270211 - SIS - Signals and Systems

Degree competences to which the subject contributes

1.1. The student must be able to understand and be proficient on the basic concepts of signals, linear systems and related functions and transformations.

2.2. The student must know how to do the mathematical analysis of signals and systems in the time and frequency domains both in analogue and digital environments.

3.3. The student must know how to interpret and use discrete signals and systems in 1D and 2D in the temporal / spatial and frequency domains.

4.4. The student must be able to apply the frequency representation of signals and systems to solve various applications.

5.5. The student must be able to evaluate discrete filters and apply them to real systems.

6.6. The student must know how to correctly formulate a problem from the proposed statement and identify the options.

Learning objectives of the subject

1. The student must be able to understand and be proficient on the basic concepts of signals, linear systems and related functions and transformations.

2. The student must know how to do the mathematical analysis of signals and systems in the time and frequency domains both in analogue and digital environments.

3. The student must know how to interpret and use discrete signals and systems in 1D and 2D in the temporal / spatial and frequency domains.

4. The student must be able to apply the frequency representation of signals and systems to solve various applications.

5. The student must be able to evaluate discrete filters and apply them to real systems.

6. The student must know how to correctly formulate a problem from the proposed statement and identify the options.
for its resolution, apply the appropriate resolution method, and validate the solution.

7.7. The student must know how to identify, model and solve problems from open situations. Also to explore and apply the alternatives for resolution. He will work with approximations.

8.8. The student must know how to use autonomously the tools, instruments and software applications available in the laboratories of the basic and advanced subjects. He should know their performances and limitations.

9.9. The student should know additional tools useful for processing discrete generic signals in 1D and 2D in the time and transformed domains.

10.10. The student must be able to evaluate advantages and disadvantages of different technological alternatives to implement analysis systems for analog and discrete signal in 1D and 2D.

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 60h</th>
<th>40.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided activities: 6h</td>
<td></td>
<td>4.00%</td>
</tr>
<tr>
<td>Self study: 84h</td>
<td></td>
<td>56.00%</td>
</tr>
</tbody>
</table>
## Content

### Signals and Systems

**Degree competences to which the content contributes:**

**Description:**
Signals and systems.  
Characterization of signals and sequences, energy and power.  
Analog and discrete systems, properties.  
Impulse response and convolution equation.  
Discrete systems represented by equations in differences.  
Impulse response (FIR and IIR systems)

### Fourier transform of analog signals.

**Degree competences to which the content contributes:**

**Description:**
Definition and properties.  
Frequency response.  
Examples: Filtering, packaging, modulation.

### Sampling.

**Degree competences to which the content contributes:**

**Description:**
Sampling Theorem.  
Interpolation formula.  
Conversion A/D, D/A.

### Fourier transform of discrete signals.

**Degree competences to which the content contributes:**

**Description:**
Definition and properties.  
Discrete Fourier Transform. DFT-1D.

### Filtering.

**Degree competences to which the content contributes:**

**Description:**
Z transform.  
Linear phase filters, filters runs all over.
### Interpolation and decimation.

**Degree competences to which the content contributes:**
- Interpolation and decimation.
- Changing the sampling frequency.

### 2D Signal Processing

**Degree competences to which the content contributes:**
- Linear & Invariant Systems, Convolution and Filtering, Fourier Transform, 2D sampling, DFT-2D, Interpolation and Decimation.
## Planning of activities

| Topic 1 | Hours: 22h 06m  
| Theory classes: 8h  
| Practical classes: 3h  
| Laboratory classes: 0h  
| Guided activities: 1h 06m  
| Self study: 10h |
|---|---|
| **Description:**  
| Theory classes and problems corresponding to topic 1 |
| **Specific objectives:**  
| 1, 2, 6 |

| Topic 2 | Hours: 15h 06m  
| Theory classes: 3h  
| Practical classes: 1h  
| Laboratory classes: 0h  
| Guided activities: 1h 06m  
| Self study: 10h |
|---|---|
| **Description:**  
| Theory classes and problems corresponding to topic 2 |
| **Specific objectives:**  
| 1, 2, 4, 6, 7 |

| Topic 3 | Hours: 15h 06m  
| Theory classes: 3h  
| Practical classes: 1h  
| Laboratory classes: 0h  
| Guided activities: 1h 06m  
| Self study: 10h |
|---|---|
| **Description:**  
| Theory classes and problems corresponding to topic 3 |
| **Specific objectives:**  
| 1, 2, 3, 4, 6, 7 |

| Topic 4 | Hours: 29h 18m  
| Theory classes: 8h  
| Practical classes: 3h  
| Laboratory classes: 2h  
| Guided activities: 1h 18m  
| Self study: 15h |
|---|---|
### Description:
Theory classes, problems and lab corresponding to topic 4

### Specific objectives:
2, 3, 4, 6, 7, 8, 9, 10

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### Topic 5

| Hours: 17h 06m |
| Theory classes: 3h |
| Practical classes: 1h |
| Laboratory classes: 2h |
| Guided activities: 1h 06m |
| Self study: 10h |

**Description:**
Theory classes and problems corresponding to topic 5

**Specific objectives:**
3, 4, 5, 6, 7, 8, 9, 10

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### Topic 6

| Hours: 15h 06m |
| Theory classes: 3h |
| Practical classes: 1h |
| Laboratory classes: 0h |
| Guided activities: 1h 06m |
| Self study: 10h |

**Description:**
Theory classes and problems corresponding to topic 6

**Specific objectives:**
2, 3, 4, 6, 7

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### Topic 7

| Hours: 33h 12m |
| Theory classes: 8h |
| Practical classes: 3h |
| Laboratory classes: 4h |
| Guided activities: 1h 12m |
| Self study: 17h |

**Description:**
Theory classes, problems and lab corresponding to topic 7

**Specific objectives:**
1, 2, 3, 6, 7, 8, 9, 10
The final grade of the course is obtained from:

- The mid-term exam: P (25%)
- The final exam:F (60%)
- Practices:L (15%)

\[
\text{grade} = \max(0.6F + 0.25P + 0.15L; 0.85F + 0.15L)
\]

In case of taking a Re-evaluation exam, the final grade is:

\[
\text{grade} = 0.85R + 0.15L
\]

**Bibliography**

**Basic:**


**Complementary:**