230203 - AE2 - Acoustics and Electroacoustics II

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications
Academic year: 2018
Degree: BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan

Teaching staff
Coordinator: ANTONIO CARRION ISBERT.
Others: ANTONIO CARRION ISBERT - ALEXANDER HELDRING

Prior skills
Basic principles of physics

Requirements
Acoustics and Electroacoustics (AE)

Degree competences to which the subject contributes

Generical:
2. 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. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
3. 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.
4. 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.

Teaching methodology
Teaching methodology
Application classes
Expositive classes
Laboratory classes
Group work
Individual work
Extended-response test (final exam)
Laboratory practice

Learning objectives of the subject
230203 - AE2 - Acoustics and Electroacoustics II

Provide students with the advanced knowledge about the theory of sound from the point of view of the generation and the propagation of sound waves in free space. Studying the behavior of sound in enclosed spaces and provide specific criteria for their acoustic conditions and isolation.

Provide students with the advanced knowledge about electroacoustic transducers, loudspeaker systems and sound reinforcement systems.

Result of learning:

The student knows how to perform advanced engineering projects about room acoustics and acoustic isolation of buildings and electroacoustic installations.
He/she becomes familiar with the specification, analysis and selection of electroacoustic transducers.
He/she knows and manages advanced systems for measurement, analysis and control of noise and vibration.
The student is able to carry out advanced studies in the field of environmental acoustics and know underwater acoustic systems.

He/she studies with books and articles in English and he/she can write a report or technical work in English and participate in a technical meeting held in this language.
The student raises the problem correctly from the proposed statement and he/she identifies the options for resolution.
The student applies the appropriate resolution method and he/she identifies the correction of the solution.
The student identifies models and he/she raises problems from open situations. The student explores and apply the alternatives for its resolution. He/she drives approaches.

<table>
<thead>
<tr>
<th>Study load</th>
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<tr>
<td><strong>Total learning time:</strong> 150h</td>
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## 230203 - AE2 - Acoustics and Electroacoustics II

### Content

<table>
<thead>
<tr>
<th>Theme</th>
<th>Description</th>
<th>Learning time</th>
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</thead>
</table>
| **THEME I. SOUND PROPAGATION IN AIR** | Frequency bands  
Absorption, refraction and diffraction of sound in air  
Sound sources localization | 8h  
Theory classes: 2h  
Self study: 6h |
| **THEME II. ARCHITECTURAL ACOUSTICS (II)** | Introduction  
Reverberation time calculation formulas. Early Decay Time (EDT).  
Acoustic absorption evaluation $\ell_w$  
Acoustic design of theatres  
Acoustic design of concert halls  
QRD one-dimensional acoustic diffusers  
Design practical example | 40h  
Theory classes: 10h  
Laboratory classes: 8h  
Self study: 22h |
| **THEME III. ENVIRONMENTAL ACOUSTICS** | Definition  
Presentation of noise source types  
Noise Maps  
Regulations  
Materials and type solutions  
Acoustic simulation  
Measurement methodology | 8h  
Theory classes: 2h  
Self study: 6h |
# Theme IV. Acoustic Impact

**Learning time:** 9h  
Theory classes: 2h  
Laboratory classes: 1h  
Self study: 6h

**Description:**  
Definition  
Presentation of noise sources related to activities and facilities  
Outdoor acoustic impact  
- Regulations  
- Materials and type solutions  
- Acoustic simulation  
Indoor acoustic impact  
- Regulations  
- Materials and type solutions  
- Prediction and calculation  
- Vibrations  
Measurement methodology

# Theme V. Noise Control

**Learning time:** 12h  
Theory classes: 3h  
Self study: 9h

**Description:**  
Definition  
Acoustic Objectives  
Presentation of noise sources  
Materials and type solutions  
Calculation procedure according to ASHRAE  
Calculation practical example

# Theme VI. Sound Insulation (II)

**Learning time:** 5h  
Theory classes: 1h  
Laboratory classes: 1h  
Self study: 3h

**Description:**  
Definitions  
Numerical Objectives  
Certification sheets  
Practical cases
<table>
<thead>
<tr>
<th>THEME VII. SOUND REINFORCEMENT</th>
<th>Learning time: 56h</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 17h</td>
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<tr>
<td></td>
<td>Laboratory classes: 3h</td>
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<td>Self study: 36h</td>
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**Description:**
- Audio system: definition
- Types of loudspeakers and loudspeaker systems. Basic technical features.
- Loudspeaker systems typologies
- Applications of loudspeaker systems
- Electroacoustic simulation
- Electroacoustic measurement methodology

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<tr>
<th>THEME VIII. VARIABLE ACOUSTICS THROUGH ACTIVE ACOUSTIC SYSTEMS</th>
<th>Learning time: 8h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Self study: 6h</td>
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</table>

**Description:**
- Variable acoustics through passive acoustic systems vs. variable acoustics through active acoustic systems
- Basic principles of active variable acoustic systems
- Venue requirements for using active variable acoustic systems
- Performance of active variable acoustic systems
- Practical example
- Final evaluations

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<tr>
<th>THEME IX. AURALIZATION</th>
<th>Learning time: 4h</th>
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<tr>
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<td>Theory classes: 1h</td>
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<td>Self study: 3h</td>
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**Description:**
- Basic principle of auralization
- Auralization process
  - Anechoic files
  - Binaural impulse response
  - Convolution
- Practical cases
### Planning of activities

| (ENG) LABORATORY PRACTICE THEME III | Hours: 9h  
<table>
<thead>
<tr>
<th></th>
<th>Laboratory classes: 9h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Room acoustic design simulation</td>
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| (ENG) LABORATORY PRACTICE THEME IV | Hours: 2h  
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<tr>
<th></th>
<th>Laboratory classes: 2h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Sound insulation measurements</td>
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| (ENG) LABORATORY PRACTICE THEME V | Hours: 2h  
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<tr>
<th></th>
<th>Theory classes: 2h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Acoustic impact measurements</td>
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### Qualification system

Final exam: 60%
Laboratory: 40%

This course will evaluate generic competition:
- Third language (intermediate level)
- Ability to identify, formulate and solve engineering problems (intermediate level)

### Regulations for carrying out activities

The laboratory work will be not re-evaluable.
Bibliography

**Basic:**


**Complementary:**

