# 230690 - RMWC - Resource Management in Wireless Communications

<table>
<thead>
<tr>
<th>Coordinating unit:</th>
<th>230 - ETSETB - Barcelona School of Telecommunications Engineering</th>
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<tbody>
<tr>
<td>Teaching unit:</td>
<td>739 - TSC - Department of Signal Theory and Communications</td>
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<td>Academic year:</td>
<td>2019</td>
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<td>Degree:</td>
<td>MASTER’S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)</td>
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<td>ECTS credits:</td>
<td>5</td>
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<td>Teaching languages:</td>
<td>English</td>
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## 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.
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

<table>
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<th>Total learning time: 125h</th>
<th>Hours large group: 39h</th>
<th>31.20%</th>
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<tbody>
<tr>
<td>Self study: 86h</td>
<td>68.80%</td>
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## Content

### 1. Mobile Communication Networks: design and operation

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

**Learning time:** 35h  
Theory classes: 9h  
Practical classes: 2h  
Self study: 24h

### 2. Network planning and dimensioning

**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

**Learning time:** 19h  
Theory classes: 4h  
Practical classes: 2h  
Self study: 13h

### 3. Network resource management

**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)

**Learning time:** 55h  
Theory classes: 13h  
Practical classes: 4h  
Self study: 38h
## 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:**

**Complementary:**