SUBJECT TEACHING GUIDE

G1011 - Filters and Data Converters

Degree in Industrial Electronic Engineering and Automatic Control Systems

Academic year 2023-2024

1. IDENTIFYING DATA					
Degree	Degree in Industrial Electronic Engineering and Automatic Control Systems			Type and Year	Optional. Year 4
Faculty	School of Industrial Engineering and Telecommunications				
Discipline	Subject Area: Electronic Technology Optional Module				
Course unit title and code	G1011 - Filters and Data Converters				
Number of ECTS credits allocated	6	Term		Semester based (1)	
Web	https://moodle.unican.es/course/view.php?idnumber=G1011_2223				
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. TECNOLOGIA ELECTRONICA E INGENIERIA DE SISTEMAS Y AUTOMATICA
Name of lecturer	YOLANDA LECHUGA SOLAEGUI
E-mail	yolanda.lechuga@unican.es
Office	E.T.S. de Ingenieros Industriales y de Telecomunicación. Planta: - 3. DESPACHO PROFESOR (S3082)
Other lecturers	FRANCISCO JAVIER DIAZ RODRIGUEZ

3.1 LEARNING OUTCOMES
- Ability to analyze and to design digital filters
- Ability to build and to characterize experimentally digital filters using DSPs and FPGAs
- Ability to characterize commercial data converters
- Ability to select the most suitable architecture of data converter for a certain application depending on the specifications

4. OBJECTIVES
Introducing the fundamentals of digital signal processing, which is widely used in the industry (instrumentation, power electronics, control, sound and image processing…)
Applying the knowledge and abilities previously acquired regarding mathematical resources such as Z-transform and Fourier Transform.
Learning to analyze and to design digital filters, as well as learning how to use simulation tools for the design process itself and for the interpretation of simulation and experimental results.
Acquiring practical experience in the design and experimental set up of digital filters using DSPs and FPGAs.
Introducing the fundamental of digital-to-analog and analog-to-digital conversion, as well as metrics, operation principals and classification of the main data converters.
Developing the skill of proposing optimal solutions for data converting topologies depending on the specifications required.

6. COURSE ORGANIZATION	
CONTENTS	
1	Time and frequency signal analysis: Signal classification, discrete signals and systems, Z-Transform and applications, frequency analysis of continuous-time and discrete signals, family of Fourier transforms, Fast Fourier Transform (FFT), sampling and signal reconstruction.
2	Digital filters: Structures for FIR systems and design methods, structures for IIR systems and design methods from analog filters, quantification effects and rounding error. Implementation of digital filters using DSPs and FPGAs
3	Data converters (DACs and (ADCs): Ideal data converter, metrics and data converter specifications. Nyquist D/A converters, high-speed A/D converters, sigma-delta modulators, oversampling DACs and ADCs

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Ongoing assessment	Others	No	Yes	20,00
Pc-based lab sessions	Others	No	Yes	30,00
Final work and presentation	Work	Yes	Yes	50,00
TOTAL				100,00

Observations

The aspects that define the ongoing assessment are: the evolution during classes, the resolution of exercises for each topic and the presentation of results.
The assessment of the final project is based on the report, the fulfillment of specifications, the optimization of resources and the public defence of the design developed by the student.
The assessment will move from a presence-based to a virtually-supported modality, according to a mixed teaching format, in case the sanitary conditions required it.
The evaluation of projects, practical laboratory exercises and written exams is planned to move to a remote modality in case a new health alert due to COVID-19 would preclude a presence-based evaluation.
For these activities telematic means will be used through the virtual classroom (Aula Virtual – Moodle), email, Skype for Business, Microsoft Teams and/or any tool provided or allowed by the University of Cantabria for the assessment, or to guarantee the validity of the exams.
The relative weights for each activity included in the assessment method of the course are maintained for all the described teaching modalities.
Thus, the students must have a computer with a webcam and a microphone, or a smartphone with a built-in camera, internet connection, Skype for Business, Microsoft Teams and/or any tool provided or allowed by the University of Cantabria.

Observations for part-time students

For those students with part-time enrollment, the lab program may be alternatively passed by means of an adapted program based on simulation that could be developed individually and telematically.
For these students, the percentage of the ongoing assessment is added to the weight of the final project. Besides, for those students with time incompatibilities, a telematic follow-up and personal tutoring will be developed.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

J. G. Proakis, D. G. Manolakis, □Tratamiento digital de señales, 4ª Edición□, Pearson Prentice Hall, 2007

F. Maloberti, □Data Converters□, Springer 2007