Course guide
230709 - 5GMCS - 5G Mobile Communications Systems

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: 2022 ECTS Credits: 5.0 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

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>39,0</td>
<td>31.20</td>
</tr>
<tr>
<td>Self study</td>
<td>86,0</td>
<td>68.80</td>
</tr>
</tbody>
</table>

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

Full-or-part-time: 36h
Theory classes: 12h
Self study: 24h
3.- 5G System Radio Interface

Description:
3.1.- Radio Interface Protocol stack
3.2.- Logical, transport and physical channels
3.3.- Basic physical layer concepts (OFDMA, SC-FDMA, multi-antenna techniques)
3.4.- E-UTRAN physical layer
3.5.- 5G NR physical layer
3.6.- Procedures
3.7.- Radio interface techniques
3.7.1.- Carrier aggregation
3.7.2.- Dual connectivity
3.7.3.- Unlicensed spectrum use
3.7.4.- Device-to-Device (D2D) communications
3.7.5.- 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.- Cellular vehicular communications (V2X)
4.3.- Broadcast and multicast communications
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:

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

RESOURCES

Other resources:
Slides of the course