadevall, F.; Ferrús, R.; Pérez-Romero, J.; Sallent, O. LTE: nuevas tendencias en comunicaciones móviles. Fundación Vodafone España, 2010. ISBN 8493474045.

RESOURCES

Other resources:

Slides of the course