



## IDENTIFYING DATA

### Fundamentals of Acoustics Engineering

Subject	Fundamentals of Acoustics Engineering		
Code	V05G300V01531		
Study programme	Degree in Telecommunications Technologies Engineering		
Descriptors	ECTS Credits	Choose	Year
	6	Optional	3rd
Teaching language	Spanish		
Department			
Coordinator	Torío Gómez, Pablo		
Lecturers	Pena Giménez, Antonio Torío Gómez, Pablo Torres Guijarro, María Soledad		
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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
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* 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.	B11	
* 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.

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	19	38	57
Autonomous troubleshooting and / or exercises	3	6	9
Practice in computer rooms	11	19	30
Laboratory practises	6	6	12
Troubleshooting and / or exercises	0	39	39
Short answer tests	1.75	0	1.75
Short answer tests	0.25	0	0.25
Short answer tests	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
Master Session	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 troubleshooting and / or exercises	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.
Practice in computer rooms	Handle and adjustment of tools of analysis and algorithms, identifying which is appropriate for a given situation. CG3, CG5, CG6, CG9, CG11, CE34, CE37, CT3, CT4.
Laboratory practises	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.
Troubleshooting and / or exercises	Given a certain situation, students should obtain the reasoned suitable solution, properly choosing the applicable formulas and arriving to a valid solution. CG3, CG5, CG6, CG11, CE34, CE37.

### Personalized attention

Methodologies	Description
Master Session	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.
Practice in computer rooms	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.
Troubleshooting and / or exercises	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 troubleshooting and / or exercises	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 practises	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
Practice in computer rooms	Assessment of the reports describing the results obtained in the computer classroom.	10	B3 B5 B6 B9 B11 C34 C37 D3 D4
Laboratory practises	Exam on the preliminary preparation of the laboratory practices	8'75	B3 B5 B6 B9 B11 C34 C37 D3 D4
Short answer tests	Written exam, with brief questions and problems.	50	B3 B5 B11 C34 C37
Short answer tests	Exam on the work done in the computer classroom.	5	B3 B5 B6 B11 C34 C37
Short answer tests	Exam on the interpretation exercises of the laboratory practices.	26,25	B3 B5 B6 B11 C34 C37

### Other comments on the Evaluation

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

Continuous evaluation (the preferred method, academic activities are linked to this system) and evaluation at the end of the semester (not recommended).

**\* Students who choose continuous evaluation:**

Students will follow the continuous evaluation system if they sign a document that will be delivered and collected during weeks 1-3, so that the collaborative work can begin.

Weighing:

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

\* Practises in computer rooms (weight: 15%). The evaluation will be done twofold: Reports describing the results obtained in the computer classroom, assessed in flexible groups of two (10%), and practise interpretation, with individual assesment (5%).

\* Laboratory practises (weight: 35%). The evaluation will be done twofold: Practise preparation, assessed in small groups (8.25%), and practise interpretation, with individual assesment (26.75%).

To ensure that all competencies are acquired, it will be necessary to 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)

**\* Students who choose for evaluation at the end of the semester:**

The possibility of a final examination will be provided to students who do not opt for the continuous evaluation. 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: 15%)

\* Laboratory practises. Individual assesment. (weight: 35%)

To ensure that all competencies are acquired, it will be necessary to 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).

**RETAKE**

Two different situations:

=> Students that are evaluated using continuous evaluation:

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 evaluate as stated in the above section "Students who choose continuous evaluation".

\* To be evaluated with the same final exam as stated in the above section [Students who choose for evaluation at the end of the semester].

=> Students who choose for evaluation at the end of the semester:

A final examination will be provided to students who do not opt for the continuous evaluation. This final exam will be assessed as stated in the above section [Students who choose for evaluation at the end of the semester].

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**Sources of information**

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

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**,

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Vance Dickason, **Loudspeaker Design Cookbook**,

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Besides the above mentioned literature, the student will have the following supporting material:

- Scripts of theory: This material contains the theoretical basis of that which is discussed in more detail in the master sessions.
- Scripts of practices: Formulations and problems over each practice session.
- Copy of the artwork used in the master sessions.
- Tasks and proposed problems.

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### **Recommendations**

#### **Subjects that continue the syllabus**

Room Acoustics/V05G300V01635

Audiovisual Technology/V05G300V01631

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#### **Subjects that are recommended to be taken simultaneously**

Audio Systems/V05G300V01532

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#### **Subjects that it is recommended to have taken before**

Physics: Analysis of Linear Circuits/V05G300V01201

Physics: Fields and Waves/V05G300V01202

Physics: Fundamentals of Mechanics and Thermodynamics/V05G300V01102

Fundamentals of Sound and Image/V05G300V01405

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