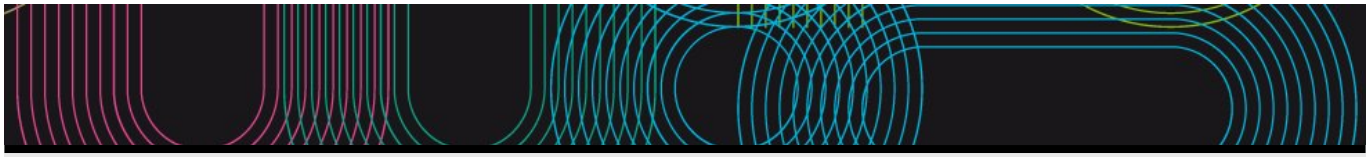

IDENTIFYING DATA				
Advanced Acoustics				
Subject	Advanced Acoustics			
Code	V05G300V01933			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish English			
Department				
Coordinator	Sobreira Seoane, Manuel Ángel			
Lecturers	García Lomba, Guillermo Sobreira Seoane, Manuel Ángel			
E-mail	msobre@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	In this subject, the use of advanced calculation methods in Acoustics are introduced. The Finite Element Method (FEM) and the Boundary Element Method (BEM) are applied to study problems of acoustic radiation, diffraction and modal analysis (calculation of mode shapes and resonance frequencies). Statistical Analysis Methods (SEA) are also introduced and applied to the calculation of flanking transmission in buildings. The language of the subject is mostly English, although the first lessons on Finite Element Methods could be explained in Spanish.			

Competencies	
Code	
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A84	(CE75/OP18) The ability to elaborate noise maps and their geographical information display.
A85	(CE76/OP19) The ability to apply numerical methods in acoustical problem solving.
A86	(CE77/OP20) The ability to indentify industrial noise problems and to design appropriate control solutions.

Learning aims	
Expected results from this subject	Training and Learning Results
CE75: The ability to elaborate noise maps and their geographical information display.	A84
CE76: The ability to apply numerical methods in acoustical problem solving.	A85
CE77:The ability to indentify industrial noise problems and to design appropriate control solutions.	A86
CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws. CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area. CG7: The ability to analyse and assess the social and environmental impact of technical solutions.	A2 A5 A7

Learning results:	
□ Knowledge of the application of numerical methods in acoustics. (CE 76)	A85
□ Knowledge on the models of sound transmission in buildings and building elements. (CE 76, CE 77)	A86
□ Knowledge of the design techniques of acoustic mufflers. (CE 77)	
□ Ability to understand the results of complex acoustic measurements and relate the results to those obtained by numerical calculation.(CE 76)	
□ Knowledge of the main techniques in industrial noise control.(CE77)	

Contents	
Topic	
Introduction.	Review of acoustic concepts: impedance, boundary conditions, Helmholtz and Euler equations.
The Finite Elements Method in Acoustics (FEM)	Theoretical introduction to the Finite Element Method. Radiation Problems with FEM. Diffraction Problems. Modal analysis with FEM: resonance frequencies and modes
The Boundary Element Method in Acoustics (BEM)	Introduction to the Boundary Element Method in Acoustics. Integral equation of Kirchhoff Helmholtz. Application to f radiation and diffraction problems. The calculation of of resonances in BEM.
Calculation methods based in S.E.A. Calculation of sound transmission in buildings.	Building Acoustics: acoustic insulation in buildings and determination of the flanking transmission. Calculation method of the international standard ISO 12354.
Other calculation methods.	Ray tracing and application to evaluation of sound propagation outdoors. Prediction of noise levels in industrial plants. Noise control.

Planning			
	Class hours	Hours outside the classroom	Total hours
Tutored works	6	24	30
Practice in computer rooms	12	9	21
Previous studies / activities	0	15	15
Master Session	19	38	57
Short answer tests	2	8	10
Reports / memories of practice	2	10	12
Jobs and projects	1	4	5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Tutored works	Practical projects that the students have to develop: 1. Design of a diffuser to optimise the radiation pattern of a loudspeaker. 2. Design and calculation of the acoustic insulation of a building.
Practice in computer rooms	THe student will work with different software packages to apply the different calculation methods presented un the subject. 1. CAD and mesh generation: FreeCAD and Gmsh. 2. Finite Element calculations : COMSOL. 3. Boundary Element calculations: OpenBEM. 4. Calculations in building acoustics.
Previous studies / activities	The students must study and prepare with the sources of information given before the lectures and the practical sessions.
Master Session	Lectures will be given, developing the main theoretical concepts of the subject.

Personalized attention	
Methodologies	**Description**
Master Session	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Tutored works	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.

Practice in computer rooms	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.

Tests	**Description**
Short answer tests	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Reports / memories of practice	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.
Jobs and projects	The doubts, questions and discussions on topics related to the subject can be carried out in tutoring sessions which can be attended either individually or in small groups (maximum 3 students). Previous appointment with the professor is needed. The appointment will be requested and agreed by email, preferably in the hours and places previously scheduled and officially published.

Assessment

	Description	Qualification
Tutored works	Tutored practical project, with the delivery of a final report. The learning aims related to the ability to elaborate projects and application of calculation methods (numerical methods) are assesed. Learning aims related to the identification of problems are also assessed (through the application of numerical calculations). Learning Aims: A2/CG2, A84 (CE75/OP18), A85 (CE76/OP19), A87 (CE76/OP20)	20
Short answer tests	Written test, with short questions on the theory of the subject. Evaluation of learning aims involving knowledge of legislation and how to perform measurements. (Learning Aims: A2/CG2 , A5/CG5)	30
Reports / memories of practice	Questions and report of the practical tasks. Evaluation of those learning aims related to noise measurement and analysis of acoustic problems using numerical calculations. Learning aims: A5/CG5, A7/CG7, A85 (CE76/OP19), A86 (CE77/OP20).	50

Other comments on the Evaluation

Following the guidelines of the degree, two systems of evaluation are offered: continuous assessment (recommended) and a final examination. Evaluation with only a final examination will be only allowed in situations in which it is imposible to follow the system recommended.

LANGUAGE: Any student can choose which language will use during the assessment process (English, Spanish).

CONTINUOUS ASSESSMENT:

The continuous assessment will be based in the evaluation of practical task, projects and two tests. Once a student has signed a document of agreement with the process of continuous assessment, the final degree will be obtained by the application of the criteria described bellow, even though a student could miss some of the tasks or tests envolved in the process.

Once the student has shown good skills in all the assesed learning aims (at least 4 over 10 points in each learning aim assesed), the final grade with be obtained from the weighted sum of the grade obtained in the following tasks with the weights given.

1. Tutored works: 20 % of the final grade.
2. Reports of practical tasks(Weight: 50 %).
3. Two short answer tests (Total weight:30 %)

FINAL EXAMINATION:

A final examination is available for those students that for some reason could not follow the continuous evaluation assessment process. In this case there is date scheduled and officially published for final examination. The final examination will consist in two short answer tests, and some additional questions related with the practical tasks and projects.

The subject is assessed in a 0 to 10 points scale and it is considered "passed" if the final grade obtained if equal or greater than 5.

RETAKE:

There is scheduled date at the end of the semester for a final examination retake, for those students that either dropped out during the semester or failed. Prior the examination, a student can choose to follow the continuous assessment or the final examination. In the former selection, the grades obtained in the projects and practical tasks will be taken into account and the student will only answer to the short answer tests. If the later, (final examination), the student will have also to answer a full examination as described before.

Sources of information

Johnson C., **Numerical solution of PDE by the finite element method.**,

Reddy, J.N., **An introduction to the Finite Element Method,**, 2ª y 3ª ed,

Quarteroni A, Valli A., **Numerical approximation of partial differential equations**,

Ciskowski R.D. and Brebbia C.A., **Boundary Element Methods in Acoustics**,

Juhl, P.M., **The Boundary Element Method for Sound Field Calculations**,

CEN European Standards, **EN 12354-1:2000. Building Acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 1: Airborne sound insulation between rooms**,

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Linear Algebra/V05G300V01104
Mathematics: Calculus I/V05G300V01105
Mathematics: Calculus II/V05G300V01203
Fundamentals of Sound and Image/V05G300V01405
Room Acoustics/V05G300V01635
Fundamentals of Acoustics Engineering/V05G300V01531