The subject "Engineering of Control" tries:
- Standardization of knowledge of the first students in Control Engineering on the analysis of control systems in continuous time in the temporary domain and frequency as well as discrete time.
- To make the grade students in the technical analysis of control systems in space of states and their application in the process control for computers.
- To make the grade pupils in designing a digital automatic control system within an industrial environment based on initial specifications on any system.
- To make students aware of the environmental impacts arising from their performance in the design and improvement of systems of regulation and control.

Learning objectives of the subject

Study load

Total learning time: 150h

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>15h</td>
<td>10.00%</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Hours small group</td>
<td>45h</td>
<td>30.00%</td>
</tr>
<tr>
<td>Guided activities</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td>Self study</td>
<td>90h</td>
<td>60.00%</td>
</tr>
</tbody>
</table>
## Content

| **Automatic control in the space of states.** | **Learning time:** 14h |
| Continuous systems | |
| | Theory classes: 10h |
| | Other activities: 1h |
| | Self study (distance learning): 3h |

| **Description:** |  |
| Objectives |  |
| The specific objective of the subject is to show the possibility of using a state space to be able to define with the minimum necessary information the behaviour of a process, as well as to determine what possibilities exist to be able to control it and to observe it from the outside. |  |

| Contents |  |
| 1. - Model of state. |  |
| 2. - Methods of obtaining of the state model. |  |
| 3. - Solution of the equation of state of linear systems. |  |
| 4. - Controllability. |  |
| 5. - Observability. |  |

| Activities, knowledge, abilities, aptitudes |  |
| The pupils will have to be able of: |  |
| - To describe the control systems in continuous time by the route of state variables. |  |
| - To solve equations of state for systems in continuous time. |  |
| - To formulate the representations external and internal in state variables. |  |
| - To determine the controlable subsystem inside a control system. |  |
| - To determine the not-observable subspace inside a control system. |  |

| Commentaries |  |
| The development of the subject can be followed through [Dom02]. |  |
| A theoretical complement, as well as of exercises and examples], [Oga99] and [Bro91 are [Oga98] |  |
Automatic control for state refeeding. Continuous systems

Learning time: 10h
Theory classes: 8h
Other activities: 2h

Objectives
The specific objective of the item is designing control structures across the state feedback. The necessary elements can be calculated through very different techniques.

Contents
1. Refeeding of state.
2. Control of monovariable systems.
3. Multivariable system control.

Activities, knowledge, abilities, aptitudes
The pupils will have to be able of:
- To calculate the refeeding matrix.
- To design control systems by the route of refeeding of the state.
- To design control elements for allocation of poles and estimation of the state.
- To design control systems for partially controllable systems.
- To design control systems for systems with non-zero slogan.

Commentaries
The development of the subject can be followed through [Dom02]. A theoretical complement, as well as of exercises and examples, [Oga99] and [Bro91] are [Oga98].
### Observers of state. Continuous systems

**Description:**
- **Objectives:**
  The specific objective of the subject is to introduce the idea of observer of a system, and as the introduction of this element modifies the initial behaviour of the process.

- **Contents**
  1. Definition of observer.
  2. Behaviour of the set system-observer.
  3. Calculation of the observer in monovariable systems.
  5. Observant of reduced order

- **Activities, knowledge, abilities, aptitudes**
  - To define an observer.
  - To design observers determining the behaviour of the set system-observer.
  - To design observers of reduced order.

- **Commentaries**
  The development of the subject can be followed through [Dom02].
  A theoretical complement, as well as of exercises and examples], [Oga99] and [Bro91 are [Oga98]

### Automatic control in the state space. Discreet systems

**Description:**
- **Objectives:**
  The specific objective of the subject is to redefine the technique of the space of state for sampled systems.

- **Contents**
  1. Solution of the homogenous equation.
  2. Calculation of the transition matrix.
  3. Solution of the complete equation.

- **Activities, knowledge, abilities, aptitudes**
  - To formulate the control systems in discreet time by the route of state variables.
  - To solve equations of state for systems in discreet time.

- **Commentaries**
  The development of the subject can be followed through [Dom02].
  A theoretical complement, as well as of exercises and examples], [Oga99] and [Bro91 are [Oga98]
### Automatic control for state refeeding. Discreet systems

**Description:**

Objectives
The specific objective of the subject is to recover the characteristics of control and observability for the case of sampled systems. Also the idea of refeeding in sampled systems moves.

Contents
1. Control in discreet time.
2. Observability in discreet time.
3. First of refeeding.

Activities, knowledge, abilities, aptitudes
The pupils will have to be able of:
- To study the control of a system.
- To determine the not-observability of a system.
- To determine the matrix of refeeding of sampled systems of control.

**Commentaries**
The development of the subject can be followed through [Dom02].
A theoretical complement, as well as of exercises and examples], [Oga99] and [Bro91 are [Oga98]

### System analyzes nonlinear

**Description:**

Objectives
The specific objective of the subject is to realize an analysis of the balance and stability concepts in the sense of Lyapunov.

Contents
1. Linear versus Nonlinear
2. Analysis of the phase plan
3. Stability of systems nonlinear: the global premises and
4. Oscillations and descriptive Function

Activities, knowledge, abilities, aptitudes
The pupils will have to be able of:
- To construct and to analyze the phase plan.
- To apply the concepts of stability and balance of Lyapunov for systems nonlinear.

**Commentaries**
The study of this subject is a classic one, and can serve as reference [Isi95] and [Slo91]
Control of systems nonlinear

Learning time: 15h
- Theory classes: 10h
- Other activities: 5h

Description:
- Objectives
  The specific objective of the subject is to realize a study of control based on methods of Lyapunov and linearization feedback, as much for systems in continuous time, like in discreet.

- Contents
  1. - Control based on methods of Lyapunov
  2. - Linearization by feedback
  3. - Descriptive Function
  4. - Stability of discreet systems
  5. - Linearization feedback of discreet systems

- Activities, knowledge, abilities, aptitudes
  The pupils will have to be able of:
  - To apply the concepts of balance of Lyapunov for the control of systems nonlinear.
  - To apply to the linearization concepts feedback.

Commentaries
- The study of this subject is a classic one, and can serve as reference [Isi95] and [Slo91]

Qualification system

The qualification of the subject considers all the work carried out throughout the course, and simultaneously it gives a final opportunity of election of evaluation to those students who have not followed the course with the sufficient dedication. In particular, the qualification is obtained choosing the second partial test or the final test:

or
12/15 C5 + 3/15 C4

where:
- C1=mark of the first partial test.
- C2=mark of the second partial test.
- C3=mark of the third partial test.
- Average C4=mark of the laboratory practices.
- C5=mark of the final test.
Bibliography

Basic:


