320112 - ER - Transmitters and Receivers

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2019
Degree: BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan, Spanish, English

Teaching staff
Coordinator: Ignacio Gil

Prior skills
It is recommended to have a background on Analog and Digital Electronics in order to take the course

Degree competences to which the subject contributes

Specific:
1. AUD: Ability to analyse, specify, build and maintain systems, equipment and headers, as well as television, audio and video installations, in both fixed and mobile environments.

Transversal:
2. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
3. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
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Teaching methodology

- Face-to-face lecture sessions.
- Face-to-face practical class work sessions.
- Face-to-face practical laboratory work sessions.
- Independent learning and exercises.
- Preparation and completion of group activities subject to assessment.

In the face-to-face lecture sessions, the lecturer will introduce the basic theory, concepts, methods and results for the subject and use examples to facilitate students' understanding.

Practical class work will be covered in three types of sessions:
  a) Sessions in which the lecturer will provide students with guidelines to analyse data for solving problems by applying methods, concepts and theoretical results (80%).
  b) Sessions in which students give presentations of group work (8%).
  c) Examination sessions (12%).

In the laboratory work sessions, the lecturer will provide students with guidelines in order to analyse, simulate and solve transceiver circuits/systems.

Students will be expected to study in their own time so that they are familiar with concepts and are able to solve the exercises set, whether manually or with the help of a computer.

In groups of five, students will carry out projects and present them publicly in applied sessions.

Learning objectives of the subject

In this subject, students gain an understanding of the main transceiver architectures and their constituent blocks. They will also become familiar with the main wireless communication standards. On completing the subject, students will be able to design high-level transmission/receiver systems to satisfy a given set of specifications. They will learn how to approach open-ended problems that involve the various basic parameters of transceivers. They will use Agilent Advanced Design Systems (ADS) software to simulate the behaviour of certain blocks at the circuit and transceiver levels, as well as at the system level. They will build on the specific transversal competencies associated with coursework, as described below.

Study load

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total learning time: 150h</td>
<td>22h 30m</td>
<td>15.00%</td>
<td>22h 30m</td>
<td>15.00%</td>
<td>15h</td>
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</tbody>
</table>
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### Content

<table>
<thead>
<tr>
<th>UNIT 1: BASIC CONCEPTS</th>
<th>Learning time: 9h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td>- Fundamental units: dB, dBm, dBW, dBµV</td>
<td>Practical classes: 3h</td>
</tr>
<tr>
<td>- Radiation fundamentals</td>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td>- Gain and linearity</td>
<td></td>
</tr>
<tr>
<td>- Noise, Noise Figure</td>
<td></td>
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<tr>
<td>- Sensitivity and Dynamic Range</td>
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<tr>
<td>- Cascaded stages impact</td>
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</tbody>
</table>

**Related activities:**
Laboratory: Introduction to ADS. Simulation of the budget in a RF superheterodyne receiver, with a given specifications, in order to receive a Digital Video Broadcasting-Terrestrial (DVB-T) signal.

<table>
<thead>
<tr>
<th>UNIT 2: ANALYSIS TECHNIQUES</th>
<th>Learning time: 18h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 7h</td>
</tr>
<tr>
<td>- Transmission line concept</td>
<td>Practical classes: 7h 30m</td>
</tr>
<tr>
<td>- Smith Chart</td>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>- Impedance matching</td>
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<tr>
<td>- S-parameters</td>
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</table>

**Related activities:**
Laboratory: Coaxial transmission line analysis. Simulation and experimental of the impact of the load, multi-reflection. Evaluation of delay time.
## UNIT 3: TRANSCEIVER ARCHITECTURES/STAGES

- Heterodyne Receivers
- Homodyne Receivers
- Direct-conversion Transmitters
- Radio software
- Filters
- Low-Noise Amplifiers (LNA)
- Mixers
- Voltage-Controlled Oscillators (VCO)
- PLL
- Power Amplifiers (PA)

### Description:

- Antenna as an electromagnetic transducer
- Main characteristics
- Types

### Related activities:


### Learning time:

- Theory classes: 8h
- Practical classes: 9h
- Laboratory classes: 6h

## UNIT 4: ANTENNAS

### Description:

- Antenna as an electromagnetic transducer
- Main characteristics
- Types

### Related activities:


### Learning time:

- Theory classes: 3h
- Practical classes: 3h
- Laboratory classes: 2h
UNIT 5: COMMUNICATION WIRELESS STANDARDS

Description:
- Wireless PAN: Bluetooth, Zigbee
- Wireless LAN: 802.11
- Wireless MAN; WiMAX
- Others

Related activities:
Directed Activity: Coaching focused on projects based on unit 5.

Qualification system

- First examination: Ex 1 35%
- Second examination: Ex 2 40%
- Laboratory work: Lab 15%
- Projects: Act 10%

Assessment (AF):

AF=0.35*Ex1+0.40*Ex2+0.15*Lab+0.10*Act

If AF>=5 -> Final Assessment=AF
If AF<5 (Si Ex2>=5 i Lab>=5) -> Final Assessment=5
Other cases -> Final Assessment=AF

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept. If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

Regulations for carrying out activities

In order to take this course, students are expected to have passed Signals and Systems and Analogue and Digital Communications (second year).
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Bibliography

Basic:


Complementary: