



IDENTIFYING DATA

Multimedia Signal Processing

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|---------------------|---|----------|------|------------|
| Subject | Multimedia Signal Processing | | | |
| Code | V05G301V01321 | | | |
| Study programme | Degree in Telecommunications Technologies Engineering | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Optional | 3rd | 1st |
| Teaching language | #EnglishFriendly Spanish | | | |
| Department | | | | |
| Coordinator | Cardenal López, Antonio José | | | |
| Lecturers | Cardenal López, Antonio José | | | |
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| General description | Multimedia signal processing is now a fundamental part of any modern information, communication, learning, and entertainment system. Once the main Digital Signal Processing concepts and bases have been introduced in the second year, this course prepares students for the analysis and processing of deterministic and random signals, before encoding and transmission of multimedia information. | | | |

In related courses both on this and next academic year, the knowledge acquired shall be applied to voice, audio, image and video signals and systems.

The main goals of the course are:

- Analyze digital signal processing schemes.
- Design digital filters according to prescribed specifications.
- Analyze and specify the basic parameters of communication subsystems from the point of view of signal processing.
- Apply statistical filtering in coding, processing and transmission of multimedia information.

To help in reaching these goals, the course is divided into four major topics: DFT and Fast Fourier Transform, Fundamentals of statistical signal processing, digital filter characterization and multirate signal processing.

English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.

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 |
| 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. |
| C26 | CE26/ST6 The ability to analyze, codify, process and transmit multimedia information using analogical and digital signal processing techniques. |
| D2 | CT2 Understanding Engineering within a framework of sustainable development. |
| 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. |

Learning outcomes

| Expected results from this subject | Training and Learning Results | |
|---|-------------------------------|-----|
| Analyze digital signal processing diagrams. | B3 | C26 |

| | | | |
|---|----------|-----|----|
| Design digital filters from specifications. | B4 | C26 | D2 |
| Analyze and specify the fundamental parameters of the communication subsystems from the point of view of digital signal processing. | B4 | C26 | |
| Statistical analysis and filtering applied to the coding, processing and transmission of multimedia information. | B3 B4 | C26 | D3 |

Contents

| Topic | |
|--|---|
| Practice 1 Fourier Analyses through DFT. | Linear Filtering using DFT. Effects of the temporal and frequency sampling. Windowing and spectral resolution |
| Topic 1 Fourier Transform of discrete signals: DFT. | Formulation and properties of the DFT. Efficient computation of the DFT (FFT). Linear Filtering Methods using DFT. Effects of the time and frequency sampling. Windowing and spectral resolution. |
| Topic 2 Introduction to Statistical signal processing. | Random signals. Correlation and spectra for stationary signals. Random signals and linear systems. Optimal Linear Filters. Wiener filter. Introduction to adaptive filtering: LMS algorithm. Spectral Estimation. |
| Practice 2 Adaptive Filtering. | Wiener Filter. LMS. |
| Topic 3 Filter Design and implementation. | Z transform: a review. Implementation of FIR and IIR filters from difference equations. Block Diagramas. Structures for digital filters. FIR and IIR Design. |
| Practice 3 Digital Filters Design and implementation. | FIR filters Design. IIR filters Design. Implementation of digital filters. |
| Topic 4 Multirate signal processing. | Decimation and Interpolation. Spectral interpretation of interpolation and decimation. FIR Filter Structures Based on Polyphase Decomposition. Filter Banks. |
| Practice 4 Multirate signal processing. | Decimation and Interpolation. Polyphase Filter Banks. |

Planning

| | Class hours | Hours outside the classroom | Total hours |
|----------------------|-------------|-----------------------------|-------------|
| Laboratory practical | 12 | 24 | 36 |
| Mentored work | 7 | 35 | 42 |
| Lecturing | 21 | 42 | 63 |
| Essay questions exam | 2 | 7 | 9 |

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

Methodologies

| | Description |
|----------------------|--|
| Laboratory practical | Application of MatLaB commands and functions to digital signal processing practical exercises. Through this methodology the competencies CG4, CE26, CT2 and CT3. are developed. (Individual) |
| Mentored work | Group work on a project centered in a practical application of signal processing. Through this methodology the competencies CG3, CG4, CE26, CT2 and CT3 are developed. (Group) |
| Lecturing | Presentation of main topics in class. Multimedia material will be made available in faict before classes take place. Personal study. Support from the instructors through tutorial help. Through this methodology the competencies CG3, CE26, CT2 and CT3. are developed. (Individual) |

Personalized assistance

| Methodologies | Description |
|----------------------|---|
| Lecturing | Lectures take place within a continuous interaction framework in which students may answer questions formulated by the teacher. They could also solve their particular doubts during the sessions. |
| Laboratory practical | In practical sessions students are required to carry on their own the assigned task. The instructor will be available during the session to solve any problems/questions students may have. |
| Mentored work | Tutored works are carried out in small working groups. The follow up of the work in progress takes place in regular meetings between the groups and the instructor, in which students may formulate any questions related to the work to be done. |

Assessment

| | Description | Qualification | Training and Learning Results |
|----------------------|--|---------------|-------------------------------|
| Laboratory practical | Individual drills related with the laboratory content. Will be taken in laboratory time, and will last 30 minutes. | 40 | B3 B4 D3 |

| | | | |
|---------------|---|----|----------|
| Mentored work | Projects to be carried out in groups. Different gradings according to levels of participation that will be assessed through cross- evaluation surveys among students. | 20 | C26 D2 |
| Lecturing | Written exam encompassing all the material exposed in the classroom and laboratory . Students will receive support to clarify any questions about the written exam. | 40 | B3 B4 |

Other comments on the Evaluation

Evaluation

Students shall be offered two evaluation systems: continuous assessment or evaluation at the end of the semester.

- Continuous assessment .
- Exam-only assessment.
- Recovery in the month of June-July.

CONTINUOUS ASSESSMENT

The continuous assessment of the course will consist in:

- Four 30-minutes drills related to the laboratory work, that will account for 40% of the final grade.
- One project to be carried out in a group that will account for 20% of the final grade.
- A written exam encompassing all the material exposed in the classroom and laboratory. Will take place on the dates scheduled by the School. The exam shall help in gauging the level of understanding of the four-course topics. The exam will feature exercises and questions to be answered in two hours. Students may bring to the exam books, laboratory and classroom notes, and any other materials downloaded from fatic. The exam will account for 40% of the final grade.

The final qualification of the student will be computed as a weighted sum (40%, 20%, and 40%, respectively) of the qualifications of the laboratory, group project, and final exam. However, in order to pass the course, the grade of the final exam must not lie below 25 out of 100 points. If that grade is lower than 25, the final qualification will be the minimum among the aforementioned weighted sum and 4.5.

The contents and weights of each continuous assessment exercises are the following:

- Laboratory drill 1 (10 %):

Fourier Analysis through DFT: will take place in the fourth week of the course.

- Laboratory drill 2 (10 %)

Adaptive filtering: will take place in the sixth week of the course.

- Laboratory drill 3 (10 %):

Design and implementation of FIR and IIR filters: will take place in the tenth week of the course.

- Laboratory drill 4 (10 %):

Multirate Filter Banks: will take place in the thirteenth week of the course.

- Project: (20%) practical application of concepts mastered in the course. Oral presentations shall take place in the fourteenth week of the course.

The planning of the different intermediate evaluation tests will be approved in an Academic Committee of Degree (CAG) and will be available at the beginning of the semester.

EXAM-ONLY ASSESSMENT

Should a student decide not to be graded through continuous assessment , she will have a written examination opportunity that will take place the same day of the final exam for all the students. Before taking the exam though, the student shall sign a form in which he states his decision to dispense with continuous assessment .

This written exam will last three hours and will be composed of 5 exercises encompassing all the material mastered in the

classroom, laboratory, and tutorial sessions, under the same conditions specified for the students that take the final exam at the end of the continuous assessment process.

Grading Periods

First opportunity to pass the course (December-January)

If the student passes the course in this period, her grade will be final and will be recorded in her academic file.

If the student does not pass the course, a provisional fail shall be posted in his academic file.

Second opportunity to pass the course (June-July)

In June-July only the written exams shall be offered. If a student wants to dispense with continuous assessment in this period, the student will be able to take the final exam reserved for those cases. Before taking the exam though, a form shall be signed, in which the student formulates the decision to dispense with continuous assessment .

The provisional fail will become definitive should the student not take any of the written exams in this second period.

END-OF-PROGRAM CALL

The student will have a written examination. This written exam will last three hours and will be composed of 5 exercises encompassing all the material mastered in the classroom.

Sources of information

Basic Bibliography

John G. Proakis, Dimitris G. Manolakis., **Tratamiento Digital de Señales**, Prentice Hall,

Complementary Bibliography

Sanjit K. Mitra., **Digital Signal Processing: A Computer Based Approach.**, Ed. McGraw-Hill,

Alan V. Oppenheim, Ronald W. Schaffer, **Discrete-Time Signal Processing**, Prentice Hall,

Recommendations

Subjects that it is recommended to have taken before

Digital Signal Processing/V05G301V01205

Contingency plan

Description

In case of online tuition, then the planning and evaluation will be maintained as described in the guide.

Lecturing and laboratory sessions will be taught remotely.

For the laboratory sessions, students must have a computer with the Matlab program installed.

The evaluation tests will be carried out using the tools provided by the University.