



IDENTIFYING DATA

Fundamentals of Acoustics Engineering

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|---------------------|---|----------|------|------------|
| Subject | Fundamentals of Acoustics Engineering | | | |
| Code | V05G301V01327 | | | |
| Study programme | Degree in Telecommunications Technologies Engineering | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Optional | 3rd | 1st |
| Teaching language | Spanish | | | |
| Department | | | | |
| Coordinator | Torío Gómez, Pablo | | | |
| Lecturers | Torío Gómez, Pablo | | | |
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| Web | http://fatic.uvigo.es | | | |
| General description | Concepts covered by the subject: vibratory systems related to the acoustic wave equation, radiation and propagation, mechanisms of acoustic-mechanical-electrical transduction, behaviour and design of speakers and microphones. | | | |

Competencies

| | |
|------|--|
| Code | |
| B3 | CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations |
| B5 | CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area. |
| B6 | CG6: The aptitude to manage mandatory specifications, procedures and laws. |
| B9 | CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics. |
| B11 | CG11 To approach a new problem considering first the essential and then the secondary aspects |
| C34 | CE34/SI1 The ability to construct, exploit and manage telecommunication services and applications, such as receiving, digital and analogical treatment, codification, transporting and representation, processing, storage, reproduction, management and presentation of audiovisual and multimedia information services. |
| C37 | CE37/SI4 The ability to carry out acoustic engineering projects related to: acoustical isolation and conditioning of rooms, loudspeaker installations, specification, analysis and selection of electro acoustical transducers, measurement, analysis and control of radio vibration systems, environmental acoustics, submarine and acoustical systems. |
| D3 | CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc. |
| D4 | CT4 Encourage cooperative work, and skills like communication, organization, planning and acceptance of responsibility in a multilingual and multidisciplinary work environment, which promotes education for equality, peace and respect for fundamental rights. |

Learning outcomes

| | |
|------------------------------------|-------------------------------|
| Expected results from this subject | Training and Learning Results |
|------------------------------------|-------------------------------|

| | | |
|--|-----------------|------------|
| * Understand the basic mechanisms of vibration of distinct elements and interpret his relation with the production of sound. | B3 B11 | C34 C37 |
| * Know the bases of the linear acoustics and understand the concepts of pressure, speed of particle, intensity, power and impedance. | | |
| * Understand the phenomena of propagation of the sound and to analyse the influence of the medium. | | |
| * Understand the phenomenon of the radiation of acoustic waves. | | |
| * Understand the basic mechanisms of the *transducción mechanical-acoustic. | | |
| * Analyse electro-mechanical-acoustic systems by the use of analogies which are based on circuit theory. | B3 B5 B11 | C34 C37 |
| * Design acoustic systems by using speakers, acoustic boxes and horns. | | |
| * Analyse different types of microphones from the point of view of their technical specifications and their possible applications. | | |
| * Interpret technical specifications within working teams. | B6 | C34 |
| * Apply norms of measuring. | B9 | C37 |
| * Elaborate trial procedures. | B11 | |
| * Develop trial procedures. | | |
| * Process data obtained from trials | | |
| * Program processing algorithms. | | |
| * Value technical results. | | |
| * Write trial reports. | | |
| * Cooperate and collaborate in working groups to carry out technical projects. | | D3 |
| * Adapt to new surroundings. | | D4 |
| * Accept the role allocation in a group. | | |
| * Contribute to the resolution of conflicts. | | |

Contents

| Topic | |
|---|--|
| 1. Sound power measurement tests. | Acoustic variables. Sound field. Propagation. Uses of intensity and power. Sound intensity probes. Power measurement standards using acoustic pressure or intensity. |
| 2. Models of radiation sources. | Directivity. Acoustic impedance. Monopole. Dipole. Monopole on infinite baffle. Baffled circular piston. Directivity measurement standards. |
| 3. Vibrating systems. | Damped and forced oscillatory motion. Vibration of strings, bars, membranes and plates. The sound in tubes. Sound sources. Acoustic filters. |
| 4. Specifications and measurement of electroacoustic systems. | Introduction to loudspeakers: baffles and crossovers. Acoustic measurement tests: measurement of speakers. Measurement of noise and nonlinear distortion. |
| 5. Analogies and transduction. | Electro-mechano-acoustic systems. Equivalent circuits. Transduction |
| 6. Speakers, horns and cabinets. | Equivalent model of an infinite baffle loudspeaker. Equivalent model of a cabinet with speaker. Horns. |
| 7. Cabinet design. | Techniques and design criteria of acoustic boxes |
| 8. Microphones. | A microphone equivalent model. Tank circuits. |
| 9. Submarine acoustics and ultrasounds | Submarine acoustics. Ultrasounds |

Planning

| | Class hours | Hours outside the classroom | Total hours |
|---------------------------------|-------------|-----------------------------|-------------|
| Lecturing | 19 | 38 | 57 |
| Autonomous problem solving | 0 | 44 | 44 |
| Practices through ICT | 13 | 0 | 13 |
| Laboratory practical | 6 | 6 | 12 |
| Problem solving | 0 | 20 | 20 |
| Problem and/or exercise solving | 2 | 0 | 2 |
| Objective questions exam | 1 | 0 | 1 |
| Problem and/or exercise solving | 1 | 0 | 1 |

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

| | Description |
|-----------|--|
| Lecturing | Oral speech, promoting the critical discussion of the concepts. Theoretical bases of algorithms and procedures used to solve problems are presented. CG3, CG5, CG11, CE34, CE37. |

| | |
|----------------------------|--|
| Autonomous problem solving | Individual resolution of exercises as a practical application of the theoretical bases and procedures described in the master sessions. Given a specific situation, the student has to obtain the suitable solution, in a reasoned way, by properly choosing the appropriate formulas and coming to a valid solution. CG3, CG5, CG11, CE34, CE37. |
| Practices through ICT | Handle and adjustment of tools of analysis and algorithms, in group, identifying which is appropriate for a given situation. CG3, CG5, CG6, CG9, CG11, CE34, CE37, CT3, CT4. |
| Laboratory practical | Cooperative and collaborative work with measuring equipment in reduced groups, and registering of acoustic magnitudes, in laboratory environments. CG3, CG5, CG6, CG9, CG11, CE34, CE37, CT3, CT4. |
| Problem solving | Given a certain situation, students individually should obtain the reasoned suitable solution, properly choosing the applicable formulas and arriving to a valid solution. CG3, CG5, CG6, CG11, CE34, CE37. |

Personalized assistance

| Methodologies | Description |
|----------------------------|---|
| Lecturing | Doubts may be solved in the tutorial classes. These will take place in the following way: - Individually or in small groups (typically with a maximum of 2-3 people). - Unless the contrary is specified, previous appointment with the professor will be required. The appointment will be requested and acknowledged by email. Place and time will preferably be as officially scheduled. |
| Practices through ICT | Doubts may be solved in the tutorial classes. These will take place in the following way: - Individually or in small groups (typically with a maximum of 2-3 people). - Unless the contrary is specified, previous appointment with the professor will be required. The appointment will be requested and acknowledged by email. Place and time will preferably be as officially scheduled. |
| Problem solving | Doubts may be solved in the tutorial classes. These will take place in the following way: - Individually or in small groups (typically with a maximum of 2-3 people). - Unless the contrary is specified, previous appointment with the professor will be required. The appointment will be requested and acknowledged by email. Place and time will preferably be as officially scheduled. |
| Autonomous problem solving | Doubts may be solved in the tutorial classes. These will take place in the following way: - Individually or in small groups (typically with a maximum of 2-3 people). - Unless the contrary is specified, previous appointment with the professor will be required. The appointment will be requested and acknowledged by email. Place and time will preferably be as officially scheduled. |
| Laboratory practical | Doubts may be solved in the tutorial classes. These will take place in the following way: - Individually or in small groups (typically with a maximum of 2-3 people). - Unless the contrary is specified, previous appointment with the professor will be required. The appointment will be requested and acknowledged by email. Place and time will preferably be as officially scheduled. |

Assessment

| | Description | Qualification | Training and Learning Results | | |
|---------------------------------|--|---------------|-------------------------------|------------|----------|
| | | | | | |
| Practices through ICT | Assessment of the reports describing the results obtained in the computer classroom. | 4 | B3 B5 B6 B9 B11 | C34 C37 | D3 D4 |
| Laboratory practical | Exam on the preliminary preparation of the laboratory practices | 6 | B3 B5 B6 B9 B11 | C34 C37 | D3 D4 |
| Problem and/or exercise solving | Written exam, with brief questions and problems. | 50 | B3 B5 B11 | C34 C37 | |
| Objective questions exam | Exam on the work done in the computer classroom. | 16 | B3 B5 B6 B11 | C34 C37 | |
| Problem and/or exercise solving | Exam on the interpretation exercises of the laboratory practices. | 24 | B3 B5 B6 B11 | C34 C37 | |

Other comments on the Evaluation

Following the guidelines of the studies, two assessment systems will be offered to the students inscribed on this subject:

Continuous assessment (the preferred method, academic activities are linked to this system) and exam-only assessment (not recommended).

*** Students who choose continuous assessment:**

Students will follow the continuous assessment system if they sign a document that will be delivered and collected when the collaborative work begins.

Weighing:

* Short answer tests of magister sessions. At the official date. Individual assesment.

* Practices in computer rooms. The assessment will be done twofold: Reports describing the results obtained in the computer classroom, assessed in flexible groups of two, and short answer tests, with individual assesment.

* Laboratory practices. The assessment will be done twofold: Practice preparation, with exam at the same session, assessed in small groups, and practice interpretation, at the last session, with individual assesment. Attendance to these laboratory practices is considered as compulsory.

When group assessment, all group components will obtain the same mark, provided that their contribution in the compulsory attendance sessions is reasonably similar, according to professor's judgement.

To ensure that all competencies are acquired, it will be necessary to jointly fulfill these two conditions to pass:

- 1) To obtain a grade equal to or greater than 4 (on a scale of 0 to 10), in the set of activities of each type.
- 2) To obtain an overall mark, calculated as the sum of the scores of activities weighted correspondingly, equal to or greater than 5 (on a scale of 0 to 10)

In the event that only condition 2) is fulfilled, and not condition 1), the global mark in the subject will be 4.

Missed quizzes and/or lab classes will not be rescheduled.

*** Students who choose for exam-only assessment:**

The possibility of a final examination will be provided to students who do not opt for the continuous assessment. This final exam will cover all the activities of the subject.

Weighing:

* Magister sessions. Individual assesment. (weight: 50%)

* Practises in computer rooms. Individual assesment. (weight: 20%)

* Laboratory practises. Individual assesment. (weight: 30%)

To ensure that all competencies are acquired, it will be necessary to jointly fulfill these two conditions:

- 1) To obtain a grade equal to or greater than 4 (on a scale of 0 to 10), in each of the sections in which the test is divided.
- 2) To obtain an overall grade in the examination equal to or greater than 5 (on a scale of 0 to 10).

SECOND CALL

Two different situations:

=> Students that are evaluated using continuous assessment:

Two options to choose (just before the exam begins):

* To perform again the written part of the exams on the official date assigned by the Center and be evaluated as stated in the above section Students who choose continuous assessment.

* To be evaluated with the same final exam as stated in the above section Students who choose for exam-only assessment.

=> Students who choose for exam-only assessment:

A final examination will be provided to students who do not opt for the continuous assessment. This final exam will be assessed as stated in the above section Students who choose for exam-only assessment.

END OF PROGRAM CALL

End of program calls will be assessed as stated in the above section Students who choose for exam-only assessment.

In the event of copycatting at any proof or work, the final assessment will be FAIL (0) and the event will be communicated to the Centre headmaster in order to conduct appropriate measures.

Sources of information

Basic Bibliography

Basilio Pueo Ortega, Miguel Romá Romero, **Electroacústica : altavoces y micrófonos**,

W. Marshall Leach, Jr., **Introduction to electroacoustics and audio amplifier design**,

Finn Jacobsen et al., **FUNDAMENTALS OF ACOUSTICS AND NOISE CONTROL**,

Complementary Bibliography

Lawrence E. Kinsler, **Fundamentals of acoustics**,

Vance Dickason, **Loudspeaker Design Cookbook**,

Recommendations

Subjects that continue the syllabus

Room Acoustics/V05G300V01635

Audiovisual Technology/V05G300V01631

Subjects that are recommended to be taken simultaneously

Audio Systems/V05G300V01532

Contingency plan

Description

=== ADAPTATION OF THE METHODOLOGIES ===

In the event that teaching cannot be in person, on-site sessions will be substituted by remote sessions and by the resolution of exercises.

=== ADAPTATION OF THE TESTS ===

In the event that assessing cannot be in person, it will be carried out remotely, either by oral exams or by written exams. If required, assessing will be complemented by homeworking or home resolution of exercises.