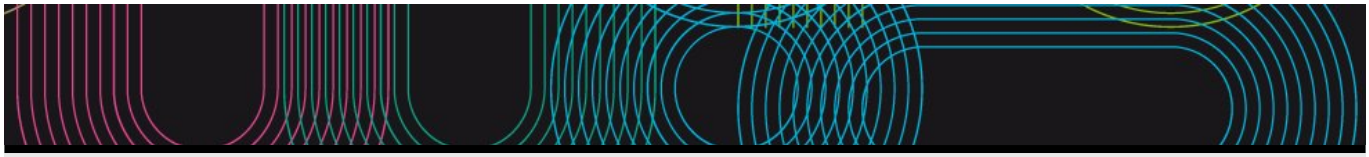
Universidade Vigo

Subject Guide 2017 / 2018



IDENTIFYING DATA				
Signal Processing in Communications				
Subject	Signal Processing in Communications			
Code	V05M145V01102			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Mandatory	1st	1st
Teaching language	English			
Department				
Coordinator	López Valcarce, Roberto			
Lecturers	López Valcarce, Roberto			
E-mail	valcarce@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course presents several of the signal processing techniques most commonly found in the design and implementation of communication systems, with focus on digital processing schemes. Covered aspects include sampling and quantization, block and adaptive estimation, block transform coding, efficient resampling and filtering methods.			

Competencies	
Code	
B4	CG4 Capacity for mathematical modeling, calculation and simulation in technological centers and engineering companies, particularly in research, development and innovation tasks in all areas related to Telecommunication Engineering and associated multidisciplinary fields.
B8	CG8 Ability to apply acquired knowledge and to solve problems in new or unfamiliar environments within broader and multidiscipline contexts, being able to integrate knowledge.
C1	CE1 Ability to apply methods of information theory, adaptive modulation and channel coding, as well as advanced techniques of digital signal processing systems and audiovisual communications.
C2	CE2 Ability to develop radio communication systems: antenna, equipment and subsystems design; channel modeling; link budgeting; and planning.
C3	CE3 Ability to implement systems by cable, line, satellite, in fixed and mobile communication environments.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Ability to apply multirate processing, adaptive filtering, block-based transform and spectral estimation techniques to communication and multimedia systems	B4 C1
Ability to implement advanced signal processing techniques in diverse fields of application: bioengineering, bioinformatics, etc.	B4 B8
Ability to apply signal processing techniques to the modeling and simulation of communication systems	B4 C1 C2
Ability to simulate the physical layer of cable, wireline, satellite systems in fixed/mobile communication environments.	B4 B8 C2 C3

Contents
Topic

Chapter 1: Block-based Transforms in Communications and Multimedia	- DFT: formulation and properties. - Frequency Analysis based on DFT. Windowing. - Power Spectrum Estimation: Welch's periodogram - DFT-based digital modulation schemes: DMT, OFDM. - DCT: formulation and properties. - Transform domain coding.
Lab Assignment 1: Sampling and quantization	- Aliasing - Baseband and bandpass sampling - Quantization noise - Converter overload - Spurious-free dynamic range - Sampling jitter
Lab Assignment 2: Simulation of a multicarrier-based digital communication system	-Experimental study of the diverse effects and tradeoffs involved in the design of the transmitter and receiver of a multicarrier communication system.
Chapter 2: Adaptive Filtering and Estimation	- Minimum Mean Squared Error criterion - Wiener filter - LMS adaptive filters - Least Squares criterion
Lab Assignment 3: Adaptive Filtering	- LMS and NLMS Algorithms - Simulation in a channel equalization context - Simulation in an echo/interference cancellation context
Chapter 3: Multirate Processing and Filter Banks	- Sampling rate conversion: decimation, interpolation - Multirate filters: polyphase decomposition - Applications: digital transceivers, filter banks
Final Project	- The student will develop the design of a signal processing system involving several aspects covered during the course, and meeting a series of specifications/requirements.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	18	18	36
Laboratory practises	20	20	40
Autonomous practices through ICT	0	40	40
Long answer tests and development	2	0	2
Reports / memories of practice	0	5	5
Jobs and projects	0	2	2
*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	Presentation of main topics, possibly with audiovisual aids. Applied/theoretical problem sessions. Skills involved: CG4, CG8.
Laboratory practises	Under the guidance of the instructor, students will develop the design and/or simulation of a signal processing system involving several of the techniques studied during the course. Skills involved: CE1, CE2, CE3.
Autonomous practices through ICT	Computer-based simulation of signal processing applications to communications and multimedia. Skills involved: CE1, CE2, CE3.

Personalized attention

Methodologies	Description
Laboratory practises	Student aid will be provided during office hours as well as on-line (email). An on-line discussion forum will be set up for the course, through the usual e-learning platform
Master Session	Student aid will be provided during office hours as well as on-line (email). An on-line discussion forum will be set up for the course, through the usual e-learning platform

Assessment

	Description	Qualification	Training and Learning Results	
Long answer tests and development	Final test in which the student must solve a series of exercises.	40	B4	C1 C2

Reports / memories of practice	Written reports corresponding to the different lab assignments. In general, they will be carried out in groups of two, and both students will be assigned the same grade. The instructor may require further clarifications in order to check the contribution to the report of all members of the group.	40	B4 B8	C1 C2
Jobs and projects	Written report describing the developed design and obtained results for the final project. In general, they will be carried out in groups of three, and all three members will be assigned the same grade. The instructor may require further clarifications in order to check the contribution to the report of all members of the group.	20	B4 B8	C1 C2 C3

Other comments on the Evaluation

Students may choose one of the following two assessment options:

1) Continuous assessment: Final grade will consist of:

- comprehensive test (up to 4 points)

- lab reports (up to 4 points)

- final project (up to 2 points)

A minimum grade of 30% in the comprehensive test is required in order to pass the course. If this minimum is not reached, the final grade will be the grade obtained in the comprehensive test.

Lab report grades from the first call will be kept for the second call, in which the student will be allowed to resubmit the final project and/or take a new comprehensive test.

2) One-shot assessment: The final grade is the one achieved in the comprehensive test, for both the first and second call.

Any kind of plagiarism will result in automatically failing the course.

It is assumed that the student chooses the continuous assessment mode as soon as he/she turns in a lab report and/or final project report.

Students are allowed to turn in their reports and exam indistinctly in English, Spanish or Galician.

Sources of information

Basic Bibliography

S. Mitra, **Digital Signal Processing: A Computer Based Approach.**, 4th,

J.G. Proakis and D.G. Manolakis, **Digital Signal Processing**, 4th,

Complementary Bibliography

Behrouz Farhang-Boroujeny, **Signal Processing Techniques for Software Radios**, 2nd,

S. Haykin, **Adaptive Filter Theory**, 4th,

P.P. Vaidyanathan, **Multirate systems and Filter Banks**,

F. Harris, **Multirate Signal Processing for Communication Systems**,

T. K. Moon, W. C. Stirling, **Mathematical methods and algorithms for signal processing**, 1st,

Recommendations

Subjects that continue the syllabus

Real-Time Signal Processing/V05M145V01301
Advanced Digital Communications/V05M145V01204
Multimedia Communications/V05M145V01206
Optical Communications/V05M145V01207
Wireless and Mobile Communications/V05M145V01313
Satellites/V05M145V01311
Communication Advanced Systems/V05M145V01302
Wideband Radio Systems/V05M145V01312

Other comments

It is assumed that students are knowledgeable in the following areas:
- Signal Processing: analog and discrete-time signals, time and frequency domains, Fourier Transform, linear systems (continuous- and discrete-time), convolution, transfer function, FIR and IIR filters, group delay, poles and zeros.
- Probability and statistics: random variables, probability density function, probability distribution function, mean, variance.

Gaussian and uniform distributions. Stochastic processes: autocorrelation, crosscorrelation, stationarity, power spectral density.
- Communications: bit rate, baud rate, carrier frequency, PAM and QAM modulation.