# 230629 - WAS - Waves and Systems

**Coordinating unit:** 230 - ETSETB - Barcelona School of Telecommunications Engineering  
**Teaching unit:** 739 - TSC - Department of Signal Theory and Communications  
**Academic year:** 2015  
**Degree:** MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)  
**ECTS credits:** 5  
**Teaching languages:** English

## Teaching staff

**Coordinator:** Cardama Aznar, Angel; Jofre Roca, Luis  
**Others:** Cardama Aznar, Angel; Jofre Roca, Luis

## Learning objectives of the subject

## Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 39h</th>
<th>31.20%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
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<td>Hours small group: 0h</td>
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<td>Guided activities: 0h</td>
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<td>Self study: 86h</td>
<td>68.80%</td>
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### Content

| ENG 1. The EM spectrum. Communications and sensing. System and channel models | Learning time: 3h  
Theory classes: 3h |
|---|---|
| ENG 2. Radiation theory: retarded field and moving charges | Learning time: 3h  
Theory classes: 3h |
| ENG 3. Radiometry and radioastronomy: brightness models and laws, radiotelescopes | Learning time: 3h  
Theory classes: 3h |
| ENG 4. Wave solutions in time and frequency domains: wave equations, modes and fields | Learning time: 3h  
Theory classes: 3h |
| ENG 5. Wave polarization and polarimetry: Poincaré sphere, polarization scattering matrix | Learning time: 3h  
Theory classes: 3h |
| ENG 6. Waves in matter. Conductors, superconductors, dielectrics, ferroelectric | Learning time: 3h  
Theory classes: 3h |
| ENG 7. Interaction of the EM waves with the human body: Energy and human metabolism. | Learning time: 3h  
Theory classes: 3h |
| ENG 8. Fourier wave fields.: Propagation and imaging, Diffraction theorem consequences | Learning time: 3h  
Theory classes: 3h |
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<table>
<thead>
<tr>
<th>Course Description</th>
<th>Learning time: 3h</th>
<th>Theory classes: 3h</th>
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<tr>
<td>(ENG) 9. Wave propagation: Reflection, diffraction, scattering, 2-way model,</td>
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<td>(ENG) 10. Time and frequency-variant radio channels: narrow and broadband models</td>
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<td>(ENG) 11. Transmitting and receiving antennas: circuital and radiation parameters, feeding</td>
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<td>(ENG) 12. Arrays and multi-antenna geometries: antenna and channel models</td>
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<td>(ENG) 13. Ultra wideband antennas: standards, antenna and channel models, impulse response</td>
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<td>(ENG) 14. Free space optical systems: ray optics, Gaussian beams, laser applications</td>
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Bibliography

Basic:


Complementary:

