Last update: 06-05-2019

230690 - RMWC - Resource Management in Wireless Communications

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 739 - TSC - Department of Signal Theory and Communications

Academic year: 2019

Degree: MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)

ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: Sallent Roig, Jose Oriol

Others: Sallent Roig, Jose Oriol

Prior skills

Co-requirements:
- Mobile Communications Systems (for students of the WICOM master)
- Advanced Mobile Communications (for students of the MET master)

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.
CE7. Ability to plan networks and decision-making about services and applications taking into account: quality of service, operational and direct costs, implementation plan, supervision, security processes, scalability and maintenance. Ability to manage and assure the quality during the development process
CE6. Ability to model, design, implement, manage, operate, administrate and maintain networks, services and contents
CE3. Ability to implement wired/wireless systems, in both fix and mobile communication environments.

Transversal:

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.
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.

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Teaching methodology

- Lectures
- Application classes
- Individual work (distance)
- Exercises
- Short answer test (Control)
- Extended answer test (Final Exam)

Planning of activities:
Exercises:
- Description: Exercises to strengthen the theoretical knowledge.
Short answer test (Control):
- Description: Mid term control.
Extended answer test (Final examination):
- Description: Final examination.

Learning objectives of the subject

Learning objectives of the subject:
The aim of this course is to train students in the analysis, modelling and design of radio resource management mechanisms for wireless communications systems, with a focus on mobile communications. The course will start by developing the concepts for designing and operating a mobile communication network, including the planning and dimensioning processes. Then, it will present the models and strategies for managing the network and the spectrum. For that purpose, the course will study different strategies for radio resource management and network optimisation, including advanced concepts for automated network optimisation (SON: Self-Organizing Networks).

Learning results of the subject:
- Knowledge of how to model, design and evaluate strategies and mechanisms for the management of the radio resources and the flexible use of the spectrum in wireless networks
- Knowledge of the deployment and resource management options for heterogeneous networks
- Knowledge of the strategies used for the automatic configuration and optimisation of wireless networks (self-organising networks)
- Knowledge of radio resource management strategies in wireless networks, including the modelling and the application of advanced decision making and machine learning strategies
- Knowledge of flexible spectrum management concepts: regulation, spectrum management components, spectrum sharing, dynamic spectrum access and cognitive radio.
- Knowledge about heterogeneous networks, including deployment, interference management, load control and use of multiple radio interfaces.
- Ability to analyze, model and evaluate advanced resource management and optimization techniques for wireless networks.

Study load

Total learning time: 125h	Hours large group:	39h	31.20%
	Self study:	86h	68.80%

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Content

1. Mobile Communication Networks: design and operation

Learning time: 35h

Theory classes: 9h
Practical classes: 2h
Self study : 24h

Description:
- Engineering functions, organisation and processes
- Base station radio design
- Dimensioning
- Integration and operation
- Transmission
- Optimisation

2. Network planning and dimensioning

Learning time: 19h

Theory classes: 4h
Practical classes: 2h
Self study : 13h

Description:
- Introduction: Planning objectives and requirements
- Link budget in LTE for Uplink and Downlink: Propagation models; Receiver sensitivity; signal to noise ratio and Interference Margin. Clutter Concept.
- Traffic Dimensioning for LTE
- LTE network design: Frequency planning options; Dimensioning and planning of Control channels
- Backhaul and X2 interface dimensioning

3. Network resource management

Learning time: 55h

Theory classes: 13h
Practical classes: 4h
Self study : 38h

Description:
- Context, models and framework for network management (ITU FCAPS, eTOM, BSS/OSS/NMS)
- Radio Resource Management strategies (admission control, scheduling, handover, cell selection, eICIC, carrier aggregation, load balancing)
- Advanced algorithmic solutions for radio resource management (applicability of machine learning techniques)
- Network optimisation and SON (network quality cycle, optimisation methodologies and tools, network monitoring and optimisation)

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4. Spectrum management	Learning time: 16h Theory classes: 4h Practical classes: 1h Self study : 11h

Description:
- Licensing regimes and spectrum management models (LSA, TVWS, etc.)
- Coexistence studies

Qualification system

Final examination:50%
Partial examinations and controls: 40%
Exercises: 10%

Bibliography

Basic:

Dahlman, Erik. 3G evolution : HSPA and LTE for mobile broadband. 2nd ed. Amsterdam: Elsevier, 2008. ISBN 9780123745385.

Romero Pérez, Jordi. Radio resource management strategies in UMTS. Chichester: John Wiley & Sons, 2005. ISBN 0470022779.

Hämäläinen, Seppo; Sanneck, Henning; Sartori, Cinzia. LTE self-organising networks (SON) : network management automation for operational efficiency [on line]. Hoboken, N.J.: Wiley, 2012 [Consultation: 15/09/2015]. Available on: <http://onlinelibrary.wiley.com/book/10.1002/9781119961789>. ISBN 9781119970675.

Complementary:

Agustí Comes, Ramon. LTE : nuevas tendencias en comunicaciones móviles. [S.l.]: Fundación Vodafone, 2010. ISBN 8493474045.

Hamied, Khalid; Ramiro, Juan. Self-organizing networks : self-planning, self-optimization and self-healing for GSM, MTS, and LTE [on line]. Chichester, West Sussex ; Hoboken, NJ: Wiley, cop. 2012 [Consultation: 15/09/2015]. Available on: <http://onlinelibrary.wiley.com/book/10.1002/9781119954224>. ISBN 9781119954224.

Sutton, Richard S; Barto, Andrew G. Reinforcement learning : an introduction. Cambridge, Mass.: MIT Press, cop. 1998. ISBN 0262193981.

Sallent Roig, Oriol; Pérez Romero, Jordi. Fundamentos de diseño y gestión de sistemas de comunicaciones móviles celulares [Recurs electrònic] [on line]. Barcelona: Universitat Politècnica de Catalunya. Iniciativa Digital Politècnica, 2014 [Consultation: 15/09/2015]. Available on: <http://hdl.handle.net/2099.3/36630>. ISBN 9788498804812.

Sesia, Stefania. LTE - The UMTS Long Term Evolution: From Theory to Practice. 2nd ed. Chichester, West Sussex, United Kingdom ; Hoboken, NJ: Wiley, 2011. ISBN 0470660252.