230013 - RP - Radiation and Propagation

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications
Academic year: 2017
Degree: BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan

Teaching staff

Coordinator: FRANCISCO TORRES TORRES
Others: FRANCISCO JAVIER FABREGAS CANOVAS - MERCEDES MAGDALENA VALL-LLOSSERA FERRAN - IGNASI CORBELLA SANAHUJA - FRANCISCO TORRES TORRES - ALBERTO AGUASCA SOLE

Prior skills

Good capability to operate complex numbers

Degree competences to which the subject contributes

Generical:
6. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS Level 2. To identify, model and pose problems starting from open situations. To explore the alternatives to solve the problem and to choose the best one according to a justified criterion. To know-how to make approaches. To propose and implement methods to validate the solutions. To have a complex system vision and of interactions among complex systems components
7. They will have acquired knowledge related to experiments and laboratory instruments and will be competent in a laboratory environment in the ICC field. They will know how to use the instruments and tools of telecommunications and electronic engineering and how to interpret manuals and specifications. They will be able to evaluate the errors and limitations associated with simulation measures and results.

Transversal:
1. 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.
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
3. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
4. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
5. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
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**Teaching methodology**

- Lectures
- Laboratory work and exercises
- Self study (home work)
- Short tests: Control exercises, grouped by subject, distributed throughout the course.
- Long tests (Final exam)
- Laboratory reports

**Learning objectives of the subject**

Based on the knowledge of Electromagnetic Fields and Lineal Circuits Theory, the students will learn the fundamentals of transmission media, both, those based on guided and radiated electromagnetic fields

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 52h</th>
<th>34.67%</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Hours small group: 13h</td>
<td>8.67%</td>
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<tr>
<td></td>
<td>Self study: 85h</td>
<td>56.67%</td>
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</tbody>
</table>
## Content

<table>
<thead>
<tr>
<th>ENG 1. Introduction and basic concepts</th>
<th>Learning time: 11h 27m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 3h 27m</td>
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<tr>
<td></td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study : 6h</td>
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</tbody>
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**Description:**
Electric energy and power; Circuits in Sinusoidal Steady State; Units and logarithmic magnitudes (dB and Neper)

<table>
<thead>
<tr>
<th>ENG 2. Transmission lines</th>
<th>Learning time: 41h 16m</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 13h 16m</td>
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<tr>
<td></td>
<td>Laboratory classes: 4h</td>
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<tr>
<td></td>
<td>Self study : 24h</td>
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</tbody>
</table>

**Description:**

<table>
<thead>
<tr>
<th>ENG 3. Impedance measures and matching networks</th>
<th>Learning time: 10h 33m</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 4h 33m</td>
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<tr>
<td></td>
<td>Self study : 6h</td>
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</tbody>
</table>

**Description:**

<table>
<thead>
<tr>
<th>ENG 4. Theory of guided waves</th>
<th>Learning time: 20h 11m</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 6h 11m</td>
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<tr>
<td></td>
<td>Laboratory classes: 2h</td>
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<tr>
<td></td>
<td>Self study : 12h</td>
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**Description:**
The wave equation. Transversal and axial fields. Propagation modes in conductive guides (TEM, TE, TM): cut-off frequency, classification of modes, dispersion, group and phase velocity. The fundamental mode in the rectangular waveguide: standing waves, equivalent transmission line.
(ENG) 5. Dielectric guides: the optical fiber

Description:

Learning time: 15h 27m
- Theory classes: 5h 27m
- Self study: 10h

(ENG) 6. Antenna fundamentals

Description:
Basic concepts: power and polarization of plane waves, basic antenna configurations, the directivity concept, spherical coordinates and solid angle. Transmission antenna parameters: Circuit model, radiated power, radiated power density, radiation intensity, radiation diagram, directivity, equivalent solid angle. Reception antenna parameters: circuit model, effective area, effective length. Noise in reception: antenna temperature, equivalent noise temperature, noise to signal ratio (NSR).

Learning time: 45h 06m
- Theory classes: 14h 06m
- Laboratory classes: 5h
- Self study: 26h

Qualification system
- Final exam: 60%
- Mid course evaluation: 25%. Two control marks will be released, the first one by the end of theme 3 and the second one at the end of theme 6
- Laboratory work and reports: 15%

Two generic skills are evaluated within this subject:
- Third language (low level)
- Student capability to undertake experimental work and handle laboratory instruments

Regulations for carrying out activities
Calculator: In order to undertake the tests and exams within this subject, a calculator that operates complex numbers is required. Programmable devices, cameras and any wireless device are strictly forbidden during tests and exams.
230013 - RP - Radiation and Propagation

Bibliography

Basic:


Complementary: