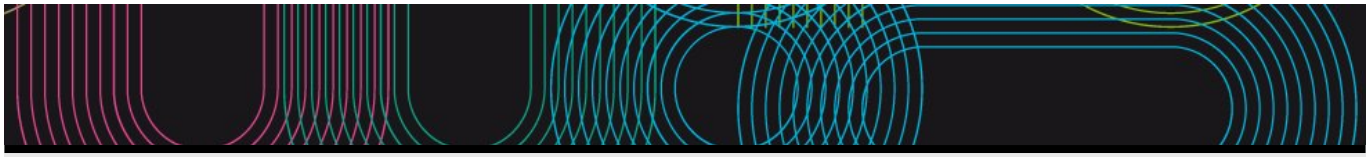

IDENTIFYING DATA				
Sound Processing				
Subject	Sound Processing			
Code	V05G306V01328			
Study programme	Bachelor Degree in Telecommunication Technologies Engineering (BTTE)			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	1st
Teaching language	Spanish			
Department				
Coordinator	Rodríguez Banga, Eduardo			
Lecturers	Rodríguez Banga, Eduardo			
E-mail	erbanga@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	This course describes the main techniques of the sound processing, with special emphasis on real applications. Students are shown the basic principles of these techniques and how the same principles may give rise to different algorithms or systems depending on the type of signal to process (speech or audio, for instance). This course also makes an introduction to Speech Technologies and their applications.			

Training and Learning Results	
Code	
B4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
B6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
C34	CE34/SI1The 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.
C38	CE38/SI5 The ability to create, modify, manage, broadcast and distribute multimedia contents taking into account the use and accessibility criteria to audiovisual, broadcasting and interactive services.
D2	CT2 Understanding Engineering within a framework of sustainable development.

Expected results from this subject	Training and Learning Results		
Understand some basic techniques for speech and audio processing.	B4	C34 C38	
Development of basic speech and audio coders.	B4	C34 C38	
Analyse speech and audio specifications and standards.	B4 B6	C34 C38	D2
Understand some basic techniques used in Speech Technologies.	B4	C34 C38	
Ability to adapt learned techniques to other applications.	B4		D2

Contents	
Topic	
Voice production and perception	Voice generation. Physiology. General characteristics of a speech signal. Perception. Auditive physiology.
Analysis of speech and audio signals	Sampling, interpolation and decimation. Short-term analysis. Time and spectral parameters. Linear prediction techniques. Cepstrum. Psychoacoustic principles: critical bands and masking.

Speech coding	Waveform coding. Parametric coding. Hybrid coding. Standards. Applications.
Audio Coding	Main characteristics of an audio signal. Psychoacoustic models. Time-frequency analysis: filterbanks and transforms. Coding. Standards. Applications.
Speech Technologies	Speech Recognition, Speech Synthesis and related applications.
Practical content	In this subject there is no division between theoretical and practical content. Indeed, practical exercises related to many of the previously described contents are considered.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	20	42	62
Practices through ICT	10	9	19
Mentored work	7	57	64
Problem and/or exercise solving	3	0	3
Problem and/or exercise solving	2	0	2

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

Methodologies

	Description
Lecturing	The instructor makes a presentation of some relevant contents of the subject. Some concepts may be illustrated by means of computer simulation. Students are encouraged to make questions and discuss some proposed problems and exercises. The main objective of these sessions is to provide the students with the theoretical background so that they can develop all the subject competences. Therefore, every subject competence is developed in these sessions.
Practices through ICT	Students will carry out computer simulations using Matlab, which will help them to better understand the concepts introduced in the theory sessions and to discover new ones. All the subject competences are developed in these sessions.
Mentored work	The students will be grouped into teams which will develop one or several tasks proposed by the instructor. The number of students in a team will be established taking into account the number of students enrolled and the complexity of the proposed tasks. Each team work will be supervised by the instructor who, in addition to evaluate the team work, may establish procedures for self and cross evaluation. Tutored works are thought to develop B4 and B6 competences, as well as C34, C38 and D2.

Personalized assistance

Methodologies	Description
Practices through ICT	The instructor will establish mechanisms to determine the degree of understanding of the main concepts by the students.
Lecturing	Personalized attention will be offered during office hours. Further information at Moovi: https://moovi.uvigo.gal
Mentored work	At the regular team meetings the instructor will track the work of each student. In addition , the instructor will establish additional mechanisms such as, for instance, cross-evaluation of the student work by his/her team mates.

Assessment

	Description	Qualification	Training and Learning Results
Mentored work	The assessment of teamwork will be carried out by collecting evidence throughout its execution, both at the group and individual levels. It will involve the delivery of a final report with the results and a presentation and/or test of knowledge regarding the work performed. The assessment will take into account the work carried out and the understanding of concepts at both the group and individual levels. The final report will be delivered around week 13 of the course term. The exact date will be communicated at the beginning of the term. The section "Other comments on the evaluation" provides more details about the mentored work and its influence (TG grade) on the final grade F.	35	B4 C34 D2 B6 C38

Problem and/or exercise solving	There will be three midterm tests during the course term: two related to the contents of the mentored work and one to the contents taught in the lectures and practicals. The section "Other comments on the evaluation" provides more details about these midterm tests and their impact on the final grade.	25	B4 B6	C34 C38	D2
Problem and/or exercise solving	Final exam with questions of any kind, covering the contents taught in the course. The section "Other comments on the evaluation" provides more details about the final exam and its impact on the final grade.	40	B4 B6	C34 C38	D2

Other comments on the Evaluation

The calculation of the final mark (F) for continuous assessment (C.A.) is based on the marks obtained jointly by the group in the mentored work (TG), in two midterm tests related to the tasks of the mentored work (T1 and T2), in a midterm test related to contents of the first parts of the course (P1) and the final exam (EX). All marks are given on a scale of 0 to 10. The three midterm tests will be taken individually.

The mark of the mentored work (TR) is calculated as

TR= min(10, 0.7*TG*W+ 0.3*(T1+T2)/2)

where W is a weighting factor, usually of value 1, which is explained below.

A fully individual mark (NI) is calculated as

NI= max(EX, 0.8*EX+0.2*P1)

and the final mark as

F=0.5*TR+0.5*NI if TR>=4 and NI>=4

F=min(4, 0.5*TR+0.5*NI) if TR < 4 or NI < 4

In order to pass, a grade of F>=5 is required. According to the previous expression, in case the grades TR or NI do not reach four points, the maximum final grade will be F=4.

The TG grade will be determined based on the evaluation of submitted tasks and a final presentation conducted by the entire group to their instructor in the last C group meeting, with questions to its different members.

The TG mark will be weighted by the factor W according to the results of the cross-evaluations and the instructor's opinion about the student's personal contribution to the group work. Normally the weighting factor will be 1, although factors less than 1 will be applied to students that hinder the normal progress of the group or show poor participation or understanding in the tasks of the mentored work. Likewise, the instructor might reward those students who stand out significantly for their contribution to the teamwork with a weighting factor of up to 1.2, especially in case of unexpected difficulties.

Failure to attend the final presentation, unless justified, will result in W=0. In the case of a justified absence, the student must promptly contact his/her instructor to schedule an interview and demonstrate his/her understanding of the group's work.

The final exam will contain a set of questions related to the mentored work tasks for students who have chosen global assessment. The grade obtained in this set of questions will be considered as TR. The grade corresponding to the remaining questions of the exam will be considered as NI. From TR and NI, the final mark F will be calculated according to the expressions described above for C.A.

Students attending the second-call exam, with independence of the assesment track followed, will be able to choose, before starting the exam, to maintain the grade obtained either in TR or NI in the first call if equal or higher than 4. In that case, they will only answer the group of questions corresponding to the part whose score they do not wish to keep. However, students should be aware of the influence of this decision on their final grade.

The end-of-program call will consist of a final exam with a single set of questions (without differentiated groups) related to any content of the course. In this case the final grade F will be directly the grade of the exam.

To ensure that students do not disadvantage their potential teammates, they will be given a period to decide whether or not to follow the C.A. track. This decision must be made within one month from the beginning of the course term. Opting for the C.A. track means that the student will be graded in the first call.

In exceptional cases, such as long-term justified reasons that unable to follow the C.A. procedure or to take essential assessment tests within the foreseen period, the instructor will decide whether or not it is appropriate to allow the student to change from C.A. to global assessment or to consider him/her 'no show'.

The different evaluation tests are not recoverable in case a student does not show up when they take place, with the exception of non-attendance due to any of the justified reasons listed in the University regulations.

Attendance to group C meetings, corresponding to the mentored group work, is mandatory in case of following the C.A. track.

Plagiarism is regarded as serious misconduct. If any form of plagiarism is detected in any test or work, according to the circumstances, the final grade of the course might be FAIL (0) and the corresponding academic authorities informed about the fact in order to take further measures.

The solution to any possible inconsistency, discrepancy or difference of interpretation that may arise from this guide, as well as any error or any other not considered case, will be discussed between the instructor and the concerned students and, in case of no agreement, the matter will be referred to the competent higher bodies.

Sources of information

Basic Bibliography

Andreas Spanias, Ted Painter and Venkatraman Attii, **Audio Signal Processing and Coding**, Wiley, 2007

Wai C. Chu, **Speech Coding Algorithms: Foundation and Evolution of Standardized Coders**, Wiley, 2004

Douglas O'Shaughnessy, **Speech Communications. Human and Machine**, Second edition, Wiley-IEEE Press, 1999

Boss, M. and Goldberg, R. E., **Introduction to digital audio coding and standards**, Kluwer Academic Publishers, 2003

Ian Vince McLoughlin, **Speech and Audio Processing: A MATLAB Based Approach**, Cambridge University Press, 2016

Complementary Bibliography

Dutoit, T. and Marqués F., **Applied signal processing : a matlab-based proof of concept**, Springer, 2009

Paul Taylor, **Text-to-Speech Synthesis**, Cambridge University Press, 2009

Recommendations

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G301V01209
Digital Signal Processing/V05G301V01205

Other comments

It is assumed that the student has some basic skills in Matlab.