Course guide
300259 - WICOM - Next Generation Wireless Communications and Iot

Last modified: 06/06/2024

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: MASTER'S DEGREE IN APPLIED TELECOMMUNICATIONS AND ENGINEERING MANAGEMENT (MASTEAM) (Syllabus 2015). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Sílvia Ruiz Boqué

Others:

PRIOR SKILLS

Radio Communications. Digital Communication Systems

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
01 MTM. (ENG) Diseñar, implementar y evaluar redes de comunicaciones móviles celulares de última generación, así como de las generaciones previstas para el futuro cercano.
02 MTM. (ENG) Diseñar, implementar y evaluar redes heterogéneas de elevada densidad mediante técnicas de virtualización de la red de acceso.
03 MTM. (ENG) Diseñar, implementar y evaluar redes móviles cooperativas (internet de las cosas) para diferentes tipos de terminales (vehículos, elementos domóticos, infraestructuras, sensores corporales, etc.).
08 MTM. (ENG) Diseñar e implementar redes de sensores inalámbricas para cualquier aplicación de cualquier ámbito social.

Generical:
06 RES. (ENG) Resolver problemas y mejorar procesos en cualquier ámbito social a partir de la aplicación de las TIC, integrando conocimientos de diversos ámbitos y aplicando ingeniería de alto nivel tecnológico.

Transversal:
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Basic:
CB6. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.
CB9. Students will be able to communicate their conclusions and the knowledge and ultimate reasons that support them to specialized and non-specialized audiences in a clear and unambiguous manner.
CB10. Students will acquire learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

TEACHING METHODOLOGY

Lectures, Problem Solving and Case discussion. Lectures will give introductory material, while through problems and cases more advanced topics and tools will be analysed.

Each of the topics described at the Detailed Contents section will be done in one hour lecture. Out of class activities will be: a) complete the given information studying the additional material given by the teacher, b) solve the problems related with each session, c) read a divulgation paper/document related with the topic.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course the student should be able to:

Understand the latest results, trends, activities and applications in the 4G, IoT, WSN, and M2M domain.
Design a 4G planning for a giving geographical area
Design a WSN, selecting the appropriate equipment.
Design a IoT network choosing the best technologies.

STUDY LOAD

Type	Hours	Percentage
Hours large group	27,0	36.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

Unit 1: LTE and LTE-A Networks

Description:
Description:
o OFDMA, SC-FDM, Physical Layer and Network Structure
o S1 and X2 interfaces
o Mobility and Radio Resource Management
o Link Budget, Data Rates, Coverage and Capacity
o LTE-A Releases 8-9 and 10-12
o Carrier Aggregation and MIMO evolution.

Related activities:
Related activities: case discussion based on readings on applied aspects of LTE and LTE-A, use of hand-on tutorials and problem solving

Full-or-part-time: 6h
Theory classes: 6h

Unit 2: WSN and IoT

Description:
Description
o Introduction to WSN architectures
o Radio Level WLAN interworking
o Machine Type Communication (MTC)
o Device-to-device communication (D2D)
o Examples of IoT in real scenarios

Related activities:
Related activities: case discussion based on readings on applied aspects of WSN and IoT, use of hand-on tutorials and problem solving. The examples on real scenario session will be done through a visit to the Barcelona Smart City Center (Institut Municipal d'Informàtica de Barcelona) as well as other companies and research institutions (seminars/visits)

Full-or-part-time: 5h
Theory classes: 5h

Unit 3: HetNets and dense cell deployment

Description:
Description
o Heterogeneous Networks (HetNet)
o Coordinated Multipoint (CoMP)
o Relay nodes (RN)
o Small Cell Enhancements (SCE)
o 3D beamforming & Massive MIMO

Related activities:
Related activities: case discussion based on readings on applied aspects of HetNets, use of hand-on tutorials and problem solving

Full-or-part-time: 5h
Theory classes: 5h

Unit 4: Cognitive Networks and Spectrum Management

Description:
Description
o Cognitive Radios and Cognitive Network Architectures
o Cognitive Cycle, Spectrum Sensing, Decision, Sharing, Mobility
o Routing Algorithms, Transport Layer and Cross Layer Solutions
o White Space Devices and WS DataBase

Related activities:
Related activities: case discussion based on readings on applied aspects of Cognitive Networks, use of hand-on tutorials and problem solving

Full-or-part-time: 4h
Theory classes: 4h

Unit 5: Cooperative Communications

Description:
Description
o Networking protocols
o Cooperative strategies and rates
o Network coding
o Cooperative PHY and MAC

Related activities:
Related activities: case discussion based on readings on applied aspects of Cooperative Communications, use of hand-on tutorials and problem solving

Full-or-part-time: 4h
Theory classes: 4h

GRADING SYSTEM

50% qualification : 4 Homework Deliverables. Students will have to deliver one or more reports regarding its progress, that can be done individually or working in pairs.
20% qualification : midterm control
20% qualification: final exam
10% qualification : participation in class and attitude.

BIBLIOGRAPHY

Basic:
- Holma, Harri; Toskala, Antti. LTE for UMTS : evolution to LTE-Advanced. 2nd ed. Chichester, UK: John Wiley, cop. 2011. ISBN 9780470660003.
- Dargie, Waltenegus; Poellabauer, Christian. Fundamentals of wireless sensor networks [Recurs electrònic] : theory and practice [on line]. Chichester: John Wiley and Sons, cop. 2010 [Consultation: 26/07/2022]. Available on: https://onlinelibrary-wiley-com.recursos.biblioteca.upc.edu/doi/book/10.1002/9780470666388. ISBN 9780470666388.

RESOURCES

Other resources:
Additionally technical papers (IEEE journals, but also operators/manufacturers reviews) will be assigned to students. Also 3GPP documents and RFC from IETF will be given.